

20th INTERNATIONAL CONFERENCE
ON
MACHINE DESIGN AND PRODUCTION

CONFERENCE PROGRAMME
AND
BOOK OF ABSTRACTS

Editorial Board

S. Engin KILIÇ
Ramazan Hakkı NAMLU
Bahram LOTFİ

umtik 2024

14-17 August 2024

Ankara- TURKEY

MATIMAREN
DEPARTMENT OF MECHANICAL ENGINEERING
MIDDLE EAST TECHNICAL UNIVERSITY
ANKARA-TURKEY



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This book can be obtained from the following addresses:

UMTIK
Mechanical Engineering Department
Middle East Technical University
06800 Ankara- Turkey

Mechanical Engineering Department
ATILIM University
06830 Ankara- Turkey

Cover Print:
METU- Ankara

Printing and Binding:
METU- Ankara

Printed by:
METU- Ankara

ISBN

Dedicated to the memory of
Metin AKKÖK,
and all other IPC members we have lost in
previous Years.

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Contact: umtik@metu.edu.tr

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Ümraniye/İstanbul,
Türkiye

TEL: +90 216 372 23 30

FAX: +90 216 372 23 31

www.originemc.com.tr

info@originemc.com.tr

Contact Address

<http://www.umtik.com>

umtik@metu.edu.tr

PREFACE

It is a great pleasure to welcome you to the 20th International Conference on Machine Design and Production. It has been 40 years since we organized the first UMTIK conference in 1984 in the Mechanical Engineering Department of the Middle East Technical University in Ankara. This conference will be the 15th of the international and the 20th of all UMTIK conferences which were organized every two years since then without interruption, except for the year 2020, due to the worldwide pandemic.

The first day of UMTIK 2024 will be “The Commemoration Day of Professor Metin Akkök”; it is dedicated to the memory of the late Professor Metin Akkök who was one of the original initiators and organizers of the inaugural UMTIK Conference and continued to make significant contributions to the subsequent UMTIK conferences until his passing on May 11, 2023. The first-day program will start by welcoming and opening speeches to UMTIK 2024 which will be followed by the commemoration of Professor Metin Akkök. There will be a Welcome Cocktail in the evening.

During the four-day UMTIK conference, there will be:

- 11 keynote speeches by the eminent international and national researchers on leading topics such as digital machining, additive manufacturing, structural dynamics, innovative design, research for value generation, environment friendly manufacturing and future for young engineers.
- 21 sessions under 12 themes such as automotive engineering, metal cutting, simulation and modeling, intelligent systems, additive manufacturing, biomedical and engineering applications, artificial intelligence in design and manufacturing, mechanics, tribology, and sustainable manufacturing.
- 6 special sessions on various topics from dynamics and machining stability for flexible systems to design science and time axis design, design and human interface to sustainable design and operation.
- 11 sponsor sessions (industry speakers) to introduce themselves to other companies and academics for future collaborations.
- Two industrial panels to discuss 1) the development of a national CNC controller for the future of Turkish CNC machine tools industry, and 2) the use and applications of TRIZ (innovative problem-solving theory).
- The Gala Dinner on the third day of the conference by the beautiful Mogan lake of Ankara.

We extend our sincere gratitude to Mr. Yalçın Zaim, Chairman of the Board of Trustees at Atılım University, Prof. Dr. Serkan Eryılmaz, Rector of Atılım University, and Prof. Dr. Yılser Devrim, Dean of the Faculty of Engineering, for all their support. Additionally, we express our thanks to Prof. Dr. Esra Gül Dardağan Kibar, Dean of the Faculty of Law, for her hospitality in allowing us to use the facilities of the Faculty of Law. Furthermore, we thank Mr. Ozan Budak, Director of Corporate Communication and Promotion, Mr. Kemal Şenoğlu, former Director of Cultural and Social Affairs, Mr. Hüseyin Dölen, Director of Distance Education, and all the staff of Atılım University for their support.

We hope all the participants will feel the warm and positive atmosphere at Atılım University. We highly acknowledge the Honorary Conference Chairs for their kind support: Presidents of the four universities, Professor Serkan Eryılmaz of Atılım University, Professor Hasan Ali Karasar of Kapadokya University, Professor Türkay Dereli of Hasan Kalyoncu University and Professor İhsan Sabuncuoğlu of TED University.

We would like to thank the honorary keynote speaker, Professor Yusuf Altıntaş and the other keynote speakers, Professor Bilgin Kaftanoğlu, Emeritus Professor H. Nevzat Özgüven, Professor İsmail Lazoğlu, Professor Bahattin Koç, Professor Charlie C. L. Wang, Professor Tomoyuki Miyashita, Professor Birol Kılış, Assoc. Prof. Tanfer Yandayan, Mr. Mümtaz Afşin Esi, Mr. Fuat Tiniş.

We would like to express our sincere appreciation to Mr. Berkin Bilge and Mr. Burak Can Çiçek for their efforts in organizing and moderating the industrial panels on the second and the fourth days of the conference. The panelists, special session organizers, session chairs, authors and all the participants are highly acknowledged for their invaluable contributions.

Asst. Prof. Bahram Lotfi and Asst. Prof. Ramazan H. Namlu are gratefully acknowledged for their tremendous time and effort in every phase of the conference organization and in the editorial work of the Proceedings and the Abstracts Book.

Last but not the least, we would like to thank TÜBİTAK “The Scientific and Technological Research Council of Türkiye”, “Turkish Machinery Exporters Union”, silver and bronze sponsors, members of the International Program Committee, Conference Secretariat “ORIGINEMC”, Scientific Secretariat (Research Assistants Yunus Emre Nehri and Mehmet Furkan Özbey) and all who contributed to the success of UMTİK 2024.

We wish all the participants a highly memorable time during their stay in Ankara.

The Organizing Committee
UMTIK 2024,
August 14th – 17th
2024
Ankara, Türkiye

AUGUST 14, 2024- WEDNESDAY	
8:00 – 9:00	REGISTRATION
9:00 – 10:00	OPENING SESSION
10:00 – 11:00	HALL 1 (I1) PLENARY SESSION I Celebration of the life and achievements of Prof. Dr. Metin AKKÖK By: Prof. Dr. R. Orhan YILDIRIM Session Chairs: Drs. YAMAN, HİMMETOĞLU & ESAT
11:00 – 11:30	COFFEE BREAK
11:30 – 12:00	HALL 1 (I2) PLENARY SESSION II Development of Mechanics, Tribology and Lubrication In loving memory of Prof. Dr. Metin AKKÖK Speaker: Prof. Dr. Bilgin KAFTANOĞLU
12:00 – 13:00	HALL 1 (I3) SPONSORS SESSION
13:00-14:00	LUNCH
14:00-15:40	HALL 1 (I4) Special Session: <i>In loving memory of Prof. Dr. Metin AKKÖK</i> Machine Design, Sustainability, Manufacturing and Tribology Session Co-Chairs: Assoc. Prof. Dr. Ulaş YAMAN, Assoc. Prof. Dr. Selçuk HİMMETOĞLU & Assoc. Prof. Dr. Volkan ESAT
15:40 – 16:20	COFFEE BREAK
16:20-17:40	HALL 1 (I5) Special Session: <i>In loving memory of Prof. Dr. Metin AKKÖK</i> Machine Design and Tribology Session Co-Chairs: Assoc. Prof. Dr. Ulaş YAMAN, Assoc. Prof. Dr. Selçuk HİMMETOĞLU & Assoc. Prof. Dr. Volkan ESAT
19:00	Welcome Cocktail (Atılım University- Garden Restaurant)

AUGUST 15, 2024- THURSDAY			
9:00-10:30	HALL 1 (I6) PLENARY SESSION III Keynote Speaker: Prof. Dr. Yusuf Altıntaş “Digital Twin for Machine Tool Monitoring”		
	Keynote Speaker: Prof. Dr. H. Nevzat ÖZGÜVEN “Dynamic Sub-structuring and Modelling Linear and Nonlinear Connection Dynamics in Structural Assemblies Using Experimental Data”		
10:30-10:45	COFFEE BREAK		
10:45- 12:15	HALL 1 (I7) PLENARY SESSION IV Panel: Yerli CNC Denetleyici Moderator: Berkin Bilge Speakers: Prof. Dr. Yusuf Altıntaş, Prof. Dr. Engin Kılıç, Prof. Dr. Onur Tunçer Uğur COŞKUN, CEO of Ad Astra Technology Group Cem ŞİROLU, TIAD YK Üyesi – CEO of Yenasoft		
12:15-13:15	LUNCH		
13:15-14:45	HALL 1	HALL 2	HALL 3
	A1	B1	C1
	Special Session: Dynamics and machining stability for flexible systems 40, 90, 91, 81	Malzeme ve Malzeme Mekaniği 23, 32, 78	Artificial Intelligence in Design and Manufacturing 34, 36, 51
14:45-16:15	HALL 1	HALL 2	HALL 3
	A2	B2	C2
	Special Session: Dynamics and machining stability for flexible systems 89, 92, 95	Makina Tasarımı I 58, 70	Fracture Mechanics and Damage Modelling 25, 28, 49, 77
16:15-16:30	COFFEE BREAK		

<i>AUGUST 15, 2024- THURSDAY (Cont'd)</i>	
16:30-18:00	Hall 1 (18) PLENARY SESSION V
	Keynote Speaker: Assoc. Prof. Dr. Tanfer YANDAYAN “Interpolation Errors of Encoders: Their Influence on The Machine Parts, Determination, Measurement, And Mitigation”
	Keynote Speaker: Prof. Dr. İsmail LAZOĞLU “Value Generation for the Society via Advanced Research: Our experience at Koç University Manufacturing and Automation Research Center”

AUGUST 16, 2024- FRIDAY			
9:00- 10:30	Hall 1 (I9) PLENARY SESSION VI Keynote Speaker: Prof. Dr. Bahattin KOÇ “Additive Manufacturing of Functionally Graded Materials”		
	Keynote Speaker: Prof. Dr. Charlie C. L. WANG “Vector 3D Printing: From Curved Slicer to Continuous Fibre Reinforcement”		
10:30-10:45	COFFEE BREAK		
10:45-12:00	HALL 1	HALL 2	HALL 3
	A3	B3	C3
	Additive Manufacturing 20, 48, 54	Simulation and Modelling-I 6, 72, 100	Materials 73, 74, 87
12:00-13:00	HALL 1	HALL 2	HALL 3
	A4	B4	C4
	Eklemleri İmalat 30, 60	Simulation and Modelling-II 75, 76, 80	Intelligent Systems in Production 8, 86, 88
13:00-14:00	LUNCH		
14:00-14:45	HALL 1 (I10) PLENARY SESSION VII Keynote Speaker: Prof. Dr. Tomoyuki MIYASHITA “Innovation Facilitation at Design Process”		
14:45-16:15	HALL 1	HALL 2	HALL 3
	A5	B5	C5
	Special Session: Design Science and Timeaxis Design 24, 27, 59, 71	Makina Tasarımı II 13, 79, 85, 96	Engineering Applications 21, 22, 61
16:15-16:30	COFFEE BREAK		

<i>AUGUST 16, 2024- FRIDAY (Cont'd)</i>			
16:30-18:00	HALL 1	HALL 2	HALL 3
	A6	B6	C6
	Special Session: Design and Human Interface 41, 42, 43, 44, 46	Biomedical Applications 64, 65	Mühendislik Uygulamaları 5, 7, 55, 66, 94
19:30	GALA DINNER		

AUGUST 17, 2024- SATURDAY			
9:00-9:45	HALL 1 (I11) PLENARY SESSION VIII Keynote Speaker: Prof. Dr. Birol KILKIŞ “Environment Friendly Industrial Parks Within the Scope of Carbon Taxes and Global Warming”		
9:45-11:00	HALL 1	HALL 2	HALL 3
	A7	B7	
	Special Session: Sustainable design and operation in the built environment 2, 3, 4	Automotive Engineering-I 1, 39, 67	
11:00-11:15	COFFEE BREAK		
11:15-12:30	HALL 1	HALL 2	HALL 3
	A8	B8	C7
	Special Session: Sustainable design and operation in the built environment 11, 26, 47	Automotive Engineering-II 14, 56, 57, 69	Talaşlı İmalat 29, 45, 84
12:30-13:30	LUNCH		
13:30-15:00	Hall 1 (I12) PLENARY SESSION IX Keynote Speaker: Fuat TİNİŞ “Future for Young Engineers” Keynote Speaker: Mümtaz Afşin EŞİ “Approaches to Structural Dynamic Design of Satellite Launch Systems and Verification & Validation in Engineering Analyses”		
15:00-15:15	COFFEE BREAK		
15:15-17:15	Hall 1 (I13) PLENARY SESSION X PANEL: TRIZ ve Uygulamaları Moderator: Burak Can Çiçek		
17:15- 18:00	CLOSING CEREMONY		

AUGUST 14, 2024 (WEDNESDAY)

(1)	PLENARY SESSION I	HALL 1	10:00 – 11:00
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Chaired by: Drs. YAMAN, HİMMETOĞLU & ESAT

Speaker: Prof. Dr. R. Orhan YILDIRIM

Celebration of the life and achievements of Prof. Dr. Metin AKKÖK

(2)	PLENARY SESSION II	HALL 1	11:30 – 12:00
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Chaired by: Drs. YAMAN, HİMMETOĞLU & ESAT

Speaker: Prof. Dr. Bilgin KAFTANOĞLU

Development of Mechanics, Tribology and Lubrication

In loving memory of Prof. Dr. Metin AKKÖK

(I3)	SPONSORS SESSION	HALL 1	12:00 – 13:00
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Chaired by: Drs. YAMAN, HİMMETOĞLU & ESAT

(I4)	SPECIAL SESSION Machine Design, Sustainability, Manufacturing and Tribology	HALL 1	14:00 – 15:40
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Chaired by: Drs. YAMAN, HİMMETOĞLU & ESAT

In loving memory of Prof. Dr. Metin AKKÖK

An Experimental Investigation on the Energy Requirement of Different Materials Manufactured on a CNC (35)

Ural ULUER, Metin AKKÖK, Engin Sadik KILIÇ, Dr. Ulaş YAMAN

Water Jet Guided Laser Micro Drilling of an Aerospace Alloy (9)

Levent SUBAŞI, Mustafa GÖKLER, Dr. Ulaş YAMAN

Integration Of 6-Axis Hexapod with Nanosecond Laser For Micro Machining (62)

Aykut BAKAN, Yigit KARPAT

Evaluation Of Lubrication Efficiency of Different MQL Oils in Ti-6Al-4V Machining (53)

Ramazan Hakkı NAMLU, Kübra KAVUT, Hanife Gülen TOM

Milling Force Estimation Using Angular Domain Harmonics with Cutting And Edge Coefficients (15)

Mert İLME, Hakan ÇALIŞKAN

AUGUST 14, 2024 (WEDNESDAY)

(15)	SPECIAL SESSION: Machine Design and Tribology	HALL 1	16:20 – 17:40
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Chaired by: Drs. YAMAN, HİMMETOĞLU & ESAT

In loving memory of Prof. Dr. Metin AKKÖK

Design and Manufacturing of a Macro Scratch Tester for Coating Adhesion Assessment (37)

Engin D. E. DEMİRELLER, Emre Oğuz ACAR, Tunç OGAN, Muzaffer ŞAHİN, Mustafa KURT, Kutay ATALAY, Bilgin KAFTANOGLU, Korcan KÜÇÜKÖZTAŞ

Design And Manufacturing of a Cost-Effective Metallographic Specimen Polishing Machine (38)

Sultan Abdulazeez ALI, Yousef Mohamed ALMASRI, Waleed ELAZZAMI, Tarık Emre ELÇİ, Emrah ŞENSOY, Servet YILMAZ, Bilgin KAFTANOGLU, Korcan KÜÇÜKÖZTAŞ

Design, Production and Validation of Low-Cost Minimum Quantity Lubrication System (52)

Öykü MERCAN, Emre ONAY, Özgür Barış TOSUN, Buse ÇETINKAYA, Salih OKYAY, Mehmetcan SARIKAHYA, Ramazan H. NAMLU, S. Engin KILIÇ

Optimizing Rubber Pad Forming: A Study on Stainless Steel and Aluminum (10)

Çağlar CEYLAN, Korcan KÜÇÜKÖZTAŞ, Hakan KALKAN

AUGUST 15, 2024 (THURSDAY)

(16)	KEYNOTE SPEECH	HALL 1	9:00 – 10:30
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Chaired by: Dr. Z. Murat KILIÇ

“Digital Twin for Machine Tool Monitoring”

Keynote Speaker: Prof. Dr. Yusuf ALTINTAŞ

“Dynamic Sub-structuring and Modelling Linear and Nonlinear Connection Dynamics in Structural Assemblies Using Experimental Data”

Keynote Speaker: Prof. Dr. H. Nevzat ÖZGÜVEN

(17)	PANEL Yerli CNC Denetleyici	HALL 1	10:45 – 12:15
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Moderator: Berkin BİLGE

Speakers: Prof. Dr. Yusuf ALTINTAŞ, Prof.Dr. Engin Kılıç, Prof.Dr Onur Tunçer Uğur COŞKUN (CEO of Ad Astra Technology Group), Cem ŞİROLU (TIAD YK Üyesi – CEO of Yenasoft)

(A1)	SPECIAL SESSION Dynamics and machining stability for flexible systems	HALL 1	13:15 – 14:45
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Chaired by: Dr. Z. Murat KILIC, Prof. Dr. Jixiang YANG, Dr. Mohit LAW

Linear Contact Dynamics Identification in Holder Extension Tool Assemblies via Inverse Structural Modification Method (40)

Hanife AYYILDIZ, Orkun ÖZŞAHİN, H. Nevzat ÖZGÜVEN

Fundamental Investigation of The Application Behavior and Stabilization Potential of Milling Tools with Structured Flank Faces on The Minor Cutting Edges (90)

Raphael I. E. SCHÖNECKER, Jonas BAUMANN, Rafael Garcia CARBALLO, Dirk BIERMANN

Tool Path Strategies for Efficient Milling of Thin-Wall Features (91)

Lütfi T. TUNC

Real Time Milling Chatter Detection and Control with Axis Encoder Feedback and Spindle Speed Manipulation (81)

Hakan ÇALIŞKAN

AUGUST 15, 2024 (THURSDAY)

(B1)	SESSION (TÜRKÇE) Malzeme ve Malzeme Mekaniği-I	HALL 2	13:15 – 14:45
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Chaired by: Dr. Barış ÇETİN

Ağır Ticari Araçlarda Kardan Mili U-Sacının Güçlendirilmesi (23)

Umut Can GÖLBAŞI, Murat ÖZBAKIŞ, Onur ŞEN

Kutu Tipi Çelik Kirişlerde Ön Gerilme Etkisinin Analitik ve Sonlu Elemanlar Yöntemiyle İncelenmesi ve Analizi (32)

Samet DÖNERKAYA, Kanay ZEYREK, Emre YAMAN

Elektro-Reolojik Termoplastik Elastomer Geliştirilmesi ve Karakterizasyonu (78)

Onur ÇETİNKAYA, Şükran KATMER, Gökçe Çalış İSMETOĞLU, Ömer Yunus GÜMÜŞ, Çetin KARATAŞ, Halil İbrahim UNAL, Ulvi ŞEKER

(C1)	SESSION Artificial Intelligence in Design and Manufacturing	HALL 3	13:15 – 14:45
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Chaired by: Prof. Dr. H. Özgür ÜNVER

Design and Optimization of An Ev Battery Enclosure Using Machine Learning (34)

Burak AYDOĞDU, Fatih KARPAT, Necmettin KAYA

Machine Learning for Predictive Modelling and Optimisation of PVD Boron Nitride Coatings (36)

Korcan KÜÇÜKÖZTAŞ, Bilgin KAFTANOĞLU, Çiğdem TURHAN

Dimensional Control in Sheet Metal Bending Using Machine Learning (51)

Mehmet Can BÜYÜKDÖĞERLİOĞLU, Haydar LIVATYALI

AUGUST 15, 2024 (THURSDAY)

(A2)	SPECIAL SESSION Dynamics and machining stability for flexible systems (II)	HALL 1	14:45 – 16:15
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Chaired by: Dr. Z. Murat KILIC, Prof. Dr. Jixiang YANG, Dr. Mohit LAW

Effect of Guideway Non-Linear Friction on Machining Chatter Stability Prediction (89)

Oier FRANCO, Xavier BEUDAERT, Kaan ERKORKMAZ, Jokin MUNOA

Stability of Micro-Milling Tool Considering Tool Breakage (92)

Yuan-Yuan REN, Bao-Guo JIA, Min WAN, Hui TIAN

Improving Robotic Milling Performance Through Active Damping of Low-Frequency Structural Modes (95)

Govind Narayan SAHU, Andreas OTTO, Steffen IHLENFELDT

(B2)	SESSION (TÜRKÇE) Makine Tasarımı I	HALL 2	14:45 – 16:15
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Chaired by: Dr. Murat BÜYÜK

Rijit Saç Metal Yapısal Parça Tasarımı Optimizasyonu (58)

Emre TORUK, Bilgin KAFTANOĞLU, Hakan KALKAN

Abkant Preslerde Dinamik Bombeleme Sisteminin Tasarım Kriterleri ve Avantajları (70)

Abdullah ÖZKAN, Mustafa GÜLTEKİN

AUGUST 15, 2024 (THURSDAY)

(C2)	SESSION Fracture Mechanics and Damage Modelling	HALL 3	14:45 – 16:15
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Chaired by: Dr. Ramazan Hakkı NAMLU

Evaluation of Different Damage Models Applied for Extruded 6xxx Series Aluminum (25)

Seda YILDIZ, Hüseyin LEKESİZ

Evaluating Steel/Adhesive Interfacial Failure using Pull-Off Tests (28)

Fatih İBRAHİMOĞLU, Ata KHABAZ-AGHDAM, Şehram DIZECI

Damage Detection on Beam Structures using Ho-Kalman Identification Method (49)

Ömer Dehan ÖZBOZ, Özkan ALTAY, Ahmet Murat ÖZBAYOĞLU, Hakkı Özgür ÜNVER

Exploring the Quantification Potentials in Assessing the Witness Plate Results off a Ballistic Test Via Digital Image Processing Techniques (77)

Hüseyin KURTULDU, Barış ÇETİN, Atanur TEOMAN, Engin GÖDE, Gökhan İbrahim ÖĞÜNÇ, Melih Cemal KUŞHAN

(I8)	KEYNOTE SPEECH	HALL 1	16:30 – 18:00
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Chaired by: Prof. Dr. Kei MATSUOKA

“Interpolation Errors of Encoders: Their Influence on The Machine Parts, Determination, Measurement, And Mitigation”

Keynote Speaker: Assoc. Prof. Dr. Tanfer YANDAYAN

“Value Generation for the Society via Advanced Research: Our experience at Koç University Manufacturing and Automation Research Center”

Keynote Speaker: Prof. Dr. İsmail LAZOĞLU

AUGUST 16, 2024 (FRIDAY)

(I9)	KEYNOTE SPEECH	HALL 1	9:00 – 10:30
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Chaired by: Assoc. Prof. Dr. Ulaş YAMAN

“Additive Manufacturing of Functionally Graded Materials”

Keynote Speaker: Prof. Dr. Bahattin KOÇ

“Vector 3D Printing: From Curved Slicer to Continuous Fibre Reinforcement”

Keynote Speaker: Prof. Dr. Charlie C. L. WANG

(A3)	SESSION Additive Manufacturing	HALL 1	10:45 – 12:00
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Chaired by: Dr. Hakan KALKAN

Design And Characterization of An Additively Manufactured Heat Exchanger with Triply Periodic Minimal Surface Core (20)

Burak CEVAHİR, Ulaş YAMAN

The Additive Manufacturing Process and Its Challenges in Human Prosthesis Development: Preliminary Studies (48)

Carla ANFLOR, Euclides SANTANNA, Karla SARTIN

Development of a Laboratory-Scale Tungsten Inert Gas-Wire Arc Additive Manufacturing Device (54)

Mustafa Çağrı ÖZKADER, Öncü AKYILDIZ, Cengiz BAYKASOĞLU

(B3)	SESSION Simulation and Modelling-I	HALL 2	10:45 – 12:00
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Chaired by: Prof. Dr. Leo COURTLY

Methodology for The Optimized Arrangement of Microelectronic Components on The Printed Circuit Board from a Mechanical Perspective (6)

Fahri Berk BİLBAY, Mustafa Cemal ÇAKIR

A Sensitivity Analysis on Induction Simulation of Heavy-Duty Drive Line Components (72)

Barış ÇETİN, Caner BAKRAÇ, Emre ÇAPOĞLU, Abidin TOKER, Ercan DEMİRCİ, Gökhan SAĞLAM

The Influence of Metal Forming on Crashworthiness (100)

Murat BÜYÜK, V. Emre SAVAŞ

AUGUST 16, 2024 (FRIDAY)

(C3)	SESSION Materials	HALL 3	10:45 – 12:00
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Chaired by: Prof. Dr. Yiğit KARPAT

Development of Joining Methods of Thermoplastic Composites for Aerospace Applications (73)

Furkan KARABOĞA, Eray KOŞTUR, Fahrettin ÖZTÜRK, Mahide Betül ÖZTÜRKMEN, Merve Özkutlu DEMİREL, Serkan TOROS, Yahya ÖZ, Zelal YAVUZ

Development of Thermal Insulation Material for Aerospace Applications (74)

Furkan KARABOĞA, Abdullah TAV, Halil I. AKYILDIZ, Merve ÖZKUTLU DEMİREL, Serkan TOROS, Yahya ÖZ

Effect of Uniformity on Porosity of Stochastic Fibrous Networks (87)

Yagiz KAYALI, Ekaterina SMOTROVA-KAYALI, Andy GLEADALL, Vadim V. SILBERSCHMIDT

(A4)	SESSION (TÜRKÇE) Eklemeli İmalat	HALL 1	12:00 – 13:00
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Chaired by: Prof. Dr. M. Cemal ÇAKIR

3B Yazıcı ile Üretilen Parçaların Farklı Baskı Yönlerindeki Dayanımının DeneySEL ve Nümerik İncelenmesi (30)

Emre Can HASKİLİT, Habip Gökay KORKMAZ, Remzi E. ECE, Serkan TOROS, Fahrettin ÖZTÜRK

Martenzitik Paslanmaz Çeliklerin Lazer Dolgu Kaynağında Örtüşme Oranının Kalinti Gerilmeye Etkisi (60)

Meryem ALTAY, Hakan AYDIN, Adem KARŞI

(B4)	SESSION Simulation and Modelling-II	HALL 2	12:00 – 13:00
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Chaired by: Prof. Dr. Carla ANFLOR

Determination of the Constitutive Material Model Parameters of an Armor Steel Conforming to Mil-Dtl-46100 Standard (75)

Barış ÇETİN, Atanur TEOMAN, Engin GÖDE, Gökhan İbrahim ÖĞÜNÇ, Caner ŞİMŞEK, Kürşat TONBUL

Burst Assessment of Aero Engine Disc (76)

Okan Deniz YILMAZ

A Benchmark Study on Alternative Boundary Element-Based Solution Strategies on Cathodic Protection of Amphibious Vehicles (80)

Barış ÇETİN, Barbaros ÇETİN, Besim BARANOĞLU

AUGUST 16, 2024 (FRIDAY)

(C4)	SESSION Intelligent Systems in Production	HALL 3	12:00 – 13:00
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Chaired by: Dr. Bahram LOTFI

A Decision Support System for Internal Logistics Operations Management (8)

Denizay AKBİYİK, Sinem ÖZEN, Tuna ULUSOY, Eren DAĞSUYU, Ece AKPINAR, Yasin Burak UÇAK, Sefa UYDURAN, Damla DEMİR, Nilgün FESİOĞLU ÜNVER

Implementation of the Kanban System on a Machine Assembly Line (86)

Hafize DURMAZ, Hasan ÇAKIR, Alper YETER, MUSTAFA BAKKAL

Exploring the Influence of Industry 4.0 on Business Models: Key Drivers and Barriers to Implementation (88)

Aida SALIMNEZHADGHAREHZIAEDDINI, Abdi M. A. ISMAIL

(I10)	KEYNOTE SPEECH	HALL 1	14:00 – 14:45
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Chaired by: Prof. Dr. Bilgin KAFTANOĞLU

“Innovation Facilitation at Design Process”

Keynote Speaker: Prof. Dr. Tomoyuki MIYASHITA

(A5)	SPECIAL SESSION Design Science and Timeaxis Design	HALL 1	14:45 – 16:15
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Chaired by: Prof. Dr. Yoshiyuki MATSUOKA, Assoc. Prof. Dr. Takeo KATO

Quantification of Aesthetic Preferences Using Image Features of Videos (24)

Ren HAYAKAWA, Yuki SHIMIZU, Takeo KATO, Yasuji FUKASAWA, Aichi INOUE

Proposal of a Preference Set-Based Design Method for Qualitative Evaluation (27)

Shotaro OYAMA, Takeo KATO

Design of the Deployment of Membranes on Satellites (59)

Teru NATORI, Tomoyuki MIYASHITA

Numerical Approach of Time-axis Design Method - Validation through an Application for Chair Design (71)

Akinari HIRAO, Takeo KATO, Yoshiyuki MATSUOKA

AUGUST 16, 2024 (FRIDAY)

(B5)	SESSION (TÜRKÇE) Makina Tasarımı II	HALL 2	14:45 – 16:15
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Chaired by: Mehmet Furkan ÖZBEY

Temassız Enerji Sistemi ile Çalışan 70 Ton Transfer Arabası (13)

Yalçın Y. GÜLER, Mehmet KOÇİSARLI, Aydoğan AKÇA, Ece KARSLI,
Engin TEKİN, Sibel Sain ÖZDEMİR

Yüksek Hacimli Talaş Kaldırma Kapasitesine Sahip Freze Tezgahi İçin Takım Değiştirme Sisteminin Geliştirilmesi (79)

Can TUNCER, Talat Yiğit GENÇEL, Enver YALÇIN, Ali ORAL

Sistematik Konstrüksiyon Yaklaşımıyla Lineer Ray Tapası Montaj Aparatı Tasarımı (85)

H. Aytuğ KURT, Alper YETER, Mustafa BAKKAL

Büyük Boyutlu Freze Tezgahları İçin Hidrolik Döner-İş Bağlama Sisteminin Geliştirilmesi (96)

Mehmet UĞUR, Talha GİRGİN, O.Talha DİNÇER, Cengiz OĞUZER, Ali ORAL

(C5)	SESSION Engineering Applications	HALL 3	14:45 – 16:15
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Chaired by: Prof. Dr. Erhan İlhan KONUKSEVEN

Enhancing Operational Efficiency in Crushers Through the Use of An Industry 4.0 Based Crusher Control System (21)

OZGE GULER, Mustafa Cemal ÇAKIR

Design, Analysis and Verification of EMC with Various Ball and Trapezoidal Drives (22)

Berk KURT, Ömer Faruk UYSAL, Tolga CANKURT

Design And Implementation of a Sampling System for Solid Flow on Conveyor Belts in Industry (61)

Barış SEZER, Hakan KALKAN, Behzat Bahadır KENTEL

AUGUST 16, 2024 (FRIDAY)

(A6)	SPECIAL SESSION Design and Human Interface	HALL 1	16:30 – 18:00
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Chaired by: Prof. Dr. Tetsuro OGI, Assoc. Prof. Dr. Kei MATSUOKA

Multilingual Communication Robot Using Language Detection System (41)

Kei MATSUOKA, Yuki KIDA, Takeo KATO, Tetsuro OGI

Human Relationship Felt in Communication Using Tele-Immersion Avatar Robot (42)

Tetsuro OGI, Yuki KIDA

Simple Reaction Test with Mouse Clicks Using 500 Hz Monitors. Is A 500 Hz Monitor Effective for Esports? (43)

Yuya ASHIZAWA, Hideo MIYACHI

Seating Positions and Behaviors in Virtual Space (44)

Toma SHIBANO, Hideo MIYACHI, Sumire HIROTA

Architecture of Autonomous Avatar and VR Simulator for Various Training Purposes and Situations (46)

Tomohiro TANIKAWA

(B6)	SESSION Biomedical Applications	HALL 2	16:30-18:00
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Chaired by: Prof. Dr. İsmail LAZOĞLU

Conceptual Design of a Novel Splint to Reduce the Effect and Risk of Occurrence of Carpal Tunnel Syndrome (64)

İnci AKSAÇ, Recep KARAYAVUZ, Yiğithan ŞAHİN, İrem TEKİN, Serhan UĞURLU, Dilek ÇÖKELİLER SERDAROĞLU, Behzat Bahadır KENTEL

The Design of a Rotating Modular Upper Limb Prosthetic Wrist Unit (65)

Aykut Ali GÜRLER, Erhan İlhan KONUKSEVEN

AUGUST 16, 2024 (FRIDAY)

(C6)	SESSION (TÜRKÇE) Mühendislik Uygulamaları	HALL 3	16:30-18:00
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Chaired by: Prof. Dr. Ulvi ŞEKER

İnce Cidarlı Çelik Tübüler Direklerin Dinamik Performansı Üzerine Pasif Sarkaç Ayarlı Kütle Sönümleyicilerin Etkilerinin Deneysel İncelenmesi (5)

Sertaç ÖZDEMİR, Rafet AKTEPE, Alper ALDEMİR, Erdem ACAR

Montaj Takim Üretim Hattı için Süre Takip ve İş Çizelgeleme Modeli (7)

Fatma İkra AKYEL, Ataberk BALCI, Mustafa Erdi CANAN, Melisa ÖZDEMİR, Enes ÖZTÜRK, Ece ZERAY, Serdar YURDUSEVEN, Ayşenur KALMAZ, Turgay ÖZTÜRK, Nilgün Fescioğlu ÜNVER

Akıllı Mücevherlerde İnovasyon: Teknoloji ve Tasarımın Birleşimi (55)

Sevban AKIN, Hüseyin Özkal ÖZSOY

Elektrikli Taşıtlarda Batarya Taşıyıcısına Farklı Lokasyonlardan Alttan Çarpmanın Çarpışma Performansına Etkisi (66)

Burak AYDOĞDU, Mehmet Kıvanç TURAN, Fatih KARPAT, Necmettin KAYA

Karbon Fiber Destekli Kompozit ile Alüminyum Alaşımının Yüzey Enerjilerinin İncelenmesi (94)

Yunus E. NEHRİ, Kadir ÇAVDAR, Ali ORAL

AUGUST 17, 2024 (SATURDAY)

(I11) KEYNOTE SPEECH

HALL 1

9:00 – 9:45

Chaired by: Assoc. Prof. Dr. Cihan TURHAN

“Environment Friendly Industrial Parks Within the Scope of Carbon Taxes and Global Warming”

Keynote Speaker: Prof. Dr. Birol KILKIŞ

(A7) SPECIAL SESSION

HALL 1

9:45 – 11:00

Sustainable design and operation in the built environment (I)

Chaired by: Assoc. Prof. Dr. Cihan TURHAN

Novel-Designed Intelligent Robot Development for Detecting Moss Growth and Cracked Tiles in Swimming Pool Structures in Built Environment (2)

Mahmut GARİP, Ahmet Esat YAVAŞ, Ahmet EMİR, Gökem Anıl GÖKALP,
Nuri Bilgehan KÖSEOĞLU, Noura ALHUMMADA, Cihan TURHAN

Understanding the State of Mind on Thermal Comfort Through Literature: Introducing Turhan and Özbey Coefficients (3)

Mehmet Furkan ÖZBEY, Cihan Turhan

Determining Payback Period and Comparing Two Small-Scale Vertical Axis Wind Turbines Installed at the Top of Residential Buildings (4)

Yousif A. SALEH, Cihan TURHAN

(B7) SESSION

HALL 2

9:45 – 11:00

Automotive Engineering-I

Chaired by: Dr. Ali EMİN

Development of a Roll Over Prevention Control Strategy for an Articulated Bus Equipped with On-Board Electric Motors (1)

Kerem BAYAR

Ürün Doğrulama ve Saha Testlerinde Kullanıma Yönelik Android Tabanlı Canlı Veri Toplama Arayüzü Geliştirme (39)

Sedat TARAKÇI, Oğuzhan ALDEMİR, Efe IŞIK

Planetary Gearbox Design for Hybridization of a Prototype Powertrain (67)

Özgür AKDENİZ, Ali EMİN

AUGUST 17, 2024 (SATURDAY)

(A8)	SPECIAL SESSION Sustainable design and operation in the built environment (II)	HALL 1	11:15 – 12:30
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Chaired by: Assoc. Prof. Dr. Cihan TURHAN

Techno-Economic Optimization of Hybrid Energy Systems for Zero Energy Buildings in Remote Communities: A Case Study in Ankara (11)

Mehdi MEHRTASH, Othman J. ALHAYALI

Thermal Management of a Multi-Functional Battery Case (26)

Ibrahim DİKER, Orhun Cem GÖKCİLER, Göktürk Memduh ÖZKAN,
Durmuş Can ACER, Ahmet ÇETİN, Necdet GEREN

Thermal Decomposition of The Solid Phase of Gun Propellants (47)

Leo COURT, Samuel DELBARRE, Mame WILLIAM-LOUIS

(B8)	SESSION Automotive Engineering-II	HALL 2	11:15 – 12:30
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Chaired by: Dr. Ramazan Hakkı NAMLU

A Lightweight Multifunctional Battery Case (14)

Necdet GEREN, Orhun Cem GÖKCİLER, Mehmet Burak İBEKCI, Çağrı
UZAY, Melih BAYRAMOĞLU

Design and Analysis of Suspension and Steering System for an Electric Vehicle (56)

Umut Berke HAKTANIR, Emre ÇELİKCAN, Umut NAZLIER, Berkay
KANDEMİR, Özgür AKDENİZ, Ali EMİN

Improvements on the Lightweight Shell of an Electric Vehicle (57)

Mustafa EROL, Cemal Emre HOKKAÖMEROĞLU, Özgür AKDENİZ

Dynamic Height Adjustment and Obstacle Climbing Capabilities of A 6x6 Unmanned Ground Vehicle with Advanced Hydropneumatics Suspension Systems (69)

Melikşah BEŞİR, Eren DOYMUŞ, İsmail Melih CANBOLAT, Ahmet H.
ALKAN, Erhan İlhan KONUKSEVEN

AUGUST 17, 2024 (SATURDAY)

(C8)	SESSION (TÜRKÇE) Talaşlı İmalat	HALL 3	11:15 – 12:30
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Chaired by: Prof. Dr. Ali ORAL

Testere Makinelerinde Oluşan Kesme Kuvvetinin İş Parçası Yüzey Pürüzlülüğü Ve Kesim Dikliğine Etkisinin İncelenmesi (29)

Mahmut Berkan ALSİNOĞLU, Yunus Emre KINACI, Burak KORKUT, Şekip Esat HAYBER

Alüminyum 7075 T6 Malzemesinin Frezelenmesinde Kesme Parametrelerinin En İyilenmesi (45)

Sinan GÖKÇE, Semin KAYA

Sertleştirilmiş Çeliklerin Frezeleme İşlemlerinde Kesici Takım Karbür Kalitesi Ve Kaplamanın İşleme Performansına Etkisi (84)

Hasan KUŞ, Çağla Gökbulut AVDAN, Çağlar YAVAŞ

(I12)	KEYNOTE SPEECH	HALL 1	13:30 – 15:00
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Chaired by: Dr. Hakan KALKAN

“Future for Young Engineers”

Keynote Speaker: Fuat TİNİŞ

“Approaches to Structural Dynamic Design of Satellite Launch Systems and Verification & Validation in Engineering Analyses”

Keynote Speaker: Mümtaz Afşin EŞİ

(I13)	PANEL TRIZ ve Uygulamaları	HALL 1	15:15 – 17:15
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Moderator: Burak Can ÇİÇEK

Speakers: Burak Can ÇİÇEK, Doğan ATİK, Miraç ERDEM, Yunus BULUT, Veysel OTLUTEPE, Sema EĞİMSER

KEYNOTE PAPERS

NO	TITLE	AUTHOR
I2	Development of Mechanics, Tribology and Lubrication	Bilgin KAFTANOĞLU
I6-1	Digital Twin for Machine Tool Monitoring	Yusuf ALTINTAŞ
I6-2	Dynamic Sub-structuring and Modelling Linear and Nonlinear Connection Dynamics in Structural Assemblies Using Experimental Data	Nevzat ÖZGÜVEN
I8-1	Interpolation Errors of Encoders: Their Influence on The Machine Parts, Determination, Measurement, And Mitigation	Tanfer YANDAYAN
I8-2	Value Generation for the Society via Advanced Research: Our experience at Koç University Manufacturing and Automation Research Center	İsmail LAZOĞLU
I9-1	Additive Manufacturing of Functionally Graded Materials	Bahattin KOÇ
I9-2	Vector 3D Printing: From Curved Slicer to Continuous Fibre Reinforcement	Charlie C. L. WANG
I10	Innovation Facilitation at Design Process	Tomoyuki MIYASHITA
I11	Environment Friendly Industrial Parks Within the Scope of Carbon Taxes and Global Warming	Birol KILKIŞ
I12-1	Future for Young Engineers	Fuat TİNİŞ
I12-2	Approaches to Structural Dynamic Design of Satellite Launch Systems and Verification & Validation in Engineering Analyses	Mümtaz Afşin EŞİ

About the Speaker

Prof. Dr. Bilgin KAFTANOĞLU



Prof. Dr. Bilgin Kaftanoğlu graduated from Middle East Technical University (METU), Department of Mechanical Engineering, as the top student of his class in 1960. Between 1960 and 1964, he pursued his Master's and Ph.D. studies in mechanical engineering at the University of London, Imperial College of Science and Technology. Subsequently, he conducted research on computers at the University of London Computing Centre, International Computers Ltd. in London, and Bell-Northern Labs in Canada. Additionally, he taught in the Department of Mechanical Engineering at the University of Ottawa from 1967 to 1969. From 1969 to 2008, he served as a faculty

member, Vice Chairman and Chairman of the Department of Mechanical Engineering, Director of the Graduate School of Natural and Applied Sciences, and Vice Rector at METU. Between 1981 and 1984, he was a professor in the Department of Mechanical/Aerospace Engineering at Oklahoma State University. Prof. Dr. Bilgin Kaftanoğlu also founded the Institute of Machine Design and Manufacturing (MATİMAREN) and the Center for Computer-Aided Design/Manufacturing and Robotics (BİLTİR). In 2008, he started his tenure as the Head of the Department of Manufacturing Engineering at ATILIM University. Since 2011, he has been serving as the Chairman of the BOREN Boron Coatings Competence Center. From 2013 to 2017, he held the position of Chairman of the Metal Forming Excellence Center at ATILIM University. He has published 312 papers on design, manufacturing, metal forming, CAD/CAM, energy, and coatings. He has supervised 97 doctoral and master's theses in Turkey, holds 4 patents, and has 3 patent applications.

DEVELOPMENT OF MECHANICS, TRIBOLOGY AND LUBRICATION IN LOVING MEMORY OF PROF. DR. METIN AKKÖK

Historical development of mechanics, tribology and lubrication in the world will be reviewed. Founding of a new University-Middle East Technical University (METU) and training of new faculty will be emphasized. Development of Mechanical Design, Tribology in METU will be reviewed. Projects undertaken by research organization MATIMAREN will be reviewed. Publications of Mechanical Design and Manufacturing (MATİM) organization will be discussed. Founding of the CAD/CAM/ROBOTICS Center will be reviewed. Contributions of Prof. Dr. Metin Akkök in all above subjects will be referenced.

About the Speaker

Prof. Dr. Yusuf ALTINTAS



Professor Altintas obtained his Bachelor's from Istanbul Technical University (1975), M.Sc. (1980) from the University of New Brunswick and Ph.D. (1987) from McMaster University in Canada. He worked as a machine tool manufacturing engineer in Turkey (1977-1978), process development engineer in Pratt & Whitney Canada in Montreal (1980-1981), and served as the principal engineer of the Canadian Institute of Metalworking at McMaster University in Hamilton (1981-1982). He joined The University of British Columbia and founded Manufacturing Automation Laboratory in 1986. He conducts research on metal cutting, machine tool vibrations, control, sensors and actuators for machine

tools, and virtual machining. He has published over 220 archival journal and 100 conference articles with over ~41,000 citations with an h index of 105 (Google Scholar), and a widely used "Manufacturing Automation: Principals of Metal Cutting Mechanics, Machine Tool Vibrations and CNC Design. 1st ed. 2000, 2nd ed.:2012 with Chinese (2003,2020) and Turkish (2017) Editions. His research laboratory created advanced machining process simulation (CUTPRO), virtual part machining process simulation (MACHPRO) and open-modular 5-axis CNC system (Virtual CNC), which are used by over 300 companies and research centers in the field of machining and machine tools worldwide.

Professor Altintas is a fellow of Royal Society of Canada, National Academy of Engineering (USA), CIRP, ASME, SME, ACATECH (Germany), CAE, EC, Tokyo University, P&WC, AvH and ISNM. He received Pratt & Whitney Canada's (P&WC) university partnership (1997), APEG BC's Meritorious Achievement (2002), APEG BC R.H. McLachlan (2010), UBC Killam Teaching Prize of Engineering (2011), Gold Medal of Engineers Canada (2011), SME Albert M. Sergent Progress Award (2012), NSERC Synergy Award, ASME Blackall Machine Tool and Gage best journal paper award, the special scientific award of the Republic of Turkey in Science and Engineering (2013), Georg Schlesinger Production Engineering Award (Berlin, 2016), and ASME William T. Ennor Manufacturing Technology Award (USA, 2016). He holds Honorary Doctorate Degrees from Stuttgart University (2009) and Budapest University of Technology (2013), and holds an Honorary Professor title from BEIHANG University in Beijing. He was the past president of CIRP (International Academy of Production Engineering Researchers) for the term 2016 – 2017. He is designated as the Distinguished University Scholar at the University of British Columbia (since 2017). He is the founding coordinator of Mechatronics Option and was cofounder of the Manufacturing Engineering Degree program at UBC.

He directed NSERC CANRIMT Machining Research Network across Canada (2010-2022), and holds the NSERC – P&WC- Sandvik Coromant Industrial Research Chair

Professorship to develop next-generation Digital Machining Twin Technology (since 2002). He is also founding president of MAL Manufacturing Automation Lab. Inc. (www.malinc.com) which develops virtual machining technology.

DIGITAL TWIN FOR MACHINE TOOL MONITORING

The aim of our current research is to develop robust monitoring and process control systems that can easily be integrated to any CNC Machine tool. The mathematical models of machining process forces, torque, power, chip load, vibrations, drive loads, servo contouring and volumetric errors along curved tool paths are developed and simulated prior to physical machining operations. CNC inherent sensory data such as servo tracking errors, spindle – feed drive torque and power, actual axis positions and velocities, as well as the data from machine mounted analog sensors are collected during machining the parts. The information predicted from the digital twin and real machining are integrated to detect chatter and tool breakage, track tool wear and contouring errors left on the part, track the wear and faults on the spindle and feed drives of the machine. Simultaneously, the sensor data is used to improve the uncertainties of material, tool and machine parameters using physics and Artificial Intelligence methods. The technology is geared towards making the machine tools intelligent and self-correcting systems. Currently, the technology under development is licensed to industry and academia by the University of British Columbia. The research, which is conducted in partnership with Fraunhofer Institute of Germany, is sponsored by Sandvik Cormorant, Pratt & Whitney Canada, Siemens CNC, Alp Aerospace from Turkey, Liechti Switzerland and DN Solutions from Korea.

About the Speaker

Prof. Dr. H. Nevzat ÖZGÜVEN



Professor H. Nevzat Özgüven received his B.S. and M.S. degrees from METU (1973, 1975), and his Ph.D. from The University of Manchester (1978). He joined the faculty of the Mechanical Engineering Department at METU in 1978. He conducted research at Imperial College, London a short time as a NATO Research Fellow (1983), and spent two years as a Visiting Fulbright Professor at The Ohio State University, Columbus between 1985 and 1987. He became a full professor at METU in 1989. Very recently, he spent one term at the Technical University of Munich (TUM) as a visiting professor (Fall 2022). Professor Özgüven

held various administrative positions which include the CEO and the President of the Board of Directors of the Turkish Cement Industry (1992-1995) being on leave from METU, Assistant President at METU (responsible for research) (1995-1998), Vice President of TÜBİTAK for more than 5 years (1998-2003), and Vice President of METU (responsible for academic affairs) for 8 years (2008-2016). He represented Türkiye on international platforms including OECD Global Science Forum and EUREKA, and served as a board member in many national and international organizations. Özgüven received several awards from TÜBİTAK, NATO, NASA, Fulbright, TTGV, TÜBA, METU and TUM. His research interests include dynamics of damped structures, rotor dynamics, gear dynamics, machine tool dynamics, and nonlinear structural dynamics. He supervised over 80 M.S. and Ph.D. students, and published a book and more than 200 papers. He is a member of Society of Experimental Mechanics, Fellow of ASME and member of Science Academy (Türkiye). Currently, he is an Emeritus Professor at METU.

DYNAMIC SUB-STRUCTURING AND MODELLING LINEAR AND NONLINEAR CONNECTION DYNAMICS IN STRUCTURAL ASSEMBLIES USING EXPERIMENTAL DATA

In the dynamic analysis of mechanical structures sub-structuring provides considerable reduction in computational effort, especially when it is employed in an engineering design where several design alternatives are tested. Another significant application of sub-structuring is in the vibration analysis of an existing structure with modifications, where the measured responses of the current structure are combined with the dynamic characteristics of the modifying system. Also, in recent years, the decoupling application of sub-structuring has become the major tool in determining connection dynamics that are still very difficult to predict from pure theoretical models. While some connections show nonlinear effects only at high vibration levels, some joints are nonlinear at any response level due to the characteristics of the connection, such as clearance. Thus, in several cases, it is unavoidable to use nonlinear models for the connection dynamics. In this talk, our research which extends over several years, the emphasis being on the work in the last 10 years, on linear and nonlinear sub-structuring, the use of these methods for the identification of connection dynamics, and some of the methods developed for the analytical and experimental modal analysis of nonlinear systems will be presented. Mainly, the frequency-based sub-structuring approaches and their extension to nonlinear sub-structuring will be discussed with several applications. An overview of analytical and experimental modal analysis methods for nonlinear systems will also be given, offering tools for vibration analysis of structures with nonlinear connection dynamics and for nonlinear sub-structuring. The presentation will include examples from real systems and applications in machine tools and the defense industry.

About the Speaker

Assoc. Prof. Dr. Tanfer YANDAYAN



Tanfer Yandayan is a Chief Research Scientist in TUBITAK UME, National Metrology Institute of Turkey. Tanfer joined TUBITAK UME in 1997 after completing his PhD degree in Mechanical Engineering at the University of Manchester, UK. His research areas are interferometric and contact dimension measurements, geometrical errors, coordinate metrology, machine tool metrology and angle metrology. He headed the dimensional lab of TUBITAK UME for 15 years and worked for integration of TUBITAK UME to international metrology system being first international representatives. He is now doing research in

manufacturing metrology and has recently completed coordination of Angle Metrology project in which high level challenging issues for nanoradian-angle metrology were tackled with international consortium of 16 organisations. He is an associate professor in Mechanical Engineering and teaches Manufacturing Metrology course at Sabanci University and metrology courses in MSc Metrology programme at Gebze Technical University. He has been giving tutorials on advanced metrology applications e.g. High Accuracy Angle Metrology (ASPE 2022 and 2023). He currently works for the projects supported by European Commissions, performs continuous research work for advanced angle metrology and manufacturing metrology applications and provides consultancy & training particularly for the defence and aerospace industry using the outcome of advanced angle metrology research work.

INTERPOLATION ERRORS OF ENCODERS: THEIR INFLUENCE ON THE MACHINE PARTS, DETERMINATION, MEASUREMENT, AND MITIGATION

Machined parts with tight tolerances and flawless surfaces are the goal in many areas of the machine tool industry, particularly in mold making. Achievement for this in the shortest possible time is an extraordinary challenge. Mold making requires large cutting volumes during roughing and the high surface quality is achieved in the finishing process. If the quality of the milled surfaces is high, manual polishing costs can be avoided. An important factor for achieving such good milling results is the type of measuring technology used with the milling machine, which can impact the surface quality. The measuring technologies used in machine tools consists of linear and angle encoders that define cutter position, as well as rotary encoders in the servomotors that contribute to control of the cutting speed [1]. These encoders act as a check and balance in the machine's control, helping it to maintain the proper speed and position of the cutting tool, and therefore enabling that cutting tool to achieve good surface finishes [1]. In five-axis machining, all combinations of axis movements are common. If an inclined or curved machining surface is manufactured through the interpolation of multiple NC axes, the interpolation error of the encoders can be seen directly on the workpiece (Figure 1) [1]. Periodically repeating surface defects on the workpiece surface are visible to the human eye and therefore bothersome—especially in mold making [3]. Encoders are composed of an optical sensor and a scale that provide position and speed feedback to a machine's controller. The important part of an encoder is the scale i.e. its measuring standard providing metrological traceability for assuring the quality of machined parts in terms of precision. The scales are usually in the form of a grating with typical line widths of 1 to 100 microns. These precision graduations play an important role in the function and accuracy of all encoders. They consist of lines and gaps at defined intervals with very little deviation, forming structures with very high edge definition. One line and gap combination equal one signal period. This signal period defines the basic resolution of the encoder and is interpolated to achieve a higher resolution value for encoder readings. Any non-linearity in the interpolation process results in a cyclic error, also known as the sub-divisional error (SDE) or interpolation error. These errors repeat themselves within every basic resolution step of the encoder and limit encoder's performance. The amplitude of these errors depends on the basic resolution and the type of the interpolator. Regular interpolators generate errors of the order of 2 % of the basic resolution leading to an interpolation error of approximately 0.1 to 2 microns for scales with the line widths of 1 to 100 microns. Interpolation error (i.e. a digitizing error of the electronic signals) of the encoders can sometimes lead to poor machining quality such as undesirable, recurring irregularities on the machined surface (Fig. 1). The human eye can clearly detect deviations within a wavelength of 0.5 to 5 mm. These deviations are visible as shadows or contrast fluctuations, and in mold manufacturing they are the cause of time-consuming and costly refinishing work [3-4]. Particularly manual polishing requires skillful operators and any fault of the operators reduced the precision of the parts or sometimes leads to scraping of the molds. This indeed results in high costs particularly for re-manufacturing of the large mold parts [4]. Therefore, the improvements in the quality of the milled surfaces with

mitigation or control of the interpolation errors will provide the manufacturers with machined parts in the required precision with cost effective approaches. The experimental investigations for showing the influence of the interpolation errors on the machined parts have been performed [1-3] in the community of machine tools and machining. All these works propose to use better encoders (high quality scales with finer graduations) with small interpolation errors to produce high quality surfaces. But this requires replacement of the encoders fitted on the machine tools with the new ones or purchase of expensive machine tools fitted with high quality encoders. Both approach results in high cost for mold manufacturers. The tools for practical determination of these errors as well as their very precise measurement using the state-of-the-art methods have been done in the metrology community [5] since the interpolation errors has much more influence on the metrology applications leading to the poor accuracies. In this presentation, the tools that can be used for direct determination of interpolation errors in cost effective and practical way will be presented after giving brief information on the encoders and interpolation errors. Later, recently developed state of the art method so called shearing technique (special error separation method) [5] for measurement of interpolation errors will be shortly described. This method is particularly convenient for determination of interpolation errors of high precise encoders e.g. those used for semiconductor machinery. The approaches used to reduce/mitigate the interpolation errors of encoders will also be discussed to show the alternative ways, instead of replacing of the available encoders. The experimental results taken using regular interpolators and interpolators with compensation mechanism will be shared and strategic movement approaches used to mitigate the interpolation errors will be presented. The overall aim of this talk is to share the knowledge developed in metrology applications with the manufacturing community for mitigation and control of interpolation errors in machine tools to determine the further joined research activities to achieve improvements in the quality of the milled surfaces in a cost-effective way.

About the Speaker

Prof. Dr. İsmail LAZOĞLU



Prof. İsmail Lazoğlu has been a faculty member at Koç University Mechanical Engineering Department since 2000. He is the founder and director of Koç University Manufacturing and Automation Research Center (MARC). He received his undergraduate degree from Istanbul Technical University (1989) and his MS and PhD degrees (1992, 1997) from Georgia Institute of Technology.

He worked as a postdoctoral researcher in various scientific and industrial projects at the University of Illinois at Urbana-Champaign and the University of British Columbia.

He continues his research in the fields of Advanced Manufacturing, Mechatronics/Automation/Robotics and Medical Systems/Artificial Organs/Biomechanics at Koç University Manufacturing and Automation Research Center.

He is a fellow of the CIRP (International Academy for Production Engineering) and is an editor of the International Journal of Advanced Manufacturing Technology-Springer Nature.

(More information is available at <https://marc.ku.edu.tr>).

**VALUE GENERATION FOR THE SOCIETY VIA ADVANCED RESEARCH:
OUR EXPERIENCE AT KOÇ UNIVERSITY MANUFACTURING AND AUTOMATION
RESEARCH CENTER**

The impact of advanced research on value production for the development of society is very critical. In this talk, various research activities carried out at Koç University Manufacturing and Automation Research Center (MARC) will be briefly introduced. Current research activities in the fields of advanced manufacturing, mechatronics/automation/robotics, medical systems/implants/artificial organs will be discussed.

About the Speaker

Prof. Dr. Bahattin KOÇ



Bahattin Koc is Full Professor of Manufacturing and Industrial Engineering at the Sabancı University (SU). He received his Ph.D. and M.S. degrees in Industrial Engineering (Manufacturing) from North Carolina State University in 2001 and 1997 respectively. He was an Associate Professor (Tenured) of Industrial and Systems Engineering at the University at Buffalo (UB) before joining Sabancı University in 2010. Dr. Koc is a founding member and was the Program Coordinator (Chair) of the Manufacturing Engineering Program at Sabancı University. He was the director of Sabancı University Integrated Manufacturing Center and also 3D Bioprinting Lab at

Sabancı University Nanotechnology Research and Application Center. Dr. Koc's research interests include additive manufacturing, heterogeneous object modeling, three dimensional (3D) Bioprinting, and nano/micro-scale modeling and manufacturing. He has published his research results in over 120 scientific papers. He holds three patents. Dr. Koc's research work has been recognized by several international and national awards. Dr. Koc is the recipient of Elginkan Foundation Science and Technology Award, Turkish Heart Association Award, Marie Curie Career Integration Award by EU Research Agency, Most Cited Author in Computer Aided Design Journal Award from Elsevier, University at Buffalo (UB) STOR Inventor Award, UB Reifler Award and UB Interdisciplinary Research and Development Award and more. As PI/Co-PI, Dr. Koc received funding of more than \$20 million for his research work. His research work has been supported by major national and international research agencies and organizations such as the Scientific and Technological Research Council of Turkey, the European Union, the European Research Council , and the DoD U.S. Army Medical Research.

ADDITIVE MANUFACTURING OF FUNCTIONALLY GRADED MATERIALS

Metal alloys or composite materials have improved the properties of constituent materials, their properties are mostly homogenous throughout the structures. However, in certain critical applications, different functionalities and material properties are needed at different locations of the part. To overcome these challenging requirements, multi material structures could be used. For a single part, a simultaneous demand for oxidation, corrosion, and wear resistances, and high thermal conductivity shall sometimes be needed in different regions of the structure and thus bringing the need of combining different materials in a single structure. Since the directly bonded multi material structures suffers from cracking and delamination issues originated from dissimilar material properties of the combining metals, functionally graded materials (FGM) were proposed. Additive manufacturing (AM) has recently gained enormous attention, particularly from the aerospace industry since it possesses many advantages over conventional manufacturing processes. Complex structures or conventionally impossible to manufacture parts can be easily produced with AM processes. In this research, novel Additive manufacturing (AM) processes are developed for manufacturing of functionally graded materials. First, we developed modelling algorithms to not only design but also calculate deposition paths for FGM parts. A directed Energy Deposition based process is then developed for manufacturing of FGM parts. In addition, topology optimization and AM alloys for extreme environments will be presented.

About the Speaker

Prof. Dr. Charlie C. L. WANG



Prof. Charlie C. L. Wang is currently Chair of Smart Manufacturing at the University of Manchester (UoM). Before joining UoM in 2020, he worked as a Professor and Chair of Advanced Manufacturing at Delft University of Technology, The Netherlands (2016) and as a Professor (2015) / Associate Professor (2009) / Assistant Professor (2003) of Mechanical and Automation Engineering at the Chinese University of Hong Kong. He also held a visiting professor position at University of Southern California in 2011 for his sabbatical leave. He received his B.Eng. degree (1998) in mechatronics engineering from Huazhong University of Science and Technology and his Ph.D. degree (2002) in mechanical engineering from Hong Kong University of Science and Technology (HKUST). Prof. Wang was the recipient of several awards, including the ASME CIE Excellence in Research Award (2016), the ASME CIE Young Engineer Award (2009), nine Best Paper Awards, five project-oriented technology innovation awards and three teaching awards. He was elected to be a Fellow of American Society of Mechanical Engineers (ASME) in 2013, and he currently holds an EPSRC Fellowship with the project "Field Computation Based Kernel for Vector 3D Printing" (2023-2028).

VECTOR 3D PRINTING: FROM CURVED SLICER TO CONTINUOUS FIBRE REINFORCEMENT

Although additive manufacturing is called 3D printing, the fabrication in most cases is still in a 2.5D way - materials are accumulated layer upon layer in planes along a fixed printing direction, restricting the flexibility of 3DP. The commonly identified problems of the current 2.5D printing practice are i) weak mechanical strength between the layers of materials, ii) additional supporting structures that are hard to remove and lead to the waste of material and fabrication time, iii) staircase appearance on the surface of printed models. Moreover, this planar fabrication also forbids printing anisotropically strong materials such as carbon fibres along designed paths like "tendons in muscles" to reinforce the mechanical strength or printing on top of curved surfaces for advanced electrical / biological functions. All restrict the fast growth of 3DP technology. These limitations can be overcome by the strategy of Vector 3D Printing (Vec3DP) that extrudes materials along dynamically varied directions. Adding more Degrees-of-Freedom (DoFs) onto the 3D printer and controlling its multi-axis motion is less difficult to implement on hardware. Robotic arms for welding or advanced multi-axis milling machines have already realised this sort of motion. However, the state-of-the-art lacks a computational kernel to effectively generate optimised toolpaths / motions of Vec3DP for models with complex geometry and material distribution although there are some pilot works that can produce relatively simple models. In this talk, I will introduce our recent research effort of investigating a field-based computation paradigm to push the boundary of Vec3DP.

About the Speaker

Prof. Dr. Tomoyuki MIYASHITA



Professor Tomoyuki Miyashita is a Professor at the Department of Modern Mechanical Engineering, Waseda University. After joining Nippon Steel Co. Ltd. in 1992, He obtained the doctoral degree from Waseda University in 2000. He was Research Associate at Waseda University and Ibaraki University since 2000 and 2002, respectively. He became Associate Professor and Professor at Waseda University in 2005 and 2007, respectively. His research interests are Design Process Modeling, Design Optimization, and Dynamics of Design Process.

INNOVATION FACILITATION AT DESIGN PROCESS

The differentiation and the integration of products are the essential procedures for product innovation. In the short-term design process, designers tend to find solutions quickly, but from the viewpoint of the long-term design process, watching related works or designs will contribute to investigating an essential solution at this stage. To understand product innovation, the approaches using S-curve theory, which explains the evolution of a technological system, have been effective. However, the S-curve theory has the disadvantage that the validity of the analysis depends greatly on the number of data. I will discuss about a novel procedure for measuring and predicting technological innovation and product evolution based on the S-curve and wavelet transform to solve the problem. To confirm the effectiveness of the proposed method, we will conduct a case study using patents of air purifiers. Furthermore, we will define and support the differentiation and the integration of the mechanical structure using the proposed method. Our analysis shows that the differentiation and the integration of the mechanical structure occur as a life cycle extension after the main technologies enter the declining phase. Therefore, the incidental technologies should be introduced at the beginning of the declining phase of the main technologies.

- Design theory
- Design model
- Design method/methodology
- Emergent design

About the Speaker

Prof. Dr. Birol KILKİŞ



Birol Kilkis was born in 1949 in Ankara. He graduated from the Mechanical Engineering Department of Middle East Technical University with high honors in 1970. After completing his innovative research on heat transfer in fluidized beds, he was awarded the diploma with honors by the von Karman Institute in Belgium after completing his studies on fluid dynamics and aeronautics. Dr. Kilkis received his Ph.D. degree in Mechanical Engineering with high honors from the Middle East Technical University. As a recipient of the TUBITAK Encouragement Award in 1981, he continued his academic career at the Middle East Technical University between 1972 and 1990, as an assistant,

instructor, Asst. Prof., Assoc. Prof., and Professor, also at capacities of Assistant Dean of Student Affairs and Assistant Director of the Graduate School of Natural and Applied Sciences, member of Energy Group. His overseas activities covered two interim periods, namely as the Director of Research and Development at the Heatway Company (Later Watts Radiant) in Missouri, USA, and as a contracting researcher for the US Department of Energy (USDOE), at the Morgantown Energy Technology Center. He was also an adjunct professor at the University of Missouri Rolla. He acted as the project principal for snow melting systems for US Air Force bases, heat tracing of fighter jet aircraft during freezing periods, and snow/ice melting of helicopter pads on Navy Vessels. He taught at Gannon University also as the director of Computer Graphics between 1981 and 1983. Dr. Kilkis has been working on heat transfer, unified heat transfer theory, high-performance buildings, quantum mechanics, fluid dynamics, heat pumps, energy strategies, hydrogen energy with renewable energy resources, hydrogen cities, 5th generation, nearly-zero-exergy cities, district energy systems, aerodynamics, exergy analysis, hydrogen cities, combined heat and power, tri-generation, green airports, sustainable aviation, integrated solar PV systems, and energy simulations. He is the co-author of the most recent book on Cogeneration with Renewables. In total, he has published more than 600 papers in several journals and proceedings on a large variety of topics. Since 1972, he has been the principal investigator of several industrial projects, including a NATO Science for Stability project on a de-centralized, co-generating 1.5 MW fluidized-bed power plant. Before joining OSTİM Technical University as a professor in 2020, he taught for 10 years at Baskent University in Ankara, also at the capacity of the chair of the Energy Engineering Graduate Program. Currently, he is the vice-chair, and WP 1 Leader in ETIP Renewable Heating and Cooling (RHC) Platform of the European Union, Brussels. He jointly holds three patents on operative temperature sensing, next-generation solar and wind energy systems. He is a Fellow of ASHRAE, recipient of ASHRAE Distinguished Service and ASHRAE Exceptional Service Awards, after acting as the Section 6 Head and founder

of TC 7.4 on Exergy Analysis in Buildings. Dr. Kilkis became the President of the Turkish Society of HVAC and Sanitary Engineers (TTMD) between 2017 and 2019.

ENVIRONMENT FRIENDLY INDUSTRIAL PARKS WITHIN THE SCOPE OF CARBON TAXES AND GLOBAL WARMING

This paper focuses on global warming, associated environmental issues, and climate change emergency from the perspective of industrial parks in terms of carbon dioxide emissions. Two primary components of carbon dioxide emissions are distinguished, namely direct emissions and nearly-avoidable emissions due to exergy destructions in industrial processes and manufacturing activities in industrial parks. The latter is directly related to exergy destructions taking place in any process as an extension of the Second Law of thermodynamics. Green industrial parks are defined and rated with a new metric called Exergy Star and is related to the same phenomena. Eco-industrial parks concept derived by the United Nations International Development Organization is expanded and redefined. The carbon tax at the border under way by the European Union is criticized in terms of its concealed dangers for industrial parks in Türkiye. In this respect, the emissions-based carbon taxes versus added values in terms of the degree of final products are formulated and shown that carbon taxes limit the product development progress for decarbonization of industrial parks and reduce the added value potential, while European countries largely benefit from carbon taxes.

About the Speaker

Fuat TİNİŞ



Fuat Tiniş graduated from Middle East Technical University (METU), Mechanical Engineering Department with a B. Sc. degree in 1980 and he received his M. Sc. degree in 1983 from the same department. Then he got a B.A. degree from Anadolu University in Management in 1994. He worked as a research assistant in METU between 1981-1983, as a Design Engineer in GÜRİŞ Machinery Corporation between 1983-1986, as a Senior Design Engineer in TUSAS Aerospace Industries (TAI) between 1986-1988, as Design Manager in IŞIK Machinery between 1988-1995 and as Engineering Director in GAMA Corporation between 1995-2018. He spent six months in General Dynamics – Fort

Worth, USA as a design trainee while working for TAI. He mainly managed design and construction of various types of industrial plants in Türkiye, in Middle East Countries, in North America, in Europe, in North Africa and in Russian Federation in coordination with all major engineering and construction companies worldwide; and still working as engineering director in ABT Yapı since 2018 for design of industrial plants, mainly in oil and gas field. He is giving mechanical engineering courses in Atılım University-Ankara as a part time instructor since 2007. He has been contributing to the Association for Evaluation and Accreditation of Engineering Programs (MÜDEK) since 2009 and served as a program co-evaluator, program evaluator, co- chair and chair in several teams. He is a member of MAK (The Engineering Programs Accreditation Board of MÜDEK) since 2019 and he is chair of MAK with the beginning of 2023. He is also a member of the Nominating Committee of MÜDEK. He is also member of Consultancy Committee and Editorial Board of Turkish Chamber of Mechanical Engineers since 2014 and 2018 respectively.

FUTURE FOR YOUNG ENGINEERS

There will definitely be differences between the professional lives of future engineers and professional lives of the past and present engineers. While I try to explain these differences, I will give some sections from my professional engineering life, which started in 1980 and continues until today. In the 1980s, when there was no internet, mobile phones, laptops, or 3D modeling techniques, calculations were made with calculators and computers with extremely limited capacity and capabilities at best; engineering drawings could be drawn first with pencil on paper, then with ink on tracing paper, and duplicated using blueprinting machines. The fastest form of communication was landline phones connected via switchboards for intercity and intercountry communication, or a means of communication called telex that only allowed verbal communication. In my engineering career, which started with these conditions and continues to the present day, I have worked as a design engineer and engineering manager in a total of 76 projects, 41 of which are international and most of which are energy production facilities. I have worked in projects in 15 countries from the North Arctic Circle to Africa, including our country. While these projects were being carried out, I had the opportunity to work with the world's leading organizations in these fields. In order to share the experiences, I gained during these studies, I have been teaching mechanical engineering courses as part-time instructor at this University since 2007. For the same purpose, I have been working on the editorial board of the monthly magazine, which is published by the Chamber of Mechanical Engineers, since 2018. I have been working at MÜDEK since 2009, which was established to enhance the quality of engineering education by means of the evaluation and accreditation at universities recognized by Higher Education Council of Türkiye. Since the beginning of 2023, I am the chairman of Engineering Education Programs Accreditation Board (MAK), which is an independent body of MÜDEK. There will be many opportunities for engineers to use while performing their duties in the future. We can list the main ones that we currently know as artificial intelligence, internet of things, additive manufacturing (3D printing), digital twins, rapid prototyping, advanced computing methods and software, robotics, etc. It is obvious that these tools will develop and diversify over time. Apart from this, new concepts and constraints such as innovation, entrepreneurship, globalization, multi-disciplinarity working, rapid population growth, global warming, carbon footprint, big data processing are also factors that will affect the working conditions and opportunities of engineers. It is an inevitable phenomenon to adapt to these new opportunities and concepts that will exist and multiplied in the future of engineering and to continue engineering professional life with these changes. Despite all these rapid changes, what has not and will not change is that, one cannot be successful in any condition and environment without having solid basic engineering knowledge and concepts.

About the Speaker

Mümtaz Afşin Esi



Mümtaz Afşin Esi is an experienced professional with 25 years in the defense industry, specializing in structural mechanics and test engineering on land, air, sea, and space platforms. He has managed numerous projects from business development to implementation and provided testing and consultancy services to both defense and civil sectors. His expertise includes structural dynamic and environmental testing to civilian and military standards, and he has designed specialized test infrastructures such as wave simulators and impactors. He has performed structural dynamic measurements on large platforms including ships, aircraft, helicopters, and missiles, and led Ground Vibration

Tests for aircraft such as the F4 and F16. In the academic field, he has lectured more than 400 students on the Fundamentals of Guided Missile Design and Vibration at the Turkish Aeronautical Association University, supervised master's theses at PADOVA University, and taught at the Ministry of National Defense Training Center. He worked as a Researcher at TÜBİTAK-SAGE from 1999 to 2012. From 2012 to 2016, he served as Senior Expert Engineer and Lead Engineer at ROKETSAN. Between 2016 and 2022, he founded the Structural Mechanics Department at Roketsan A.Ş. and served as Executive Engineer. Currently, he is a Senior Lead Engineer in the Space Systems Directorate at ROKETSAN and a Part-Time Academic Staff at Atılım University. He is also a member of NAFEMS, the International Engineering Modeling, Analysis and Simulation Society.

APPROACHES TO STRUCTURAL DYNAMIC DESIGN OF SATELLITE LAUNCH SYSTEMS AND VERIFICATION&VALIDATION IN ENGINEERING ANALYSES

The structural dynamic design of satellite launch systems is a critical aspect of ensuring mission success and reliability. This presentation explores various approaches to the structural dynamic design of these systems, emphasizing the importance of accurate modeling and analysis. Key methodologies for designing and analyzing the dynamic response of launch systems are discussed, highlighting how they contribute to the overall stability and performance during different phases of flight. Furthermore, the presentation delves into the processes of verification and validation (V&V) in engineering analyses, which are essential for confirming the accuracy and reliability of the design models and simulations. Through a combination of theoretical insights, case studies, and practical examples, this presentation aims to provide a comprehensive understanding of the strategies employed in the dynamic design of satellite launch systems and the rigorous V&V procedures that underpin engineering confidence in these high-stakes projects.

ABSTRACTS

AN EXPERIMENTAL INVESTIGATION ON THE ENERGY REQUIREMENT OF DIFFERENT MATERIALS MANUFACTURED ON A CNC LATHE (35)

M. Ural ULUER, *uluer@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

Metin AKKÖK, *akkok@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

S. Engin KILIÇ, *engin.kilic@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Ulaş YAMAN, *uyaman@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

This paper investigates the process energy requirements for machining steel, cast iron and aluminum parts using identical designs. Parts were manufactured on an Anatool TP32 CNC lathe and energy consumption was measured with a Siemens PAC3200 power meter. A measurement methodology was employed to determine and compare the theoretical, variable auxiliary and constant auxiliary energy requirements. This comparison highlights the impact of material properties on different levels of process energy, promoting more sustainable approaches in part design.

Keywords: Energy Requirement, CNC Lathe, Energy Monitoring

WATER JET GUIDED LASER MICRO DRILLING OF AN AEROSPACE ALLOY (9)

Levent SUBAŞI, *levant.subasi@tei.com.tr* Tusas Engine Industries Inc., 26210, Eskisehir, Turkey

Mustafa İ. GÖKLER, *gokler@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

Ulaş YAMAN, *uyaman@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

Micro drilling of aerospace alloys is a challenge considering the material properties, geometrical complexities and the technical requirements. Water Jet Guided Laser (WJGL) machining is a novel process used in several industries. The primary advantage of the process is its combination of precision and cooling, which increase the quality in the machining area. In this study, WJGL technology was adapted for the first time to perform micro drilling of an aerospace alloy. Furthermore, material removal mechanism of the process is investigated, a process model is developed, real-time process monitoring methods are proposed and drilling time and quality optimization was performed.

Keywords: Laser Drilling, Process Modeling, Process Monitoring, Optimization

INTEGRATION OF 6-AXIS HEXAPOD WITH NANOSECOND LASER FOR MICRO MACHINING (62)

Aykut BAKAN, *aykut.bakan@bilkent.edu.tr* Bilkent University, 06800, Ankara, Turkey
Yiğit KARPAT, *ykarpat@bilkent.edu.tr* Bilkent University, 06800, Ankara, Turkey

ABSTRACT

Manufacturing parts with complex geometries is an everlasting need in the aerospace, automotive, and biomedical industries. Recent developments bring forth the requirements of machining parts with complex geometries. Therefore, machining setups that are flexible and precise are needed to satisfy such requirements. This work presents our findings on machining structured surfaces using a 6-axis hybrid hexapod integrated with a nanosecond fiber laser. In this paper, we provide a detailed description of the inverse kinematic analysis and experimental determination of the workspace of the hexapod, as well as the modeling of the complex surfaces of the parts to be machined. Results indicate the viability of the micromachining setup in advanced manufacturing applications.

Keywords: Complex Geometry, 6-Axis Hybrid Hexapod, Nanosecond Fiber Laser, Workspace, Surface Modelling

EVALUATION OF LUBRICATION EFFICIENCY OF DIFFERENT MQL OILS IN Ti-6Al-4V MACHINING (53)

Ramazan Hakkı NAMLU, *ramazan.namlu@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Kübra KAVUT, *kubra.kavut@belginoil.com* Belgin Oil, R&D Department, Kocaeli, 41480, Turkey

Hanife Gülen TOM, *hanife.gulen@belginoil.com* Belgin Oil, R&D Department, Kocaeli, 41480, Turkey

ABSTRACT

Ti-6Al-4V is a challenging material to machine due to its low thermal conductivity and high chemical reactivity, resulting in high cutting forces, poor surface finishes, and reduced tool life. Conventional Cutting Fluids (CCF) are often used to mitigate these issues, but they have significant environmental and health drawbacks. Minimum Quantity Lubrication (MQL) has emerged as a viable alternative, delivering a mixture of compressed air and oil to the cutting zone to reduce friction and heat with minimal fluid use. This study compares the effectiveness of three MQL oils—TMP Ester, Polymeric Ester with viscosity indexes of 180 and 221—against CCF in milling Ti-6Al-4V. Results showed that MQL significantly reduced cutting forces and improved surface quality compared to CCF. Among the MQL oils, the Polymeric Ester with a viscosity index of 221 performed best, offering the lowest cutting forces and superior surface finish. This oil's high thermal and oxidative stability, combined with its high viscosity index, maintained an effective protective film under high temperatures, enhancing machining efficiency. These findings suggest that polymeric ester MQL oils are a more sustainable and efficient alternative to CCF in machining Ti-6Al-4V.

Keywords: Ti-6Al-4V, Minimum Quantity Lubrication, Cutting Force, Surface Quality

MILLING FORCE ESTIMATION USING ANGULAR DOMAIN HARMONICS WITH CUTTING AND EDGE COEFFICIENTS (15)

Mert İLME, *mert.ilme@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

Hakan ÇALIŞKAN, *chakan@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

In line with the industry 4.0 concept, today's milling research focuses more on the control of the cutting process. To identify the cutting forces, this study proposes a novel method. The method requires previous knowledge of the tool and workpiece engagement geometry. It utilizes an improvement of an angular domain convolution model for the forces, which is expressed as explicit functions of cutting parameters and tool/workpiece geometry. The edge cutting coefficients are added to the force model in addition to cutting coefficients to increase the accuracy. The method is validated with experimental data.

Keywords: Milling; Cutting Force Calculation; Cutting and Edge Coefficients

DESIGN AND MANUFACTURING OF A MACRO SCRATCH TESTER FOR COATING ADHESION ASSESSMENT (37)

Engin Deniz Ege DEMİRELLER, *demireller.engindeniz@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Emre Oğuz ACAR, *acar.emreoguz@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Tunç OGAN, *ogan.tunc@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Muzaffer ŞAHİN, *sahin.muzaffer@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Mustafa KURT, *kurt.mustafa@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Kutay ATALAY, *atalay.kutay@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Bilgin KAFTANOĞLU, *bilgin.kaftanoglu@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

Korcan KÜÇÜKÖZTAŞ, *korcan.kucukoztas@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

ABSTRACT

This study presents the design and manufacturing of a macro scratch tester developed with locally sourced materials, aiming to deliver comparable scratch resistance tests to existing models. Coating technologies are vital in the manufacturing sector for enhancing material properties, such as increasing the hardness and lifespan of cutting tools or improving the high-temperature resistance of jet engine components. With the wide variety of potential coatings, effective adhesion testing is essential. Scratch testers are used to evaluate the adhesive properties of coatings.

The newly designed macro scratch tester measures scratch resistance accurately by utilizing an Arduino microprocessor, a specialized camera, and a mechanism for applying a linearly increasing load using a linear actuator and a spheroconical diamond indenter. The system captures scratch images with high precision, capable of

examining scratches as small as 3 mm in length. The use of an open-source platform allows for flexibility and cost-effectiveness, making it accessible for various industrial and academic applications.

The device's performance was evaluated through comparison tests with a professional macro scratch tester assessing the adhesion of boron nitride coated samples. Being conducted with the same scratch length and linear load, these tests demonstrated that the newly developed system provides results that are comparable in accuracy and reliability. Comparison of the scratch images obtained from both devices confirms the robustness of the newly developed design. The results indicate that this macro scratch tester has significant potential for widespread use, offering an affordable and efficient alternative to existing models.

Keywords: Machine Design, Scratch Testing, Coating Adhesion, Material Science, Macro Scratch Tester, Tribology.

DESIGN AND MANUFACTURING OF A COST-EFFECTIVE METALLOGRAPHIC SPECIMEN POLISHING MACHINE (38)

Sultan Abdulazeez ALI, *ali.saali@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Yousef ALMASRI, *almasri.yousef@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Waleed ELAZZAMI, *ellazzami.wiaahmed@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Tarik Emre ELÇİ, *elci.tarikemre@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Emrah ŞENSOY, *sensoy.emrah@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Servet YILMAZ, *yilmaz.servet@student.atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Bilgin KAFTANOĞLU, *bilgin.kaftanoglu@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

Korcan KÜÇÜKÖZTAŞ, *korcan.kucukoztas@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

ABSTRACT

This study presents the design and manufacturing of a cost-effective metallographic specimen polishing machine, engineered using locally sourced materials to facilitate microscopic analysis of metallic specimens. The machine, comprising a gearbox, disk plate, bush bearing, motor, and rotating shaft, produces a mirror-like, flat surface on metallic specimens essential for precise microscopic examination, particularly for proper coating application. The machine was tested with specimens at varying operational speeds. Results demonstrate the machine's capability to consistently achieve high-quality surface finishes. With a low production cost, this machine offers a valuable tool for material laboratories, enhancing accessibility for researchers and students in materials science and engineering. Its low maintenance requirements further underscore its practicality for prolonged use in educational and research settings. The surface roughness of each specimen was assessed using a confocal microscope at each stage of the polishing process, where progressively

finer grades of sanding papers and polishing cloth were used. The measurements indicated a significant reduction in surface roughness values with each successive step.

Keywords: Machine Design, Metallography, Specimen Preparation, Polishing Machine.

DESIGN, PRODUCTION AND VALIDATION OF LOW-COST MINIMUM QUANTITY LUBRICATION SYSTEM (52)

Öykü MERCAN, *mercan.oyku@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Emre ONAY, *onay.emre@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Özgür Barış TOSUN, *tosun.baris@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Buse ÇETİNKAYA, *cetinkaya.buse@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Salih OKYAY, *okyay.salih@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Mehmetcan SARIKAHYA, *sarikahya.mehmetcan@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Ramazan Hakkı NAMLU, *ramazan.namlu@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

S. Engin KILIÇ, *engin.kilic@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

ABSTRACT

This study presents the design and manufacturing of a low-cost Minimum Quantity Lubrication (MQL) system aimed at enhancing the efficiency and sustainability of machining operations. The MQL system was developed with affordability and practicality in mind, utilizing readily available components to minimize costs without compromising functionality. To validate the performance of the MQL system, a series of slot milling experiments were conducted. The experimental results demonstrated a significant reduction in surface roughness when compared to both conventional cutting fluids (up to %12) and dry cutting (up to %15) methods. The improved surface finish achieved with the MQL system underscores its potential as a viable alternative to traditional cooling techniques in milling processes, offering both economic and quality benefits.

Keywords: Minimum quantity lubrication, Sustainability, Surface roughness

OPTIMIZING RUBBER PAD FORMING: A STUDY ON STAINLESS STEEL AND ALUMINUM (10)

Çağlar CEYLAN, *caglar.ceylan@atilim.edu.tr*, Atılım University, Metal Forming Center of Excellence 06830, Ankara, Türkiye

Korcan KÜÇÜKÖZTAŞ, *korcan.kucukoztas@atilim.edu.tr*, Atılım University, Metal Forming Center of Excellence 06830, Ankara, Türkiye

Hakan KALKAN, *hakan.kalkan@atilim.edu.tr*, Atılım University, Metal Forming Center of Excellence 06830, Ankara, Türkiye

ABSTRACT

The performance of sheet metal forming processes depends on various parameters such as material formability and process conditions. Forming Limit Diagrams (FLDs) may help determine the formability limits of materials. However, reaching these limits in real process conditions may not always be possible. Therefore, different types of sheet metal forming methods are used in industrial applications. Rubber Pad Forming (RPF) is a desirable sheet metal forming operation where thickness reduction and strain distribution are critical.

This study explores RPF of stainless steel and aluminum sheets using specially designed dies. The materials tested include 304 stainless steel sheets in thicknesses of 0.5 mm, 0.7 mm, and 0.8 mm, and 1050 aluminum sheets in thicknesses of 0.4 mm, 0.5 mm, 0.6 mm, and 0.8 mm. Rubber pads with shore hardness values of 40, 70, and 90, and thicknesses of 15 mm, 20 mm, and 25 mm are also utilized in the experiments. The methodology involves systematically varying materials, rubber pads and press parameters to evaluate their effects on thickness reduction distribution, strain distribution and formability during the RPF process.

The GOM ARGUS system is utilized to measure thickness reduction, strain distribution, and to gather FLD's to identify the best parameters for RPF, focusing on the interaction between material grade, rubber type, and process parameters.

Expected outcomes include determining the optimal combination of rubber pad hardness and thickness to minimize thickness reduction and ensure uniform strain distribution. Softer pads are anticipated to enhance formability for aluminum sheets,

while harder pads may better maintain thickness distribution in stainless steel sheets. Sheet thickness will significantly influence results, with thinner sheets showing higher deformation sensitivity and thicker sheets requiring higher forming forces. The press parameters are adjusted accordingly to accommodate each sheet metal and rubber pad combination.

Keywords: Rubber Pad Forming, Forming Limit Diagram, Thickness Reduction, Process Optimization, Optical Measurement.

LINEAR CONTACT DYNAMICS IDENTIFICATION IN HOLDER EXTENSION TOOL ASSEMBLIES VIA INVERSE STRUCTURAL MODIFICATION METHOD (40)

Hanife AYYILDIZ, *hanife.ayyildiz@asml.com* ASML, 5504 DR, Veldhoven, The Netherlands

Orkun ÖZŞAHİN, *ozsahin@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

H. Nevzat ÖZGÜVEN, *ozguven@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

Stability Lobe Diagrams (SLD) have effectively addressed chatter during machining processes. They are determined primarily by the tool-tip Frequency Response Functions (FRFs). To predict tool-tip FRFs theoretically, it is crucial to have a comprehensive understanding of the contact dynamics between the sub-components of the Spindle(S)-Holder(H)-Extension(E)-Tool(T) assemblies. While FRF Decoupling Methods are commonly used for experimental identification of the contact dynamics between the parts, they often require individual modal tests for each sub-component. In this study, the Inverse Structural Modification Method (ISMM) is employed to identify the contact dynamics properties between the holder and extension. The ISMM offers an advantage over other FRF decoupling methods by eliminating the need for stand-alone tests of the sub-components. Instead, only a modal test of the entire assembly is required to apply the ISMM. The ISMM is developed for and first applied to the contact dynamics identification of a bolted joint. In this research, the ISMM is proposed to be applied to machine tool dynamics. It is proposed to use a quasi-static model for the connection so that a complex stiffness matrix represents the contact dynamics between the holder and extension. The validity of the ISMM is demonstrated through a real experimental study. By utilizing the identified complex stiffness matrix it is shown that the first two natural frequencies of the HET assembly can reliably be predicted, which demonstrates that ISMM can accurately identify the contact dynamics between the holder and extension. These findings highlight the effectiveness and accuracy of the ISMM in predicting the dynamic behavior of the HET assembly.

Keywords: Machine Tool Dynamics, Contact Dynamics, Identification of Contact Dynamics, Dynamic Stiffness

FUNDAMENTAL INVESTIGATION OF THE APPLICATION BEHAVIOR AND STABILIZATION POTENTIAL OF MILLING TOOLS WITH STRUCTURED FLANK FACES ON THE MINOR CUTTING EDGES (90)

Raphael Isaak Elias SCHÖNECKER, *raphael.schoenecker@tu-dortmund.de* Institute of Machining Technology (ISF), TU Dortmund University, 44227 Dortmund, Germany

Jonas BAUMANN, *jonas.baumann@tu-dortmund.de* Institute of Machining Technology (ISF), TU Dortmund University, 44227 Dortmund, Germany

Rafael Garcia CARBALLO, *rafael.garcia@tu-dortmund.de* Institute of Machining Technology (ISF), TU Dortmund University, 44227 Dortmund, Germany

Dirk BIERMANN, *dirk.biermann@tu-dortmund.de* Institute of Machining Technology (ISF), TU Dortmund University, 44227 Dortmund, Germany

ABSTRACT

In milling processes in which material removal is performed periodically from solid material, dynamic effects are generally considered to be responsible for instabilities and subsequent productivity limits. Usually, in such applications, the process-inherent complex dynamic load spectrum on machine, tool and workpiece is considered with vibration-based relative displacements that can be attributed to the regenerative effect. There are numerous techniques in the literature addressing the suppression of these dynamic effects, but they require a large amount of analysis and implementation effort as well as specific expert knowledge. The approach presented here, however, provides a universally applicable method for suppressing chatter vibrations and deflections. By applying structure elements to the flanks of the minor cutting edges of HSS end mills, it is possible to increase the stability limit $a_{p,crit}$ in milling processes of aluminum alloy EN AW-7075. Structured tools were used in ramp milling tests to investigate various effects, such as the influence of certain geometric design features on the stabilization potential compared to a reference tool. Furthermore, the effects of varied process parameter configurations and wear-related effects on the performance of the tool concept were focused as well. Three key design features of the cutting edge and the structured profiles were identified from the results of the investigation, which, when combined in the most efficient design in each case led to the development of an optimized structure and process configuration with cumulative potential for increasing the stability limit up to 200 %.

Keywords: Process Dynamics, Chatter Suppression, Stability Limit $a_{p, Crit}$; Structure Elements

TOOL PATH STRATEGIES FOR EFFICIENT MILLING OF THIN-WALL FEATURES (91)

Lutfi Taner TUNC, *ltunc@uncc.edu* Mechanical Engineering and Engineering Science, University of North Carolina at Charlotte, Charlotte, NC, 28223, US

ABSTRACT

Milling of thin-wall geometries has been a challenge due to inherent chatter vibrations and workpiece deflections. Moreover, tool path generation strategies in CAD-CAM systems are not able to serve such a purpose. In this study, 5-axis milling tool path strategies for increased efficiency in milling of thin-wall features are discussed and their benefits are shown. The effect of tool path generation and the relation to parameter selection are highlighted. Most of the discussion relies on previously reported experimental results. It is shown that by tailoring the tool path considering the concerns and limitations associated with thin-wall part structure and geometry, it is possible to increase productivity by at least two folds.

Keywords: Thin-Wall, Milling, Stability, 5-Axis Milling

REAL TIME MILLING CHATTER DETECTION AND CONTROL WITH AXIS ENCODER FEEDBACK AND SPINDLE SPEED MANIPULATION (81)

Hakan ÇALIŞKAN, *chakan@metu.edu.tr* Mechanical Engineering Department, Middle East Technical University, 06800 Ankara, Türkiye

ABSTRACT

Chatter is the instability phenomenon limiting the productivity of milling operations. Although offline methods are developed for selecting suitable process parameters to avoid chatter, those do not guarantee a stable operation due to varying system dynamics. This paper proposes an online technique, where the chatter is detected and suppressed by manipulating the spindled speed via the feedback of the real time signal processing of the axis encoder measurement. Milling vibrations consists of stable forced and unstable chatter vibrations. The forced vibrations occur at known tooth passing frequency and its harmonics, on the other hand chatter vibrations occurs close to one of the natural modes, in addition there are sidebands which are spread at the multiples of tooth passing frequency above and below the chatter frequency. The developed algorithm processes the axis encoder signal, resolves the stable periodic and unstable chatter signals, and extracts chatter frequencies. The energy of the chatter vibrations is calculated and feedback to the chatter controller. The controller overrides the spindle speed in order to suppress the chatter energy below a particular threshold value. The varying spindle speed is a challenging problem, the proposed time domain algorithm is able to extract the amplitudes of the varying spindle harmonics and furthermore is able to detect the varying chatter frequencies. The developed algorithm is tested in real time on Deckel FP5cc CNC which is inhouse retrofitted with Beckhoff servo motors, drivers, IO modules and a PC based controller. We believe the proposed algorithm is also applicable in the industry, an external PC calculating the spindle speed override command, based on axes encoder measurements, can easily be adapted to a conventional CNC controller.

Keywords: Machine Tool, Milling, Chatter, Control

EFFECT OF GUIDEWAY NON-LINEAR FRICTION ON MACHINING CHATTER STABILITY PREDICTION (89)

Oier FRANCO, *ofranco@ideko.es* University of the Basque Country, Department of Mechanical Engineering, Bilbao, Spain

Xavier BEUDAERT, *xbeudaert@ideko.es* Dynamics and Control, Ideko, 20870 Elgoibar, Basque Country, Spain

Kaan ERKORKMAZ, *kaane@uwaterloo.ca* Precision Controls Laboratory, University of Waterloo, Waterloo, ON, Canada

Jokin MUNOA, *jmunoa@ideko.es* Dynamics and Control, Ideko, 20870 Elgoibar, Basque Country, Spain

ABSTRACT

In large-scale machine tool applications, the low structural natural frequencies constrain the machine tool cutting capabilities. The machine tool joints interact with the structural mode shapes, and hence, the feed drive system characteristics can significantly influence the resultant dynamics at the cutting point. This paper presents a study of the effect of guideway friction during the machine tool dynamic characterization and its impact on the chatter stability prediction accuracy. The influence of friction on the resultant tool centre point dynamics is measured in seven different industrial machines. A one-degree-of-freedom model that considers the non-linear friction and controller forces together with motion commands is utilized to analyse the effect of axis motion on the machine's dynamic behaviour. Based on that, an initial experimental chatter stability analysis is conducted in a dedicated laboratory test bench. Then, a more dynamically complicated machine tool is characterized through different techniques to address the force and feed non-linearity. For both cases, it is concluded that the classical impact hammer testing approach leads to more conservative stability limit predictions.

Keywords: Machine Tool Dynamics; Feed Drives; Friction; Chatter; Control.

STABILITY OF MICRO-MILLING TOOL CONSIDERING TOOL BREAKAGE (92)

Yuan-Yuan REN, School of Mechanical Engineering, Northwestern Polytechnical University, Xi'an 710072, China

Bao-Guo JIA, Lean Production Shop, AVIC Xi'an Aircraft Industry Group Company Ltd., Xi'an 710089, China

Min WAN, *m.wan@nwpu.edu.cn* School of Mechanical Engineering, Northwestern Polytechnical University, Xi'an 710072, China

Hui TIAN, Lean Production Shop, AVIC Xi'an Aircraft Industry Group Company Ltd., Xi'an 710089, China

ABSTRACT

Micro-milling, widely employed across various fields, faces significant challenges due to the small diameter and limited stiffness of its tools, making the process highly susceptible to cutting chatter and premature tool breakage. Ensuring stable and safe cutting processes necessitates the prediction of chatter by considering the tool breakage. Crucially, the modal parameters of the spindle–holder–tool system are important prerequisites for such stability prediction. In this paper, the frequency response functions (FRFs) of the micro-milling tool are calculated by direct FRFs of the micro-milling cutter and cross FRFs between a point on the shank and one on the tool tip. Additionally, by utilizing a cutting force model specific to micro-milling, the bending stress experienced by the tool is computed, and the tool breakage curve is subsequently determined based on the material's permissible maximum allowable stress. The FRFs of the micro-milling tool, alongside the tool breakage curve, are then integrated to generate the final stability lobe diagrams (SLDs). The effectiveness and reliability of the proposed methodology are confirmed through a comprehensive series of numerical and experimental validations.

Keywords: Micro-Tool FRFs, Micro-Milling Cutting Force, Tool Breakage Curve, Stability Prediction

IMPROVING ROBOTIC MILLING PERFORMANCE THROUGH ACTIVE DAMPING OF LOW-FREQUENCY STRUCTURAL MODES (95)

Govind Narayan SAHU, govinds@iittp.ac.in Department of Mechanical Engineering, Indian Institute of Technology Tirupati, Tirupati, Andhra Pradesh, 517619, India

Andreas OTTO, andreas.otto@iwu.fraunhofer.de Fraunhofer Institute for Machine Tools and Forming Technology, IWU, Chemnitz, Saxony, 09126, Germany

Steffen IHLENFELDT, Fraunhofer Institute for Machine Tools and Forming Technology, IWU, Chemnitz, Saxony, 09126, Germany

ABSTRACT

Industrial robots are increasingly prevalent due to their large workspace and cost-effectiveness. However, their limited static and dynamic stiffness can lead to issues like mode coupling chatter and regenerative chatter in robotic milling processes, even at shallow cutting depths. These problems significantly impact performance, product quality, tool longevity, and can damage robot components. An active inertial actuator was deployed at the milling spindle to enhance dynamic stiffness and suppress low-frequency vibrations effectively. It has been identified that the characteristics of the actuator change with its mounting orientation, a common scenario in robotic machining processes. This variation has not been reported in the literature. Our study includes the identification of model parameters for the actuator in both horizontal and vertical mountings. Additionally, the novelty of the present work lies in the specific design and implementation of compensation filters tailored for the active inertial actuator in both horizontal and vertical configurations. These filters address the unique challenges posed by low-frequency vibrations in robotic milling, offering significant improvements in dynamic stiffness and vibration suppression. Traditional model-based compensators were effective for vertical mounting, while pole-zero placement techniques with minimum phase systems were optimal for horizontal mounting. These compensators significantly enhanced dynamic stiffness, reducing maximum low-frequency robot structural modes by approximately 100% in horizontal mounting and approximately 214% in the vertical configuration of the actuator. This advancement promises to enhance industrial robot capabilities across diverse machining applications.

Keywords: Active Damping; Machining; Chatter; Robotic Milling; Low-Frequency Vibration.

QUANTIFICATION OF AESTHETIC PREFERENCES USING IMAGE FEATURES OF VIDEOS (24)

Ren HAYAKAWA, *renhayakawa0126@keio.jp* Graduate School of Keio University, 2238522, Yokohama, Japan

Yuki SHIMIZU, *yuki.s_17@keio.jp*

Takeo KATO, *kato@mech.keio.ac.jp* Keio University, 2238522, Yokohama, Japan

Yasuji FUKASAWA, *yasuji.fukasawa@agc.com* AGC Inc., 1008405, Tokyo, Japan

Aichi INOUE, *aichi.inoue@agc.com* AGC Inc., 1008405, Tokyo, Japan

ABSTRACT

In the manufacturing industry, product differentiation is becoming increasingly difficult, and the importance of appearance design is becoming more important. Several attempts have been made to evaluate aesthetic preferences for product appearance using shape and image features. Traditionally, actual product images were used, but advances in optical simulation technology have led to research using simulated images. This has made it possible to conduct evaluation experiments under various conditions. However, there have been no studies using simulation movies yet. Therefore, the objective of this study is to quantify the aesthetic preferences of optical simulation videos for diamonds using image features.

Keywords: Aesthetic Evaluation, Frequency Analysis, Image Feature, Optical Simulation, Statistical Analysis

PROPOSAL OF A PREFERENCE SET-BASED DESIGN METHOD FOR QUALITATIVE EVALUATION (27)

Shotaro OYAMA, *sho2776@keio.jp* Keio University Graduate School, 2238522, Kanagawa, Japan

Takeo KATO, *kato@mech.keio.ac.jp* Keio University, 2238522, Kanagawa, Japan

ABSTRACT

The preference set-based design method can ensure robustness to the designer's intentions and performance requirements by providing a range of design solutions. However, most of the sensory qualities that are important in recent product design are based on qualitative data, and this method, which assumes quantitative data, is not applicable. In this study, we propose a preference set-based design method that can be applied to both qualitative and quantitative data using rough sets theory, which allows for the derivation of relationships between attributes with an inherent ordering. Additionally, we suggest its applicability through case studies.

Keywords: Preference Set-Based Design Method, Rough Sets Theory, Dominance-Based Rough Set Approach, Sensory Qualities, Robustness,

DESIGN OF THE DEPLOYMENT OF MEMBRANES ON SATELLITES (59)

Teru NATORI, *teruteru.natori@toki.waseda.jp* Waseda University, Tokyo, Japan

Tomoyuki MIYASHITA, *tomo.miyashita@waseda.jp* Waseda University, Tokyo, Japan

ABSTRACT

In recent years, the development of small satellites has become increasingly active. However, this has led to an increase in the amount of space debris. As a countermeasure, satellites are required to be equipped with a deorbit mechanism. One of the deorbit mechanisms for satellites is to deploy a membrane to reduce the velocity. This research proposes a method to determine the deployment of the membrane by the change in the rotation of the satellite. The validity of the method is demonstrated through modelling and numerical analysis, and its feasibility is demonstrated by designing the system.

Keywords: Satellite, Membrane, De-orbit

NUMERICAL APPROACH OF TIMEAXIS DESIGN METHOD - VALIDATION THROUGH AN APPLICATION FOR CHAIR DESIGN (71)

Akinari HIRAO, *hirao@shibaura-it.ac.jp* Shibaura Institute of Technology, 135-8548, Tokyo, Japan

Takeo KATO, *kato@mech.keio.c.jp* Keio University, 223-8522, Yokohama, Japan

Yoshiyuki MATSUOKA, *matsuoka@mech.keio.c.jp* Keio University, 223-8522, Yokohama, Japan

ABSTRACT

Timeaxis design is a design theory that deals with time axis and enables sustainable design by responding to changes in the required characteristics of products as they are used over time. The authors have developed a Timeaxis design method that considers a multi-time-scale model. This method is applied to actual product design considering a time axis by defining elements based on value changes along a time axis based on a multi-space design model, defining each relationship as a mapping function between spaces, and solving it by multi-objective optimization. In this study, an overview of the method is presented, and the effectiveness of the method is verified by applying it to the design of a chair that can be used over a long period of time as a child grows up, as an example of time-axis design.

Keywords: Timeaxis Design, Multispace Design Model, Chair Design

MULTILINGUAL COMMUNICATION ROBOT USING LANGUAGE DETECTION SYSTEM (41)

Kei MATSUOKA, *matsuoka.kei@kagawa-u.ac.jp* Kagawa University, 760-8521, Takamatsu, Japan

Yuki KIDA, *ykida@keio.jp* Keio University, 223-8526, Yokohama, Japan

Takeo KATO, *kato@mech.keio.ac.jp* Keio University, 223-8522, Yokohama, Japan

Tetsuro OGI, *ogi@sdm.keio.ac.jp* Keio University, 223-8526, Yokohama, Japan

ABSTRACT

In a conventional multilingual information system, the user must actively choose the language. Therefore, in this study, a multilingual communication robot system that realizes natural communication using multiple languages for various foreign visitors was developed. In this system, when a user approaches a guide robot, the language used in the user's smartphone is automatically acquired using iBeacon, and the robot can talk to the user using the user's language. Using this method in this study, the guide robot was able to spontaneously guide the user in the language used by the user.

Keywords: Communication Robot, Multilingual Communication, Language Detection System

HUMAN RELATIONSHIP FELT IN COMMUNICATION USING TELE-IMMERSION AVATAR ROBOT (42)

Tetsuro OGI, *ogi@sdm.keio.ac.jp*₁, Keio University, 223-8526, Yokohama, Japan

Yuki KIDA, *ykida@keio.jp*, Keio University, 223-8526, Yokohama, Japan

ABSTRACT

In this study, a tele-immersion avatar robot that allows remote users to communicate with local users with high presence sensation while feeling that their body was unified into the robot present at the local site was developed. The avatar robot is equipped with audiovisual information transmission function, body movement control function, and voice conversation function. An evaluation experiment using the developed avatar robot in research presentation was conducted, and a questionnaire for remote users and local users regarding the psychological human relationship that was felt during the communication was conducted to evaluate the proposed system.

Keywords: Avatar Robot, Tele-Immersion, Remote Communication, Human Relationship

SIMPLE REACTION TEST WITH MOUSE CLICKS USING 500 Hz MONITOR -IS A 500 Hz MONITOR EFFECTIVE FOR ESPORTS? (43)

Yuya ASHIZAWA, *g2172004@tcu.ac.jp* Tokyo City University, 2248551, Yokohama, Japan

Hideo MIYACHI, *miyachi@tcu.ac.jp* Tokyo City University, 2248551, Yokohama, Japan

ABSTRACT

We are interested in the skills people improve through eSports. In this context, we have focused on the use of high-frequency monitors for eSports and have investigated the effects of high-frequency monitors on eSports. In a previous study, we found that in a simple reaction test, even ordinary people without special training could perceive a 360 Hz monitor and react faster than a 60 Hz monitor. Also, in a slightly more complex cursor aiming test, in which the cursor is placed on a target, the high-frequency monitor was found to have an advantage in game scores. Since the latest 500 Hz monitors will begin shipping in Japan in 2023, we conducted a simple reaction test and a cursor aiming test using these monitors. The results showed that a 500Hz monitor allowed participants to react faster in a simple reaction test. However, no significant effect was observed for the 500Hz monitor in the mouse cursor aiming test. It was suggested that the advantage of high-frequency monitors in eSports depends on the content of the game.

Keywords: High-Refresh Rate Monitor, E-Sports, Simple Reaction Time

SEATING POSITIONS AND BEHAVIORS IN VIRTUAL SPACE (44)

Toma SHIBANO, *g2172062@tcu.ac.jp*, Tokyo City University, 2248551, Yokohama, Japan

Hideo MIYACHI, *miyachi@tcu.ac.jp*, Tokyo City University, 2248551, Yokohama, Japan

Sumire HIROTA, *sumire@tcu.ac.jp*, Tokyo City University, 2248551, Yokohama, Japan

ABSTRACT

The purpose of this study was to investigate seating behaviors in VR office and to explore the appropriate design for the VR office, comparing with the results of Sommer's (1965) study in real settings. In 1st experiment, 19 pairs of male students were asked to perform the competitive and cooperative work in 2 VR offices for each. The results were different from the ones by Sommers (1965). Experiment 1 showed that the type of work had a different effect on seating position, with competing favoring a position near the front and cooperation favoring a position directly next to the front. In Experiment 2 the confederate seated the seat specified beforehand. As a result, regarding the angle between the gazes of each other, Sommer's two assertions that Opposite was preferred in Competing and Side by Side was preferred in Cooperating were not followed up in the VR space. The times for seating and the reasons to choose the seat were also measured in experiment 2. The reasonable design of the table in the VR office was discussed.

Keywords: VR Office, Seating Behaviors, Cooperating, Competing

ARCHITECTURE OF AUTONOMOUS AVATAR AND VR SIMULATOR FOR VARIOUS TRAINING PURPOSES AND SITUATIONS (46)

Tomohiro TANIKAWA, *tani@cyber.t.u-okyo.ac.jp* The University of Tokyo, 1138656, Tokyo, Japan

ABSTRACT

In mechanical design, it is extremely important to consider what kind of interactions with people will occur in the usage situation. However, the evaluation from the viewpoint of the human interface, i.e., how people will use the machine, is currently conducted by actually using the machine by people. We propose the use of VR to reproduce the situation in which the machine will be used, and to verify. In this paper, we present a pilot implementation of a VR simulator and an architecture for autonomous avatars. In this paper, we present a pilot implementation of a VR simulator and an architecture for autonomous avatars that can simulate not only physical simulations, but also take into account human emotions and attention.

Keywords: Human Factor, Behavior Simulation, Virtual Reality

NOVEL-DESIGNED INTELLIGENT ROBOT DEVELOPMENT FOR DETECTING MOSS GROWTH AND CRACKED TİLES IN SWIMMING POOL STRUCTURES IN BUILT ENVIRONMENT (2)

Mahmut GARİP, *garipmahmut2003@gmail.com* Atılım University, 06830, Ankara, Turkey

Ahmet Esat YAVAŞ, *ahmetesat_yavas42@hotmail.com* Atılım University, 06830, Ankara, Turkey

Ahmet EMİR, *emir@alpagusavunma.com.tr* Atılım University, 06830, Ankara, Turkey

Görkem Anıl GÖKALP, *gokalpgorkem66@gmail.com* Atılım University, 06830, Ankara, Turkey

Nuri Bilgehan KÖSEOĞLU, *nuri.bilgehan06@hotmail.com* Atılım University, 06830, Ankara, Turkey

Noura ALHUMMADA, *noura.mahmoud@protonmail.com* Ankara Yıldırım Beyazıt University, 06010, Ankara, Turkey

Cihan TURHAN, *cihan.turhan@atilim.edu.tr* Atılım University, 06830, Ankara, Turkey

ABSTRACT

Nowadays, some of the villas and almost all fully equipped gyms have a swimming pool in the built environment. Therefore, adding to these built environments a special pleasant visual and ensure more efficiency for athletes and occupants are a sensible choices for architects and engineers. However, cracked tiles and moss growth on the structures can create problems in the swimming pools. To this aim, this study purposes to design an autonomous underwater vehicle (AUV) to detect cracked tiles underwater and moss growth due to the pollution in the water. The novel AUV detects these problems by using image processing system. The system includes three main components; mechanical, electronic and software systems. Through the mechanical system, this study designs the vehicle and simulates the vehicle in a dynamic simulation programme. In the electronic system, the novel vehicle lays on BMS (Battery Management System) sensors and circuit design. Image processing, object detection and determining colors with a high-sensitivity algorithm are included in the software system. The results of this study depict that novel-designed intelligent robots can be used efficiently for detecting problems in swimming pools of the built environment.

Keywords: Swimming Pool, Tile, Moss, Pollution, Image Processing, Autonomous Underwater Vehicle, Mechanical, Electronic, Software

UNDERSTANDING THE STATE OF MIND ON THERMAL COMFORT THROUGH LITERATURE: INTRODUCING TURHAN AND ÖZBEY COEFFICIENTS (3)

Mehmet Furkan ÖZBEY, *furkan.ozbey@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Cihan TURHAN, *cihan.turhan@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

ABSTRACT

Thermal comfort, defined as "the state of mind which expresses satisfaction with the thermal environment" by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), is a crucial aspect of indoor environmental quality. While Fanger's Predicted Mean Vote (PMV)/ Percentage of Dissatisfied (PPD) method and Adaptive Thermal Comfort (ATC) models serve as cornerstones in thermal comfort research, the ATC model offers a broader perspective by incorporating behavioral and psychological adjustments alongside physical parameters. However, literature investigates the ATC model predominantly focuses on behavioral adaptations, neglecting psychological adjustments emphasized by ASHRAE as integral to "the state of mind. Moreover, qualitative approaches dominate the literature, with limited quantitative investigations. Therefore, this paper aims to address the importance of human psychology by systematically reviewing previous field studies to elucidate the magnitude and significance of psychological adjustments to the thermal comfort. Additionally, it introduces the Turhan and Özbey coefficients, derived from a quantitative study, to provide a more comprehensive understanding of the impact of psychological factors on thermal comfort. This work is highlighted the importance of the human psychology to achieve better indoor environmental quality in aspects of thermal comfort.

Keywords: Adaptive Thermal Comfort, Human Behaviour, Human Psychology.

DETERMINING PAYBACK PERIOD AND COMPARING TWO SMALL-SCALE VERTICAL AXIS WIND TURBINES INSTALLED AT THE TOP OF RESIDENTIAL BUILDINGS (4)

Yousif A. SALEH, *saleh.yousif@student.atilim.edu.tr* Atılım University, 06830, Ankara, Turkey

Cihan TURHAN, *cihan.turhan@atilim.edu.tr* Atılım University, 06830, Ankara, Turkey

ABSTRACT

In recent years, there has been a notable surge in the energy consumption of residential buildings. Given the ongoing advancements in our world, it is imperative that researchers prioritize investment in renewable energy to align with the goal of achieving highly sustainable, near-zero energy buildings. Many countries are actively pursuing this objective, aiming to phase out fossil fuels due to their detrimental environmental impact. Wind energy emerges as a key player in the realm of renewable resources, particularly in regions characterized by strong wind patterns. A specific case study conducted in Turkey's Izmir province, notably in the Karaburun district boasting annual wind speeds of 6-8 m/s, sheds light on this potential. This study focused on evaluating the efficacy of two types of small-scale Vertical Axis Wind Turbines (VAWTs) in reducing energy consumption within a three-story residential structure, while also considering the associated costs. Using advanced simulation tools like ANSYS Fluent and DesignBuilder Software, this study meticulously analyzed the impact of Ice-Wind VAWTs and Savonius VAWTs. The results were illuminating: Ice-Wind VAWTs, when installed in a suitable configuration on the building's roof, showed a notable reduction in energy consumption by an estimated percentage. Cost analysis showed that the pay-back period is found as 3.2 years. These findings underscore the tangible benefits and cost considerations associated with integrating renewable energy solutions like VAWTs into residential infrastructure.

Keywords: Residential Buildings, Vertical Axis Wind Turbine, Ice-Wind Turbine, Savonius Wind Turbine, Numerical Investigation

TECHNO-ECONOMIC OPTIMIZATION OF HYBRID ENERGY SYSTEMS FOR ZERO ENERGY BUILDINGS IN REMOTE COMMUNITIES: A CASE STUDY IN ANKARA (11)

Mehdi MEHRTASH, *mehdi.mehrtash@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Othman J. ALHAYALI, *othman.jaseem@uoanbar.edu.iq* Renewable Energy Research Centre, University of Anbar, Anbar, Iraq

ABSTRACT

The demand for renewable energy sources has surged due to concerns about fossil fuel scarcity, environmental sustainability, and rising conventional energy costs. This study assesses the viability and economic efficiency of off-grid hybrid renewable energy systems (HRES) for providing electricity to remote communities, focusing on zero-energy buildings (ZEBs) in Ankara, Turkey. Using the HOMER program, we explore five scenarios with various combinations of wind turbine (WT), photovoltaic (PV), diesel generator (DG), and battery to find the most cost-effective and reliable solution for powering 30 rural households near Ankara. Findings highlight an optimal configuration, featuring 107 kW of PV, three 10 kW WT, a 10 kW DG, and 45 units of 7.15 kWh batteries, which generate significant energy with minimal environmental impact. With a calculated cost of energy (COE) at 0.25 \$/kWh and a net present cost (NPC) of 568,431 \$, this setup demonstrates promising cost-efficiency. Sensitivity analysis highlights how resilient the system is to changes in fuel prices. Furthermore, declining expenses associated with PV and WT installations emphasize the ongoing affordability of renewable energy solutions. This study offers valuable insights for stakeholders committed to advancing sustainable energy solutions and enhancing electricity access in remote areas.

Keywords: Hybrid Renewable Energy Systems (HRES), Techno-Economic Analysis, Zero-Energy Buildings (ZEBs), Off-Grid Systems

THERMAL MANAGEMENT OF A MULTI-FUNCTIONAL BATTERY CASE (26)

İbrahim DİKER, *idiker@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

O. Cem GÖKCİLER, *ocgokciler@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

Göktürk M. ÖZKAN, *gmozkan@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

Durmuş Can ACER, *dcacer@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

Ahmet ÇETİN, *acetin@adiyaman.edu.tr* Adıyaman University, 02040, Adıyaman, Türkiye

Necdet GEREN, *gerendr@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

ABSTRACT

The current study aims to optimize the thermal management system of the composite battery case, which is planned to protect and improve the battery's safety and life cycle. The relatively heavier and more complex structure of liquid-cooled thermal management systems will be compensated by a composite battery case produced with a new patent-protected technique. The thermal management system will be studied first numerically to obtain an optimized geometry for the highest heat transfer with uniform temperature distribution and minimum pressure loss. Then, measurements will be performed on the manufactured battery case. The preliminary numerical analysis of the thermal management system is presented in this study.

Keywords: Liquid Cooling Battery Thermal Management System, Battery Casing Technology, Response Surface Methodology

THERMAL DECOMPOSITION OF THE SOLID PHASE OF GUN PROPELLANTS (47)

Léo COURTY, *leo.courty@univ-orleans.fr* University of Orléans, 18000, Bourges, France

Samuel DELBARRE, *samuel.delbarre@etu.univ-orleans.fr* University of Orléans, 18000, Bourges, France

Mame WILLIAM-LOUIS, *mame.william-louis@univ-orleans.fr* University of Orléans, 18000, Bourges, France

ABSTRACT

Gun propellants are a family of energetic materials designed to produce a high amount of gases during a short period of time. Their accidental ignition can lead to severe accidents that caused many casualties in the past. To overcome this problem, gun propellants belonging to LOW-Vulnerability Ammunitions (LOVA) family have been developed. However, this loss of sensitivity can lead to ignition issues in operational use. Thermal decomposition of the solid phase is a key step in the ignition process and remains challenging. This paper presents the thermal decomposition of three LOVA gun propellants based on RDX and nitrocellulose. Decomposition is studied by ThermoGravimetric Analysis (TGA) between 30 and 300 °C under nitrogen atmosphere. A kinetic analysis method, considering ICTAC (International Confederation for Thermal Analysis and Calorimetry) recommendations, is developed in this paper and has been applied to TGA results. Doing so, global kinetic parameters are determined to obtain a solid phase decomposition law. Models using this law provide mass losses in good agreement with TGA results. This study is part of a wider project which aims to model ignition and combustion processes of low-vulnerability gun propellants using detailed chemical kinetics for the gas phase.

Keywords: Thermal Decomposition; LOVA Gun Propellant; RDX, Nitrocellulose; Model-Fitting Analysis

DESIGN AND OPTIMIZATION OF AN EV BATTERY ENCLOSURE USING MACHINE LEARNING (34)

Burak AYDOĞDU, *burakaydogdu@uludag.edu.tr* Bursa Uludag University, 16059, Bursa, Turkey

Fatih KARPAT, *karpata@uludag.edu.tr* Bursa Uludag University, 16059, Bursa, Turkey

Necmettin KAYA, *necmi@uludag.edu.tr* Bursa Uludag University, 16059, Bursa, Turkey

ABSTRACT

In this study, structural optimization of a battery enclosure under bending and torsional constraints was carried out. Machine learning (ML) approach was used to calculate the objective and constraint functions in the optimization problem. The ML model was trained and validated with data obtained from finite element analyses. The optimization model was then solved by the differential evolution algorithm. Five thicknesses, which are the design parameters in the enclosure, were optimized for minimum mass, and according to the results, the enclosure's mass decreased by 18.29%.

Keywords: Battery Enclosure, Design Optimization, Machine Learning, Differential Evolution Algorithm

MACHINE LEARNING FOR PREDICTIVE MODELLING AND OPTIMISATION OF PVD BORON NITRIDE COATINGS (36)

Korcan KÜÇÜKÖZTAŞ, *korcan.kucukoztas@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

Bilgin KAFTANOĞLU, *bilgin.kaftanoglu@atilim.edu.tr*, Metal Forming Centre of Excellence, Atılım University, 06830, Ankara, Türkiye

Çiğdem TURHAN, *cigdem.turhan@atilim.edu.tr*, Department of Software Engineering, Atılım University, 06830, Ankara, Türkiye

ABSTRACT

This study explores the tribological properties of Boron Nitride (BN) coatings on D2 steel substrates deposited using the Physical Vapour Deposition (PVD) process with the Magnetron Sputtering (MS) method. The research aims to optimise the coating process through a data-driven approach by systematically varying experimental parameters and collecting extensive data using surface characterisation techniques, including pin-on-disk tribometry, nano hardness testing, and thin-film thickness measurement. The dataset also includes theoretical model data to optimise coating thickness.

Correlation analysis identified relationships between experimental parameters and coating characteristics, while feature importance metrics highlighted key influencing factors. Exploratory data visualisation provided insights into the distribution and interplay of characterisation results. Multiple machine learning models were developed and trained to both predict surface characterisation results and to optimise coating parameters, with the best model selected automatically based on regression evaluation metrics. This approach significantly improves decision-making time and enhances the efficiency of the coating process. The study presents a novel approach for optimising the deposition process of BN coatings, contributing valuable insights to tribology and surface engineering using advanced artificial intelligence techniques.

Keywords: Boron Nitride Coatings, Physical Vapour Deposition, Tribology, Surface Characterisation, Data Analysis, Artificial Intelligence, Machine Learning, Process Optimisation.

DIMENSIONAL CONTROL IN SHEET METAL BENDING USING MACHINE LEARNING (51)

Mehmet Can BÜYÜKDÖĞERLİOĞLU, *mehmet.buyukdogerlioglu@std.yildiz.edu.tr*
EAE Elektrik Inc. Dilovası, Kocaeli 41455 Türkiye

Haydar LİVATYALI, *hlivatya@yildiz.edu.tr* Yıldız Technical University, Besiktas,
Istanbul, 34349, Türkiye

ABSTRACT

This study aims to improve dimension control in sheet metal forming processes by addressing the challenge of springback variation in bending operations. Traditional methods for ensuring product quality are often slow and costly, hindering efficiency and increasing expenses. A machine learning approach is proposed, utilizing process data and image-based dimensional measurements to predict and control variations in the dimensions of an electrical busbar terminal made of aluminum and copper alloy strips after die bending. The focus is on key parameters such as material type, form type, and dimensions including length, width and thickness. A total of thirty-two variations were identified, and 3200 images were processed, each variation type comprising 100 samples. For labelling, 10% of each class was used. The dataset was divided into 70% for training and 30% for testing. After benchmarking gradient boosting, support vector machine, random forest, logistic regression, k-nearest neighbor, decision tree, K-means, and Naive Bayes algorithms, gradient boosting and support vector machine proved to be the most effective methods in terms of accuracy, F1-score, precision and sensitivity.

Keywords: Dimensional Control, Sheet Metal Bending, Machine Learning, Product Quality.

EVALUATION OF DIFFERENT DAMAGE MODELS APPLIED FOR EXTRUDED 6XXX SERIES ALUMINUM (25)

Seda YILDIZ, *seda.yildiz@yesilova.com.tr-yilidzseda@gmail.com* Yeşilova Holding - Bursa Technical University, 16310, Bursa, Turkey

Hüseyin LEKESİZ, *huseyin.lekesiz@btu.edu.tr* Bursa Technical University, 16310, Bursa, Turkey

ABSTRACT

Aluminum alloys are widely used in industry due to their lightweight, machinability, corrosion resistance, and recyclability. Extrusion method makes manufacturing possible for long pieces with specific profiles. However, a comprehensive approach to proper damage modeling is limited in the literature. This study focuses on the material properties and damage parameters of extruded 6xxx series aluminum alloy using Hollomon, Swift, Voce, and Swift & Voce hardening equations. Stress-strain results from analyses were compared with test results. Damage parameters for Johnson Cook and Hosford-Coulomb models were obtained. FE analysis of a crash-box design was evaluated by comparing tensile and compressive behaviors.

Keywords: Aluminum Alloy, Extrusion, Hardening Curves, Damage Model, Crash Box

EVALUATING STEEL/ADHESIVE INTERFACIAL FAILURE USING PULL-OFF TESTS (28)

Fatih İBRAHİMOĞLU, *fatih.ibrahimoglu@tedu.edu.tr* TED Üniversitesi, Ankara, Turkey

Ata KHABAZ-AGHDAM, *ata.khabaz@tedu.edu.tr* TED Üniversitesi, Ankara, Turkey

Şehram DİZECİ, *sehram.dizeci@tedu.edu.tr* TED Üniversitesi, Ankara, Turkey

ABSTRACT

This research delves into analyzing the failure mechanisms of the interface layer in Araldite 2011, a toughened epoxy adhesive, when bonded to steel surfaces. The predominant occurrence of interfacial failure in Pull-off testing has prompted the selection of this method to establish a triangular traction-separation (TR) damage model of the adhesive/metal interface, employing 2D cohesive zone modeling (CZM) elements. By scrutinizing failure patterns within the steel interface, a cohesive zone model (CZM) is derived, aligning closely with experimental findings. This comprehensive characterization of interface layer damage not only facilitates the prediction of failure mechanisms in adhesive joints but also enhances the accuracy of mechanical behavior forecasts in scenarios involving adhesive failure.

Keywords: Cohesive Zone Model, Interface Failure, Pull-Off Test

DAMAGE DETECTION ON BEAM STRUCTURES USING HO-KALMAN IDENTIFICATION METHOD (49)

Ö. Dehan ÖZBOZ, *oozboz@etu.edu.tr* TOBB ETÜ, 06560, Ankara, Turkey

Özkan ALTAY, *ozaltay@tai.com.tr* TURKISH AEROSPACE, 06980, Ankara, Turkey

A. Murat ÖZBAYOĞLU, *mozbayoglu@etu.edu.tr* TOBB ETÜ, 06560, Ankara, Turkey

H. Özgür ÜNVER, *houunver@etu.edu.tr* TOBB ETÜ, 06560, Ankara, Turkey

ABSTRACT

Due to its non-destructive nature and real time monitoring capabilities, Vibration-Based Structural Health Monitoring Systems have a promising potential for damage assessment. Among possible methods, Sub-Space methods provide state-space model, and modal parameters of the system. Ho-Kalman method forms the backbone of Sub-Space Methods. Using impulse response of the structure, the modal parameters such as natural frequencies, damping ratios, and mode shapes can be captured. By investigating vibration characteristics of intact and damaged specimens, the effect of the damage on the modal parameters of Steel and Carbon Fiber Reinforced Polymer (CFRP) beams has been investigated.

Keywords: Structural Health Monitoring, Sub-Space Identification, Ho-Kalman Method, Model Order Reduction, Damage Detection

EXPLORING THE QUANTIFICATION POTENTIALS IN ASSESING THE WITNESS PLATE RESULTS OF A BALLISTIC TEST VIA DIGITAL IMAGE PROCESSING TECHNIQUES (77)

Hüseyin KURTULDU, *hkurtuldu@baskent.edu.tr*, Biyomedikal Mühendisliği Bölümü, Başkent Üniversitesi, 06790, Ankara, Türkiye

Barış ÇETİN, *cerin.baris@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

Atanur TEOMAN, *ataatymnn@gmail.com*, Savunma Teknolojileri Araştırma Grubu, Eskişehir Osmangazi Üniversitesi, 26040, Eskişehir, Türkiye

Engin GÖDE, *engingode81@yahoo.com*, STM Savunma Teknolojileri Mühendislik ve Ticaret A.Ş., 06830, Ankara, Türkiye

Gökhan İbrahim ÖĞÜNCÜ, *gokhanibrahim.ogunc@jsga.edu.tr*, Jandarma ve Sahil Güvenlik Akademisi, 06805, Ankara, Türkiye

Melih Cemal KUŞHAN, *mkushan@ogu.edu.tr*, Savunma Teknolojileri Araştırma Grubu, Eskişehir Osmangazi Üniversitesi, 26040, Eskişehir, Türkiye

ABSTRACT

For most of the ballistic tests, a witness plate is implemented to the back face of the target material with a certain gap dimension as requested by the standards. This witness plate generally used to assess the ballistic test by means of a qualitative perspective. In this study, some witness plates having damage and defects which were occurred during ballistic test was evaluated with image processing techniques. This technique basically relies on providing high illumination to create a significant contrast aiming to detect the edge of the fractured sections precisely. Furthermore, with the help of necessary calibration actions (detecting the pixel over millimeter factor) the whole morphological shapes could be quantified. In this regard, the general concepts of morphology as like Ferret's diameter, circularity and etc. are utilized to yield meaningful conclusions among different witness plates. The first results revealed that, this digital image processing strategy may shed light into the quantification of the tested work pieces such as anti-spalling tendency, cone angle detection and etc.

Keywords: Ballistic Test, Witness Plate, Image Processing

DESIGN AND CHARACTERIZATION OF AN ADDITIVELY MANUFACTURED HEAT EXCHANGER WITH TRIPLY PERIODIC MINIMAL SURFACE CORE (20)

Burak CEVAHİR, *burak.cevahir@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

Ulaş YAMAN, *uyaman@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

Triply periodic minimal surface (TPMS) structures are being used more frequently as a result of growing interest in additive manufacturing (AM), as intricate shapes like TPMS structures cannot be manufactured using conventional fabrication methods. Having tailorable properties such as relative density, wall thickness and cell size, mathematically regulated TPMS based structures can have intriguing usage in engineering applications. Naturally dividing the volume that they cover into two makes TPMS based structures very handful in heat transfer applications, whereas, having high stiffness values while having less material makes TPMS structures also applicable for light-weighting designs for space applications. This study focuses on a compact counterflow heat exchanger (CCHEX) designed by utilizing the high surface area to volume ratio of different TPMS structures. The heat transfer areas for three different TPMS structures are calculated inside a prescribed heat exchanger volume. Among many other design options, a Gyroid based heat exchanger is manufactured using 17-4 PH. stainless steel powder. The manufactured prototype is designed considering the AM design criteria so that no support structures are needed. Furthermore, a test setup capable of measuring the pressure, temperature, and flow rate data for the v fluid sides at the inlet and outlet sections is constructed. Test results are validated using computational fluid dynamics simulations so that many other heat exchanger designs can be evaluated without manufacturing and testing. Using the workflow generated, various types of TPMS structures can be analyzed and compared for their thermal performance and volume requirements in laminar flow region.

Keywords: TPMS Structures, Heat Exchangers, Additive Manufacturing

THE ADDITIVE MANUFACTURING PROCESS AND ITS CHALLENGES IN HUMAN PROSTHESIS DEVELOPMENT: PRELIMINARY STUDIES (48)

Carla ANFLOR, *anflor@unb.br* GMEC/University of Brasilia, Brasilia, Brazil

Euclides SANTANNA, *euclidesunb@gmail.com* GMEC/University of Brasilia, Brasilia, Brazil

Karla SARTIN, *ksartin@udf.edu.br* GMEC/University of Brasilia, Brasilia, Brazil

ABSTRACT

This study examines the methodologies employed in computational modeling of the mandible and their effects on research outcomes. It reviews prior research that modeled the mandible with different material properties, treating it as a single unit, in pairs, or as multiple sub-regions. By utilizing sliced tomographic images, a finite element model of an intact mandible was constructed to investigate the dispersion of stress fields based on various bone material properties reported in the literature. The study elaborates on the methods used for mandible model development, approaches to achieve high precision, and the impact of mechanical properties. Significant variations in stress field outcomes were identified, with differences ranging from 4.4% to 67.4% in the symphysis region, evaluated using RMSE to determine model similarity.

Keywords: Mandible, Finite Element Method, Computational Modeling, Orthotropic Material, Bi-Material

DEVELOPMENT OF A LABORATORY-SCALE TUNGSTEN INERT GAS-WIRE ARC ADDITIVE MANUFACTURING DEVICE (54)

Mustafa Çağrı ÖZKADER, *mustafacagriozkader@hitit.edu.tr*, Hitit University, Department of Mechanical Engineering, 19030, Çorum, Türkiye

Öncü AKYILDIZ, *oncuakyildiz@hitit.edu.tr*, Hitit University, Department of Metallurgical and Materials Engineering, 19030, Çorum, Türkiye

Cengiz BAYKASOĞLU, *cengizbaykasoglu@hitit.edu.tr*, Hitit University, Department of Mechanical Engineering, 19030, Çorum, Türkiye

ABSTRACT

Tungsten Inert Gas (TIG) - Wire Arc Additive Manufacturing (WAAM) is a metal additive manufacturing (AM) method based on TIG welding. This method offers several significant advantages compared to other AM methods, such as low investment cost, high production efficiency, and high deposition rate. In this study, an in-house laboratory-scale TIG-WAAM device equipped with temperature and displacement sensors is designed and manufactured. The design of the device has been considered holistically in terms of mechanical, electronic, and software aspects. Within this approach, a flex AM system is developed that can move a TIG welding torch along predetermined paths under computer control, feed the additional metal to the arc center synchronizing with the movement, includes an additional gas shield to protect the welding area from the adverse effects of the atmosphere. Additionally, a 360° rotatable wire feeding system has been designed and manufactured. To control the WAAM system, a control board operating with embedded software, and a human-machine interface are developed. The device was operated with different manufacturing parameters for performance evaluation. The results show that the developed WAAM system can create a continuous weld seam in determined routes and allows production of samples with good surface quality and no porosity. At the same time, it is also showed that the system is useful for in-situ temperature and displacement monitoring and therefore paves way to control the WAAM process for producing parts with desired microstructures and properties.

Keywords: Metal Additive Manufacturing, Wire Arc Additive Manufacturing, Machine Design

METHODOLOGY FOR THE OPTIMIZED ARRANGEMENT OF MICROELECTRONIC COMPONENTS ON THE PRINTED CIRCUIT BOARD FROM A MECHANICAL PERSPECTIVE (6)

Fahri Berk BİLBAY, *bilbayberk@gmail.com* Marelli Mako Turkey, 16220, Bursa, Turkey

Mustafa Cemal ÇAKIR, *cemal@uludag.edu.tr* Uludag University, 16059, Bursa, Turkey

ABSTRACT

Printed circuit boards (PCBs) may vary in terms of electronic components and their layout on the PCBs depending on the use. Specific loading circumstances greatly complicate the process of defining design idea for PCBs. These loadings can result in damage to both the PCBs and electronic components.

The goal of this work is to consider road conditions when designing PCBs and strategically place the components in suitable locations using experimental techniques. An interface has been developed that allows the PCB designer to select component positions on the board using test standards and confirmed analyses, rather than relying on human experience.

Keywords: Printed Circuit Board; Sine Sweep Analysis; Random Vibration Analysis; Thermal-Mechanical Analysis; PCB Reliability; Thermal Map; Sherlock; Optislang; Optimization; Automotive Lighting; LEDs.

A SENSITIVITY ANALYSIS ON INDUCTION SIMULATION OF HEAVY-DUTY DRIVE LINE COMPONENTS (72)

Barış ÇETİN, *cetin.baris@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

Caner BAKRAÇ, *caner.bakrac@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

Emre ÇAPOĞLU, *emre.capoglu@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

Abidin TOKER, *abidintoker@onatus.com*, Onatus Öngörü Teknolojileri Müh. Dan. Yazılım. San. ve Tic. Ltd. Şti., 41400, Kocaeli, Türkiye

Ercan DEMİRCİ, *ercan.demirci@doksanisilislem.com*, Döksan Isıl İşlem ve Ar-Ge Merkezi A.Ş., 06935, Ankara, Türkiye

Gökhan SAĞLAM, *gokhan.saglam@doksanisilislem.com*, Döksan Isıl İşlem ve Ar-Ge Merkezi A.Ş., 06935, Ankara, Türkiye

ABSTRACT

When the demanding engineering requirements are considered in terms of strength and durability for armored combat vehicles, especially for the drive line component, some specific surface treatments are commonly utilized. In that sense, induction heat treatment also provides a viable enhancement in fatigue and wear resistance of piece parts. This study deals with the induction treatment simulation of a drive line component having a complex geometry. Complex geometry introduces some challenges in inductor design and the determination of the allowable gap dimension. To conduct a sensitivity analysis, Finite Element Analysis (FEA) based numerical models are run to observe the effects of material selection, stepped heating operation and the gap clearance between the workpiece and inductor. The preliminary results of the conducted simulations revealed that the FEA based analysis may provide significant results and insights for process optimization of induction heat treatment process for the studied components.

Keywords: Induction, Inductor Design, FEA

THE INFLUENCE OF METAL FORMING ON CRASHWORTHINESS (100)

Murat BÜYÜK, *murat.buyuk@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

V. Emre SAVAŞ, *veli.savas@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

In this study, the effects of metal forming on the Numisheet'96 [1] S-Rail model are considered to evaluate the overall crashworthiness behavior. S-Rail manufacturing simulations are performed through a metal stamping operation followed by a spring-back stage. These stages are compared and validated with the experimental results. Then, a mapping algorithm is developed to transfer the residual effects of metal forming including deformed geometry, thicknesses, strains and stresses from metal stamping model to the crashworthiness model, which can significantly be different in terms of mesh sizes. A sensitivity study for different mesh sizes is conducted to observe the mesh dependency while mapping residual data from metal forming simulation into the crashworthiness model and overall effects during the crushing. Both metal forming and crushing simulations are conducted by using a 3-D non-linear, explicit dynamics numerical solver, LS-DYNA [2]. It is found that the residual effects of metal forming have more significant effects on the energy absorption capability of parts under crash loads than the effects of mesh size dependency.

Keywords: Metal Forming, Crashworthiness, Residual Stress and Strain

DETERMINATION OF THE CONSTITUTIVE MATERIAL MODEL PARAMETERS OF AN ARMOR STEEL CONFORMING TO MIL-DTL-46100 STANDARD (75)

Barış ÇETİN, *cetin.baris@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

Atanur TEOMAN, *ataatymnn@gmail.com*, Savunma Teknolojileri Araştırma Grubu, Eskişehir Osmangazi University, 26040, Eskişehir, Türkiye

Engin GÖDE, *engingode81@yahoo.com*, STM Savunma Teknolojileri Mühendislik ve Ticaret A.Ş., 06830, Ankara, Türkiye

Gökhan İbrahim ÖĞÜNÇ, *gokhanibrahim.ogunc@jsga.edu.tr*, Jandarma ve Sahil Güvenlik Akademisi, 06805, Ankara, Türkiye

Caner ŞİMŞEK, *simsekcaner92@gmail.com*, Jandarma ve Sahil Güvenlik Akademisi, 06805, Ankara, Türkiye

Kürşat TONBUL, *kursattonbul@gmail.com*, T.C. Cumhurbaşkanlığı Savunma Sanayi Başkanlığı., 06420, Ankara, Türkiye

ABSTRACT

Aiming to perform high precision simulations on the plastic and fracture behavior of armor steels, the constitutive material parameters should be extracted with high accuracy. Due to this fact, a detailed experimental effort was conducted on an armor steel which conforms to Mil-Dtl-46100 standard (with nominal hardness of 500 HB). In particular, quasi-static and Split-Hopkinson pressure bar tests were conducted and the test data were processed through specifically created MatLab codes by means of which the material parameters were determined. Then, the obtained material parameters were assessed through the experimental findings which unveiled that Johnson-Cook plasticity model was remarkably capable of mimicking the plastic response of the studied armor steel.

Keywords: Armor Steel, Material Parameters, Johnson-Cook Plasticity Model

BURST ASSESSMENT OF AERO ENGINE DISC (76)

O. Deniz YILMAZ, *okan.yilmaz@trmotor.com.tr*, TRMOTOR INC., 06800, Ankara, Turkey

Cihan SAVAŞ, *cihan.savas@trmotor.com.tr*, TRMOTOR INC., 06800, Ankara, Turkey

Emre BALDAN, *emre.baldan@tei.com.tr*, TUSAŞ ENGINE INC., 26210, Eskişehir, Turkey

ABSTRACT

The design of aero engine discs is governed by strict regulations due to the high mechanical and thermal stresses. These components must be designed as a fail-safe to prevent incidents. The certification of an aero engines requires costly spin-tests. The aim of this paper introduce a new method that replaces tests with simulations using both implicit and explicit finite element solvers. Traditional burst calculations focus on average hoop stress in axisymmetric regions, but axial and radial stress components can exist in three-dimensional features.

The model predicts burst speed, identifies burst locations, and assesses the impact of stress concentration under various conditions. Accurate damage initiation considers factors like crack driving force, plastic deformation, and stress triaxiality. Results from implicit and explicit solvers ensure precise calculations of burst speed, location, and stress concentration. The structural integrity assessment of an aero-engine disc shows consistent agreement between solvers regarding crack propagation and critical speed determination.

Keywords: Aero Engine, Disc Burst, Plasticity, Crack Propagation, Finite Element Analysis, Stress Analysis

A BENCHMARK STUDY ON ALTERNATIVE BOUNDARY ELEMENT-BASED SOLUTION STRATEGIES ON CATHODIC PROTECTION OF AMPHIBIOUS VEHICLES (80)

Barbaros ÇETİN, *barbariscetin@bilkent.edu.tr*, İ.D. Bilkent University, 06800, Ankara, Türkiye

Besim BARANOĞLU, *besim.baranoglu@novumek.com*, Novumek Teknoloji A.Ş., 06830, Ankara, Türkiye

Barış ÇETİN, *cetin.baris@fnss.com.tr*, FNSS Savunma Sistemleri A.Ş., 06830, Ankara, Türkiye

ABSTRACT

In order to prevent corrosion or eliminate any possible risks due to the possible degradation related to corroded surfaces, some precautions are taken for amphibious vehicles. One of the common methods is to implement cathodic protection, which dictates the installation of sacrificing anodes (SA) to the hull surface with proper quantity and spatial distribution. This optimization of SA in terms of quantity and localization on the hull is generally conducted most of the time via numerical analysis, which necessitates the solution of the forward problem several times in an efficient way. In that sense, the boundary element method (BEM) has intense advantages in terms of precision and computation cost compared to conventional finite elements-based formulations. Therefore, BEM is nearly the most viable option for modeling cathodic protection. Conventional BEM formulations can also be further improved by implementing semi-infinite solutions, NURBS-based surface definitions, and/or condensation of variables to reduce the rank of system matrices. This contribution is devoted to performing a benchmark analysis among those alternative numerical methods that were utilized for the solution of a generic problem. The obtained precision and computational cost results are assessed to provide important insights into this specific industry-driven problem.

Keywords: Corrosion, Cathodic Protection, BEM

DEVELOPMENT OF JOINING METHODS OF THERMOPLASTIC COMPOSITES FOR AEROSPACE APPLICATIONS (73)

Furkan KARABOĞA, *furkan.karaboga@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Eray KOŞTUR, *eray.kostur@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Fahrettin ÖZTÜRK, *fahrettin71@gmail.com* Turkish Aerospace Industries, Inc., Ankara Yıldırım Beyazıt University, 06980, Ankara, Turkey

Mahide Betül ÖZTÜRKMEN, *betul.konca@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Merve Özkutlu DEMİREL, *merve.ozkutludemirel@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Serkan TOROS, *serkan.toros@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Yahya ÖZ, *yahya.oz@metu.edu.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

Zelal YAVUZ, *zelal.yavuz@tai.com.tr* Turkish Aerospace Industries, Inc., 06980, Ankara, Turkey

ABSTRACT

Fiber-reinforced thermoplastic matrix composite laminates pose great potential for current and future aircraft components. Thermoplastic composites' recyclability, long shelf life, resistance to environmental conditions, and high toughness properties are rapidly increasing their application areas. In addition, its environmental hazardous is much lower compared to thermosets. Thermoplastic composites have gained an important position in aviation due to these properties. In this study, some joining methods that can be used for a thermoplastic matrix composite aircraft structure have been experimentally examined. The methods were compared by performing a single lap shear test (ASTM D5868) at the coupon level. In addition, details about a novel ultrasonic welding machine that performs the welded joining method are also given. Results show that the joint strength of thermoplastic composites can be tailored by the chosen method and corresponding parameters.

Keywords: Composites, Thermoplastic Composites, Joining Methods, Adhesive Bonding, Ultrasonic Welding, Consolidation

DEVELOPMENT OF THERMAL INSULATION MATERIAL FOR AEROSPACE APPLICATIONS (74)

Furkan KARABOĞA, *furkan.karaboga@tai.com.tr* Turkish Aerospace, 06830, Ankara, Turkey

Abdullah TAV, *abdullahtav@uludag.edu.tr* Uludağ University, 16000, Bursa, Turkey

Halil I. AKYILDIZ, *halilakyildiz@uludag.edu.tr* Uludağ University, 16000, Bursa, Turkey

Merve ÖZKUTLU DEMİREL, *merve.ozkutludemirel@tai.com.tr* Turkish Aerospace, 06830, Ankara, Turkey

Serkan TOROS, *serkantoros@ohu.edu.tr* Niğde Ömer Halisdemir University, 51245, Niğde, Turkey

Yahya ÖZ, *yahya.oz@tai.com.tr* Turkish Aerospace, 06830, Ankara, Turkey

ABSTRACT

It is extremely important to meet thermal insulation requirements in aircraft to ensure appropriate operational conditions, maintain structural integrity, and achieve energy savings and cost savings. In particular, it is critical to keep the external surface temperature of the pipelines through which hot gases or liquids pass at a certain level so that the aircraft operates under optimum temperature conditions. Silica-based aerogels, which are frequently used to provide this requirement, are high-performance thermal insulation materials. In this study, the operational performance and suitability for aviation of a composite insulation blanket containing aerogel was examined by using experimental and numerical methods.

Keywords: Composites, Thermal Insulation, Insulation Material, Aerogel

EFFECT OF UNIFORMITY ON POROSITY OF STOCHASTIC FIBROUS NETWORKS (87)

Yagiz KAYALI, *y.kayali@lboro.ac.uk* Loughborough University, LE11 3TU, Loughborough, UK

Ekaterina SMOTROVA-KAYALI, *e.smotrova@lboro.ac.uk* Loughborough University, LE11 3TU, Loughborough, UK

Andy GLEADALL, *a.gleadall@lboro.ac.uk* Loughborough University, LE11 3TU, Loughborough, UK

Vadim V. SILBERSCHMIDT, *v.silberschmidt@lboro.ac.uk* Loughborough University, LE11 3TU, Loughborough, UK

ABSTRACT

Fibrous networks (FNs) are a widespread group of materials that can be found in nature or engineered [1]. They can be described as porous materials with randomly distributed fibres as the main constituent. Due to the stochastic nature of the FNs, geometric modelling and characterisation of their microstructure are challenging [2]. In the literature, several parameters of stochastic FNs, such as basis weight, orientation distribution function, fibre curliness, etc., were considered to characterise their microstructure. However, recent investigations demonstrated that these parameters are insufficient to fully understand this material's complex microstructure and, hence, mechanical behaviour. Therefore, another parameter, called uniformity, that evaluates the spatial distribution of the fibres based on local variations of their basis weight was suggested [3]. In this study, the influence of the uniformity on the porosity of the FNs is evaluated.

Keywords: Geometric Modelling, Characterisation, Stochastic Microstructure

A DECISION SUPPORT SYSTEM FOR INTERNAL LOGISTICS OPERATIONS MANAGEMENT (8)

Denizay AKBIYIK, *dakbiyik@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

Sinem ÖZEN, *sinemozen@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

Tuna ULUSOY, *m.tunaulusoy@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

Eren DAĞSUYU, *edagsuyu@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

Ece AKPINAR, *eceakpinar@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

Yasin Burak UÇAK, *burak.ucak@tai.com.tr* Turkish Aerospace Industries, 06980, Ankara, Turkey

Sefa UYDURAN, *sefa.uyduran@tai.com.tr* Turkish Aerospace Industries, 06980, Ankara, Turkey

Damla DEMİR, *damla.demir@tai.com.tr* Turkish Aerospace Industries, 06980, Ankara, Turkey

Nilgün FESCİOĞLU ÜNVER, *nfunver@etu.edu.tr* TOBB University of Economics and Technology, 06560, Ankara, Turkey

ABSTRACT

Continuous improvement in industrial processes has made efficient internal material transportation critical. This study presents a decision support system for tracking internal transportation vehicles and providing effective inner logistics management. The proposed model includes a barcoding based transportation vehicle tracking system, a forecasting model for daily transportation demands of different buildings and presents a predictive demand-vehicle assignment mathematical model. Results show that the model reduces the operational costs due to vehicle search and vehicle transportation, and material damage costs due to vehicle-material mismatch at a great extent.

Keywords: Internal Logistics, Decision Support System, Relational Database, ERP, Integer Programming, Pareto Optimality, Fuzzy Logic, Reorder Point, Exponential Smoothing

IMPLEMENTATION OF THE KANBAN SYSTEM ON A MACHINE ASSEMBLY LINE (86)

Hafize DURMAZ, *hafizedurmaz@yilmazmachine.com.tr* Yılmaz Makine, R&D Department, 41455, Kocaeli, Türkiye

Hasan ÇAKIR, *hasancakir@yilmazmachine.com.tr* Yılmaz Makine, R&D Department, 41455, Kocaeli, Türkiye

Alper YETER, *alperyeter@yilmazmachine.com.tr* Yılmaz Makine, R&D Department, 41455, Kocaeli, Türkiye

Mustafa BAKKAL, *bakkalmu@itu.edu.tr* Istanbul Technical University, 34367, İstanbul, Türkiye.

ABSTRACT

In this paper, the discussion is going to be about Lean Manufacturing (LM) and how it aims to optimize efficiency in industrial operations. However, assembly lines in the machine industry often face challenges such as production delays and operational inefficiencies. This study indicates these issues by implementing Failure Mode and Effects Analysis (FMEA) and Kanban systems in Yılmaz Machine company. By identifying potential failures through FMEA and improving workflow management with Kanban, the research demonstrates significant growth in production effectiveness. This approach not only reduces risks but also arranges processes, resulting in reduced lead times and improved overall efficiency in manufacturing operations.

Keywords: Lean Manufacturing, Kanban.

EXPLORING THE INFLUENCE OF INDUSTRY 4.0 ON BUSINESS MODELS: KEY DRIVERS AND BARRIERS TO IMPLEMENTATION (88)

Aida SALİMNEZHAD, *aida.salimnezhad@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Abdi M. A. ISMAIL, *Abdimajid.ahmed.ismail98@gmail.com*

ABSTRACT

This study aims to identify the key drivers and barriers to implementing the Fourth Industrial Revolution (4IR) and their impact on the business model. Specifically, the study focuses on Small and Medium-sized Enterprises (SMEs) and employs a survey and DEMATEL technique to identify the most significant drivers and barriers, while also conducting a literature review to explore the impact of Industry 4.0 on business models. The result of this research highlights four dominant drivers, including Agility/flexibility, decentralized decision-making; data collection in real-time; efficiency & quality, and increasing the technical skill of employees while the most significant barriers include data confidentiality and safety, resistance, work interruption, and standards problem.

Keywords: Fourth Industrial Revolution, Drivers and Barriers, Business Models, Small and Medium-Sized Enterprises.

ENHANCING OPERATIONAL EFFECIENCY IN CRUSHERS THROUGH THE USE OF AN INDUSTRY 4.0 BASED CRUSHER CONTROL SYSTEM (21)

Özge GÜLER, *ozge.guler@burcelik.com.tr* Burçelik Bursa Çelik Döküm San. A.Ş., 16159 Bursa, Turkey.

Mustafa Cemal ÇAKIR, *cemal@uludag.edu.tr* Uludağ Üniversitesi, 16150, Bursa, Turkey

ABSTRACT

In the aggregate and mining industry, an excessive flow rate of raw material from the feeder, caused by irregularities in the raw material being processed by crushers, can lead to blockages or excessive strain on the crusher. Conversely, a low flow rate of raw material can result in high energy consumption by the crusher, despite operating at a low capacity. The issues encountered in the first group result in excessive energy usage in the secondary and tertiary groups. The study focuses on a system that utilizes artificial intelligence and is based on industry 4.0 principles. The system aims to maintain production in the crusher within a specific range by controlling the flow rates of the feeders using an algorithm. This control is done automatically without the need for user intervention. The system optimizes energy consumption while maximizing production capacity and ensures uninterrupted operation.

The system was developed during the installation phase at an aggregate pilot plant in the Kahramanmaraş Evri region. It assesses the material capacity data using a belt scale on the crusher, feeder, and output conveyor. This data is then compared to the limit values stored in the database, and the system generates an information signal to initiate the required control actions. Based on this matching result, it sends information to the inverter, coordinates the production cycle, manages and documents the process stages using a structured learning system and artificial intelligence logic. The installation procedure was conducted using two distinct density gradation inputs. As a consequence of the reporting, the records in the report were compared during both the active and inactive states of the system. The project achieved an efficiency of 22% in terms of energy consumption per unit capacity. Based on the whole yearly energy usage, a total of 368609.7 kg of carbon emissions were averted. The facility's aggregate crushing capacity was increased by 40%.

Keywords: Aggregate Production, Process Monitoring, Process Control, Artificial Intelligent, Industry 4.0

DESIGN, ANALYSIS AND VERIFICATION OF EMC WITH VARIOUS BALL AND TRAPEZOIDAL DRIVES (22)

Berk KURT, *berk.kurt@hktm.com.tr*, Hidropar Hareket Kontrol Teknolojileri Merkezi A.Ş. (HKTM), 41400, Gebze, Kocaeli

Ö. Faruk UYSAL, *omer.uysal@hktm.com.tr*, Hidropar Hareket Kontrol Teknolojileri Merkezi A.Ş. (HKTM), 41400, Gebze, Kocaeli

Tolga CANKURT, *tolga.cankurt@hktm.com.tr*, Hidropar Hareket Kontrol Teknolojileri Merkezi A.Ş. (HKTM), 41400, Gebze, Kocaeli

ABSTRACT

This paper examines electro-mechanical cylinder system, one of the linear motion systems. The electromechanical cylinder system is a dynamic system that can be controlled with high precision and can provide relatively high force output. The operating logic of an electromechanical cylinder and the design constraints were studied by integrating different types of actuators in addition to the restrictive part designs in the general design. Following the design investigations, once the design was complete, the response of the system at different loads and speeds was investigated. These investigations were used to compare theoretical and practical results. Along with these comparisons and tests, durability tests of the system were also carried out.

Keywords: Electro-mechanical Cylinder, Ball Screw, Trapezoidal Screw

DESIGN AND IMPLEMENTATION OF A SAMPLING SYSTEM FOR SOLID FLOW ON CONVEYOR BELTS IN INDUSTRY (61)

Barış SEZER, *barissezer1997@gmail.com*, Atılım University, 06830, Ankara, Türkiye

Hakan KALKAN, *hakan.kalkan@atilim.edu.tr*, Atılım University, 06830, Ankara, Türkiye

Behzat Bahadır KENTEL, *behzatkentel@baskent.edu.tr*, Baskent University, 06790, Ankara, Türkiye

ABSTRACT

In industrial production facilities, determining the quality of the produced material is of great importance. There are two types of methods to examine the content and quality of the material. These methods are physical and chemical analyses. The facilities have test analysis laboratories to perform these quality control processes. In these laboratories, starting from the raw state of each product, samples are taken and then, tested and analyzed at certain stages. During these tests, the content and quality of the material are observed. The results of these tests and analyses contribute to the increasing of the production quality, to the reduction of production costs and energy costs, to the production of the desired products and therefore help increasing the reliability of companies. In this study, a prototype was produced after observations, theoretical studies and engineering calculations. Many tests were carried out on this prototype and after these tests, the parameters to be used were decided. With this new sampling machine, it is aimed to achieve a sampling system that works with a better performance, requires minimal maintenance whilst the sample taken can fully represent the entire product.

Keywords: Sample, Sampling System, Quality Control, Representative

CONCEPTUAL DESIGN OF A NOVEL SPLINT TO REDUCE THE EFFECT AND RISK OF OCCURRENCE OF CARPAL TUNNEL SYNDROME (64)

İnci AKSAÇ, *aksacinci123@gmail.com* Baskent University, 06790, Ankara, Turkey
Recep KARAYAVUZ, *21998416@mail.baskent.edu.tr* Baskent University, 06790, Ankara, Turkey

Yiğithan ŞAHİN, *21996665@mail.baskent.edu.tr* Baskent University, 06790, Ankara, Turkey

İrem TEKİN, *irtek90@gmail.com* Baskent University, 06790, Ankara, Turkey
Serhan UĞURLU, *22093411@mail.baskent.edu.tr* Baskent University, 06790, Ankara, Turkey

Dilek ÇÖKELİLER SERDAROĞLU, *cokeliler@baskent.edu.tr* Baskent University, 06790, Ankara, Turkey

Behzat Bahadır KENTEL, *behzatkentel@baskent.edu.tr* Baskent University, 06790, Ankara, Turkey

ABSTRACT

A splint is designed to prevent the progression of the carpal tunnel syndrome and reduce the risk of occurrence. It is designed to have at most 5° flexion/extension for restricted position and at most 30° flexion and extension for limited motion. It can allow or restrict motion of the hand using an adjustable support which changes the stiffness of the beam in the splint. The modulus of elasticity of the beam has been found as 8.5 GPa using a biomechanical model of the hand. For this novel design, appropriate material for the beam will be selected and a prototype will be manufactured in the future.

Keywords: Carpal Tunnel Syndrome, Splint, Hand Motions

THE DESIGN OF A ROTATING MODULAR UPPER LIMB PROSTHETIC WRIST UNIT (65)

A. Ali GÜRLER, *aykut.guler@proted.com.tr* Proted Prosthetic & Orthotics INC, 06378, Ankara, Turkey

E. İlhan KONUKSEVEN, *konuk@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

This study investigates the machining properties of TiB₂ reinforced Al 2014 metal matrix composite (MMC) with electro-discharge machining (EDM) and powder-mixed electro-discharge machining (PMEDM). Three different types of Al 2014 composite specimens reinforced with 2 vol%, 4 vol%, and 8 vol% TiB₂ were fabricated in optimum conditions using vacuum infiltration method. The composite specimens with different reinforced ratios were investigated to illustrate the influence of different fractions ratios and different process parameters on machinability of MMCs. The experiments were performed with different currents and reinforcement ratios to determine the effect of TiB₂ content on material removal rate (MRR) and tool wear rate (TWR). Experiments indicate that compared with EDM, MRR and TWR machined by using PMEDM are improved. The discharge current and the reinforcement ratio also have a significant effect on the value of the material removal rate (MRR). Investigations show that with increasing of applied current, MRR increases, however, MRR decreases at higher reinforcement ratios. The results also show that in higher currents and reinforcement ratios, tool wear rate increases.

Keywords: Prosthetics, Wrist Unit, Amputation

DEVELOPMENT OF A ROLL OVER PREVENTION CONTROL STRATEGY FOR AN ARTICULATED BUS EQUIPPED WITH ON-BOARD ELECTRIC MOTORS (1)

Kerem BAYAR, kerem.bayar@man.eu, Saracalar Mahallesi, Özal Bulvarı, No 212, 06750, Akyurt Ankara

ABSTRACT

Articulated buses equipped with electric drivetrain provide high degrees of freedom in terms of actuators for vehicle stability control algorithms. Through coordination of individual wheel braking/acceleration and articulation joint damping moment, the existing algorithms can be improved. With this background, this work focuses on developing a roll-over prevention control algorithm for an articulated bus equipped with on-board electric motors at middle and rear axles. The desired yaw and roll rates are tracked by utilization of the control allocation algorithm, based on the load transfer ratio, such that the possibility of roll over prevention is mitigated.

Keywords: Roll Over Prevention, Articulated Bus, Control Allocation, Yaw Rate, Roll Angle, Articulation Angle, Vehicle Sideslip Angle, On Board Electric Motor

PLANETARY GEARBOX DESIGN FOR HYBRIDIZATION OF A PROTOTYPE POWERTRAIN (67)

Özgür AKDENİZ, *ozgur.akdeniz@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Ali EMİN, *ali.amini@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

ABSTRACT

This paper aims to design a planetary gearbox design that can be used to hybridize an existing internal combustion engine in a cost-effective way. A planetary gearbox system allows mechanical coupling between two different power sources with speed summation properties. Another important factor of the planetary gearset is the high efficiency and the potential for a high gear reduction, allowing two different power units with different operating ranges to work together flawlessly. A mathematical model was created using Goodman Criterion and the resultant parameters were used to design and manufacture a planetary gearbox system. The resultant gearbox aims to offer a highly efficient mechanical coupling system for hybridization.

Keywords: Planetary Gearset, Powertrain Coupling Systems, Electrification, Hybrid, Hybridization, Fuel Consumption

DESIGN OF A LIGHTWEIGHT MULTIFUNCTIONAL BATTERY CASE (14)

Necdet GEREN, *gerendr@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

O. Cem GÖKCİLER, *ocgokciler@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

M. Burak İBEKÇİ, *mbibekci@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

Çağrı UZAY, *cagriuzay@ksu.edu.tr* Kahramanmaraş Sutcu Imam University, 46050, Kahramanmaraş, Türkiye

Melih BAYRAMOĞLU, *bayramog@cu.edu.tr* Cukurova University, 01250, Adana, Türkiye

ABSTRACT

In this paper, a battery casing that incorporates an active cooling system is invented and introduced. The case has features of light weight, ability to absorb impact loads and self- healing. Carbon-fiber reinforced polymer composite with micro-vascular channels of different diameters will be produced and used as the case material. Active cooling is achieved by circulating coolant in the larger diameter channels and the smaller diameter channels are responsible for self-healing ability. Thus, this innovative energy storage device will have the potential to be used in electric/hybrid vehicles with its self-healing ability, without the need for additional piping system.

Keywords: Battery Casing Technology, Energy Storage, Thermal Management, Self-Healing, Micro-Vascular Composites

DESIGN AND ANALYSIS OF SUSPENSION AND STEERING SYSTEM FOR AN ELECTRIC VEHICLE (56)

Umut B. HAKTANIR, *ubhaktanir@gmail.com* Atilim University, 06830, Ankara, Turkey

Emre ÇELİKCAN, *emrecelikcangs@gmail.com* Atilim University, 06830, Ankara, Turkey

Umut NAZLIER, *umutnazlier1@gmail.com* Atilim University, 06830, Ankara, Turkey

Berkay KANDEMİR, *kndberkay@gmail.com* Atilim University, 06830, Ankara, Turkey

Özgür AKDENİZ, *ozgur.akdeniz@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

Ali EMİN, *ali.amini@atilim.edu.tr* Atilim University, 06830, Ankara, Turkey

ABSTRACT

This paper aims to design a new suspension and steering system, including an electronic differential system and electric-powered steering for an electric vehicle. The main goal is to design the new systems to be strong, durable to forces from the road and car itself, lightweight, and efficient. The electronic differential system for the vehicle will be created and optimized for better driving dynamics and efficiency. The electrically assisted steering pump and motor will be optimized by integrating them into the system.

Keywords: Steering System, Suspension System, Electric Powered Steering, Electronic Differential System, Knuckle, Double Wishbone, Electric Vehicle

IMPROVEMENTS ON THE LIGHTWEIGHT SHELL OF AN ELECTRIC VEHICLE (57)

Mustafa EROL, *mustafaerol99@gmail.com*, Atılım University, 06830, Ankara, Turkey
Cemal Emre HOKKAÖMEROĞLU, *cemalemre14@gmail.com*, Atılım University,
06830, Ankara, Turkey

Özgür AKDENİZ, *ozgur.akdeniz@atilim.edu.tr*, Atılım University, 06830, Ankara,
Turkey

ABSTRACT

The purpose of this study is to achieve a 75% weight reduction in the shell of an electric racing vehicle using composite materials. Factors considered in the design of the composite shell include maintaining aerodynamic functionality under required flow loads without deformation, and achieving a lightweight structure that forms a three-part system for quick and easy access to the vehicle's interior when needed. All analyses were performed using ANSYS-Student software. For aerodynamic load analysis, a one way fluid-structure interaction model was used. For defining composite materials from scratch, a material designer tool was employed, a composite prep and post-processing tool was utilized for composite layup method and application, and a mechanical analysis tool was used to easily view these results. After the designed shell system was produced, an 80% weight reduction was achieved, meeting the necessary factors.

Keywords: Composite Vehicle Body, Electric Vehicle, Composite Analysis Methods

DYNAMIC HEIGHT ADJUSTMENT AND OBSTACLE CLIMBING CAPABILITIES OF A 6X6 UNMANNED GROUND VEHICLE WITH ADVANCED HYDROPNEUMATIC SUSPENSION SYSTEMS (69)

Meliksah BEŞİR, *mbesir@hidroan.com.tr* Hidroan Ankara Hidrolik Mak. San. Tic. Ltd. Şti., 06800, Ankara, Turkey

Eren DOYMUS, *eren.doymus@hidroan.com.tr* Hidroan Ankara Hidrolik Mak. San. Tic. Ltd. Şti., 06800, Ankara, Turkey

I. Melih CANBOLAT, *melih.canbolat@hidroan.com.tr* Hidroan Ankara Hidrolik Mak. San. Tic. Ltd. Şti. & Middle East Technical University, 06800, Ankara, Turkey

Ahmet H. ALKAN, *aalkan@hidroan.com.tr* Hidroan Ankara Hidrolik Mak. San. Tic. Ltd. Şti., 06935, Ankara, Turkey

E. İlhan KONUKSEVEN, *konuk@metu.edu.tr* Middle East Technical University, 06800, Ankara, Turkey

ABSTRACT

This study presents an approach of dynamic height adjustment and obstacle climbing method using a 6x6 unmanned ground vehicle (UGV) equipped with advanced hydropneumatic suspension systems. This suspension system allows dynamic height adjustment of each wheel, enhancing stability and traction for obstacle climbing action. Obstacles are detected from point cloud data and the vehicle takes appropriate action to negotiate the obstacle depending on the dimensions of the obstacle. Webots simulation environment and the test vehicle are both utilized to test the system's performance. UGV's ability to autonomously climb various obstacles with stability has been demonstrated.

Keywords: Unmanned Ground Vehicle, 6x6 UGV, Hydropneumatic Suspension, Obstacle Climbing, LIDAR Sensor, RANSAC Algorithm, Webots Simulation

TÜRKÇE BİLDİRİLER
(İngilizce Özetler)

PAPERS IN TURKISH
(with English Abstracts)

AĞIR TİCARİ ARAÇLARDA KARDAN MİLİ U-SACININ GÜÇLENDİRİLMESİ (23)

Umut Can GÖLBAŞI, *u.golbasi@tirsankardan.com.tr* Tirsan Kardan, 45030, Manisa

Murat ÖZBAKİŞ, *m.ozbakis@tirsankardan.com.tr* Tirsan Kardan, 45030, Manisa

Onur ŞEN, *o.sen@tirsankardan.com.tr* Tirsan Kardan, 45030, Manisa

ÖZET

Kardan milinin önemli bir parçası olan askı, barındırdığı kauçuk parça ile oluşan titreşimleri sönmülerken bir diğer parçası U-sacı ile kardan milinin araç ile bağlantısını sağlamaktadır. Dolayısıyla U-sacının tasarımı kardan milin ömür ve performansı üzerinde önemli bir etkiye sahiptir. Bu durum göz önünde bulundurularak ortaya koyulan çalışmada, yol dışı ve ağır ticari araçlarda U-sacına yönelik geliştirmeler konu edilmiştir. Bu kapsamda literatür araştırması yapılmış, U-sacında mukavemet ve rijitliği artırmaya yönelik tasarım çalışmaları gerçekleştirilmiştir. Sonlu elemanlar analiz sonuçlarına göre, maksimum gerilme ve deformasyon miktarında sırası ile %33,2 ve %9,1 iyileşme sağlandığı görülmüştür.

Anahtar Kelimeler: FEA, Kardan Mili, Askı, U-sacı

ABSTRACT

The center bearing, an important part of the propeller shaft, absorbs vibrations with its rubber part, while the U-support provides the connection between motor vehicle and driveshaft. Therefore, the design of the U-support has a significant impact on the life and performance of the driveshaft. By considering this situation, the study focused on developments for the U-support in off-road and heavy commercial vehicles. Design studies were conducted to increase the strength and rigidity on the U-support. According to the finite element analysis, it was observed that improvement of 33,2% and 9,1%, was achieved for the stress and deformation, respectively.

Keywords: FEA, Driveshaft, Center Bearing, U-support

KUTU TİPİ ÇELİK KİRİŞLERDE ÖN GERİLME ETKİSİNİN ANALİTİK VE SONLU ELEMANLAR YÖNTEMİYLE İNCELENMESİ VE ANALİZİ (32)

Samet DÖNERKAYA, s.donerkaya@bvs.com.tr BVS Bülbüloğlu Vinç San. ve Tic. A.Ş. Ar-Ge Merkezi, 06935, Ankara, Türkiye

Kanay ZEYREK, k.zeyrek@bvs.com.tr BVS Bülbüloğlu Vinç San. ve Tic. A.Ş. Ar-Ge Merkezi, 06935, Ankara, Türkiye

Emre YAMAN, e.yaman@bvs.com.tr BVS Bülbüloğlu Vinç San. ve Tic. A.Ş. Ar-Ge Merkezi, 06935, Ankara, Türkiye

ÖZET

Bu çalışma, ön gerilmeli çelik kutu kiriş sistemlerinin incelenmesi ile ilgilidir. Vinç sektöründe kullanılan geleneksel çelik kutu kirişlerin kaldırma kapasitelerinin ön germe teknolojisi ile artırılması hususunda araştırma ve geliştirme faaliyetleri kapsamında elde edilen bulgular analiz edilmiştir. Böylece istenildiği takdirde kütleli ve taşıma kapasitesi iyileştirilmesine imkan sunulmaktadır. Ön gerilme teknolojisinin vinç sektöründeki kirişlere entegrasyonu sonucu oluşan kritik gerilme ve sehim durumları analitik ve sonlu elemanlar metodu kullanarak incelenmiştir. Ön germe kuvvetinin artırılması ile kiriş alt ve üst kuşak plakalarındaki gerilme durumunun simetrik kesitli kirişlerden farklı olduğu belirlenmiştir. Çalışma kapsamında; farklı ön germe kuvvetleri kullanılması suretiyle ön germe kuvvetine bağlı oluşan sehim miktarları elde edilmiştir. Ön germe kuvvetinin artırılması ile sehim değerlerinin düştüğü gözlemlenmiştir. Referans vinç sistemindeki kirişin 340 kN ön germe etkisi altında standart bir kirişten %23.4'lük daha az sehim yaptığı tespit edilmiştir. Halat tespit fikstürlerinin bağlandığı kiriş alt ve üst plakalarında gerilmelerin ciddi boyutlara ulaşmadığı ancak halat tutma fikstürünün kirişe bağlantı bölgelerinde ön germe kuvvetinin artmasına bağlı olarak vinç sisteminde maksimum Von Mises gerilmelerinin oluştuğu çalışma kapsamında tespit edilmiştir.

Anahtar Kelimeler: Çelik Kutu Kiriş, Ön Gerilme, SEA, Vinç Sistemleri

ABSTRACT

This study is concerned with the investigation of pre-stressed steel box girder systems. The findings obtained within the scope of research and development activities on increasing the lifting capacity of conventional steel box girders used in the crane industry with pre-stressing technology are analysed. Thus, it is possible to improve the mass and carrying capacity if desired. The critical stress and deflection conditions resulting from the integration of pre-stressing technology into the beams in the crane sector are analysed using analytical and finite element method. It has been determined that the stress state in the upper and lower belt plates of the beam is different from the beams with symmetrical cross-section by increasing the pre-stressing force. Within the scope of the study, the deflection amounts due to pre-stressing force were obtained by using different pre-stressing forces. It was observed that the deflection values decreased with increasing the prestressing force. It was determined that the beam in the reference crane system deflected 23.4% less than a standard beam under 340 kN pre-tensioning effect. It was determined in the study that the stresses did not reach serious dimensions in the upper and lower plates of the beam to which the rope holding fixtures were connected, but maximum Von Mises stresses occurred in the crane system due to the increase in the pre-stress force in the connection areas of the rope holding fixture to the beam.

Keywords: Crane Systems, Prestressing, SEA, Steel Box Beam

ELEKTROREOLOJİK TERMOPLASTİK ELASTOMER GELİŞTİRİLMESİ VE KARAKTERİZASYONU (78)

Onur ÇETİNKAYA, *onur.ctinkaya@gmail.com* Gazi Üniversitesi, 06560, Ankara

Şükran KATMER, *sukatmer@gmail.com* 06170, Ankara

Gökçe ÇALIŞ İSMETOĞLU, *gokcecalis@gazi.edu.tr* Gazi Üniversitesi, 06560, Ankara

Ömer Yunus GÜMÜŞ, *omer.gumus@btu.edu.tr* Bursa Teknik Üniversitesi, 06560, Ankara

Çetin KARATAŞ, *cetink@gazi.edu.tr* Gazi Üniversitesi, 06560, Ankara

H. İbrahim ÜNAL, *hiunal@gazi.edu.tr* Gazi Üniversitesi, 06560, Ankara

Ulvi ŞEKER, *useker@gazi.edu.tr* Gazi Üniversitesi, 06560, Ankara

ÖZET

Elektroreolojik (ER) malzemeler, bir dış elektrik alanı algılayan ve bu alana bağlı olarak viskoelastik özelliklerini değiştirebilen malzemelerdir. ER malzemelerin bir türü olan elektroreolojik elastomerler, yaygın olarak termoset elastomer matris içerisine ER aktif taneciklerin karıştırılması ile hazırlanır. ER aktif tanecikler, uygulanan dış elektrik alan (E) ile polarize olur ve yapısal olarak düzenlenerek elektik alan kuvveti doğrultusunda tersinir olarak yönlenebilen metal, ametal, inorganik (mineral, kil) veya organik iyonomer yapılarıdır. ER malzemelerin E'ni algılaması sonucu viskoz ve elastiklik modül değerleri değişir ve bu durum ER malzemelerin darbe sönümleyici olarak kullanılmasına imkân sağlar.

Bu çalışmada literatür için yeni termoplastik elastomer matrisli bir ER malzeme geliştirilmesi amaçlanmıştır. Matris malzeme olarak termoplastik stiren-etilen-butilen-stiren (SEBS) kopolimeri ve ER aktif tanecik olarak karbon siyahı (KS) kullanılmıştır. Ağırlıkça %1, %2 ve %3 oranlarında KS içeren SEBS/KS kompaundları hazırlanmış ve sıkıştırma kalıplama ile hazırlanan disk şeklinde numunelerin ER özellikleri $E = 0-2,0 \text{ kV mm}^{-1}$ koşullarında tork reometrede incelenmiştir.

Sonuçlar, %2 SEBS/KS kompaundunun elastiklik modülünün (G') elektrik alan yokken 170 kPa ve $E = 2,0 \text{ kV mm}^{-1}$ altında 200 kPa 'ın üzerine çıktığını göstermiştir. Bu kompaundun darbe sönümleyici özelliklerine sıcaklığın etkisi incelendiğinde $E = 0 \text{ kV mm}^{-1}$ altında artan sıcaklık ile G' değerinin düştüğü ve $E = 2,0 \text{ kV mm}^{-1}$ altında G' değerinin sabit kalarak 200 kPa üzerindeki değerini koruduğu belirlenmiştir. Benzer şekilde kayma hızının artışı ile G' değerinin sabit kaldığı tespit edilmiştir.

Anahtar Kelimeler: Elektroreoloji, Termoplastik Elastomer, Sıkıştırma Kalıplama, SEBS, Karbon Siyahı

ABSTRACT

Electrorheological (ER) materials can response an external electric field and can change their viscouelastic properties. Electrorheological elastomers are a type of ER materials and commonly prepared by addition of ER active particles into a thermoset elastomer matrix. ER active particles are generally in metal, nonmetal, inorganic (mineral, clay) or organic ionomer structures. They can be polarized with structural arrangements under E, and this leads to a reversible orientation of particles through the direction of the applied E. This ability of ER materials gives rise to change their viscous and elastic moduli and allows them to be used as shock absorbers.

The aim of this study is to develop a new ER material with thermoplastic elastomer matrix. Thermoplastic styrene-ethylene-butylene-styrene (SEBS) copolymer was used as a matrix material and carbon black (CB) was used as an ER active particle. SEBS/CB compounds containing 1, 2 and 3 wt.% KS were prepared, and the disk-shaped samples of them were obtained by compression moulding to examine ER properties under $E = 0\text{--}2.0\text{ kV mm}^{-1}$ by using a torque rheometer.

The results showed that the elastic modulus (G') of the 2% SEBS/CB compound was 160 kPa without electric field whereas G' was increased to over 200 kPa under $E = 2.0\text{ kV mm}^{-1}$. When the effects of temperature on shock absorbers properties were investigated, G' values the compound decreases with increasing temperature under $E = 2.0\text{ kV mm}^{-1}$. On the other hand, G' values of the compound maintained its value above 200 kPa with increasing temperature under $E = 2.0\text{ kV mm}^{-1}$. Similarly, it was also detected that G' remained stable with increasing in shear rate.

Keywords: Electrorheology, Thermoplastic Elastomer, Compression Moulding, SEBS, Carbon Black

RİJİT SAC METAL YAPISAL PARÇA TASARIMI OPTİMİZASYONU (58)

Emre TORUK, *emretoruk@gmail.com*, Türk Havacılık ve Uzay Sanayii, Ankara, 06980, Türkiye

Bilgin KAFTANOĞLU, *bilgin.kaftanoglu@atilim.edu.tr*, İmalat Mühendisliği / Metal Şekillendirme Mükemmeliyet Merkezi, Atılım Üniversitesi, Ankara, 06836, Türkiye

Hakan KALKAN, *hakan.kalkan@atilim.edu.tr*, İmalat Mühendisliği / Metal Şekillendirme Mükemmeliyet Merkezi, Atılım Üniversitesi, Ankara, 06836, Türkiye

ÖZET

Bu çalışmada, 0.6 mm kalınlığında CP2 titanyum sac malzeme üzerine bir şekillendirme deseni oluşturulmuş, bu desen hidroform yöntemi ile sac malzemeye basılmıştır. Desen ile birlikte mukavemet, geri yaylanma ve incelme (en fazla %10) konuları iyileştirilmiştir. Elde edilen simülasyon ve deneysel sonuçlarla bir algoritma geliştirilmiş, sac malzemenin uzunluk-genişlik gibi parametrelerinin değişmesi durumunda belirli bir yük altındaki sehim oranları hesaplanmış ve yeniden simülasyon gerçekleştirme ihtiyacı ortadan kaldırılmıştır. Deneysel aşamada, 4 noktadan desteklenen sac malzemenin orta noktasından 5N yük yüklenmiş ve oluşan sehim ölçülmüştür. Deneysel aşamada elde edilen parça 3B lazer teknolojisiyle taranarak bilgisayar ortamına aktarılmış, deneysel sonuç ile elastik-plastik analiz sonuçları hem geometrik olarak hem de esneme oranı olarak karşılaştırılmıştır.

Anahtar Kelimeler: Sac Metal Şekillendirme, Hidroform, İncelme, Geri Yaylanma, Kırışma, Yırtılma, Esnek Şekillendirme

ABSTRACT

In this study, a forming pattern was created on CP2 titanium sheet material with a thickness of 0.6 mm, and this pattern was pressed onto the sheet material using the hydroforming method. Along with the pattern, strength, springback, and thinning (Up to 10%) were improved. An algorithm was developed based on the obtained simulation and experimental results, allowing for the calculation of deflection rates under a specific load when parameters such as length and width of the sheet material change, eliminating the need for repeated simulations. During the experimental phase, a 5N load was applied to the center of the sheet material supported at four points, and the resulting deflection was measured. The experimental part was scanned using 3D laser technology and transferred to the computer, where experimental results were compared with elastic-plastic analysis result both geometrically and in terms of deflection rate.

Keywords: Sheet Metal Forming, Hydroforming, Thinning, Spring Back, Wrinkling, Tear, Flexforming.

ABKANT PRESLERDE DİNAMİK BOMBELEME SİSTEMİNİN TASARIM KRİTERLERİ VE AVANTAJLARI (70)

Abdullah ÖZKAN, *abdullah.ozkan@karatay.edu.tr* KTO Karatay Üniversitesi, 42020, Konya

Mustafa GÜLTEKİN, *arge@mvdinan.com* MVD Makina San. A.Ş., 42050, Konya

ÖZET

Bu bildiri, metal şekillendirme sektöründe kullanılan abkant preslerde kullanılan hidrolik dinamik bombeleme sistemlerinin tasarımı ve endüstriyel avantajlarını incelemektedir. Geleneksel mekanik sistemlerden farklı olarak, hidrolik dinamik bombeleme daha yüksek hassasiyet, esneklik ve verimlilik sağlar. Geleneksel sistemlerde kamalı tertibat sistemi yüksek tonaj altında anlık bombeleme miktarı değiştirilemezken, hidrolik bombeleme sistemi tasarımında üç tabla kullanarak bu sorunu çözer ve presleme anında bombeleme miktarı ayarlanabilir. Yapısal sonlu elemanlar analizleri, sistemin farklı malzeme uzunluklarında gerekli performansı gösterdiğini doğrulamaktadır. Sonuç olarak, bu teknoloji üretim süreçlerini iyileştirir ve rekabet avantajı sunar.

Anahtar Kelimeler: Hidrolik Bombeleme, Abkant Pres, Metal Şekillendirme

ABSTRACT

This paper examines the design and industrial advantages of hydraulic dynamic crowning systems used in press brakes within the metal forming industry. Unlike traditional mechanical systems, hydraulic dynamic crowning offers higher precision, flexibility, and efficiency. In traditional systems, wedge mechanisms do not allow for instantaneous adjustment of the crowning amount under high tonnage, whereas the hydraulic crowning system resolves this issue by using a three-table design, enabling crowning adjustment during pressing. Structural finite element analyses confirm that the system achieves the required performance for different material lengths. Consequently, this technology improves production processes and offers a competitive advantage.

Keywords: Hydraulic Crowning, Press Brake, Metal forming

3B YAZICI İLE ÜRETİLEN PARÇALARIN FARKLI BASKI YÖNLERİNDEKİ DAYANIMININ DENEYSEL VE NÜMERİK İNCELENMESİ (30)

Emre Can HASKİLİT, *haskilitemrecan@mail.com* Niğde Ömer Halisdemir Üniversitesi, 51240, Niğde

Habip Gökay KORKMAZ, *hkorkmaz@ohu.edu.tr* Niğde Ömer Halisdemir Üniversitesi, 51240, Niğde

Remzi Ecmel ECE, *reece@tai.com.tr* Türk Havacılık Uzay Sanayii A.Ş. 06980, Ankara

Serkan TOROS, *serkantoros@ohu.edu.tr* Niğde Ömer Halisdemir Üniversitesi, 51240, Niğde

Fahrettin ÖZTÜRK, *fahrettin71@gmail.com* Türk Havacılık Uzay Sanayii, A.Ş., 06980, Ankara, Ankara Yıldırım Beyazıt Üniversitesi, Etlik, 06010, Keçiören, Ankara

ÖZET

Bu çalışmada, Ultem 9085 malzemesi kullanılarak 3 boyutlu (3B) yazıcı ile belirli standartlarda üretilmiş deney numunelerinde farklı baskı yönlerinin mekanik dayanım üzerindeki etkisi deneysel ve sayısal olarak incelenmiştir. Sayısal analizler ANSYS yazılımı kullanılarak yapılmış olup, analiz sonuçları deneysel sonuçlarla karşılaştırılmıştır. Ayrıca, baskı kalitesi kırılma yüzeylerinin mikroskop altında incelenmesiyle değerlendirilmiştir. Sonuç olarak çekme deneyinde kuvvetin, numunelerin baskı yönünde kullanılan katmanların yönü ile aynı olması durumunda yüksek bir dayanım sergilerken, kuvvete dik baskı yönlerinde yapılan deneylerde gerilme katmanlar arası yapışma yüzeylerinde meydana geldiği için daha düşük gerilme ve birim deformasyon değerlerinde malzeme kopmaktadır. Aynı durum 3 nokta eğme testin de gözlemlenmiştir.

Anahtar Kelimeler: 3 Boyutlu Yazıcı, Eklemeli İmalat, Ultem 9085, Sonlu Elemanlar Analizi

ABSTRACT

In this study, the effect of different printing directions on the mechanical strength of test specimens produced in specific standards with a 3D printer using Ultem 9085 material was investigated experimentally and numerically. Numerical analyses were performed using ANSYS software and the results were compared with the experimental results. In addition, the stress quality was assessed by examining the fracture surfaces under a microscope. As a result, in the tensile test, if the force is the same as the direction of the layers used in the printing direction of the specimens, the material breaks at lower stress and unit deformation values since the stress occurs on the adhesion surfaces between the layers in the experiments performed in the printing directions perpendicular to the force. The same situation was also observed in the 3-point bending test.

Keywords: 3D Printer, Additive Manufacturing, Ultem 9085, Finite Element Analysis

MARTENZİTİK PASLANMAZ ÇELİKLERİN LAZER DOLGU KAYNAĞINDA ÖRTÜŞME ORANININ KALINTI GERİLMEME ETKİSİ (60)

Meryem ALTAY, *meryemaltay@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa

Hakan AYDIN, *hakanay@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa

Adem KARŞI, *akarsi@coskunoz.com.tr* Coşkunöz Ar-Ge Merkezi, 16140, Bursa

ÖZET

Lazer dolgu kaynağı, kalıp sektöründe onarım uygulamalarına yönelik bir eklemeli imalat yöntemlerinden biridir. Yüksek ilerleme hızı ve yüksek kaplama verimliliği özelliklerine sahiptir. Büyük parçaların onarımı için lazer ışınının üst üste binmesini gerektiren çok katmanlı üretim gerekmektedir. Kaplama katmanındaki kalıntı gerilme, kaplama katmanının mekanik ve fiziksel özelliklerini doğrudan etkileyerek çatlak kusurlarına neden olmaktadır. Kalıntı gerilme oluşum mekanizmaları oldukça karmaşıktır ve deformasyon üzerinde büyük etkisi olduğu için araştırılması gerekmektedir. Bu çalışmada, FGS600-3A küresel grafitli dökme demir üzerine 42C martenzitik paslanmaz çelik toz malzeme lazer kaplama teknolojisi ile kaplanmıştır. Kaynak parametreleri lazer gücü için 1,3 kW ve ilerleme hızı için 8 mm/s olacak şekilde sabit tutularak, 3 katmanlı üretim gerçekleştirilmiştir. Örtüşme oranı %20 - %50 - %80 arasında değiştirilmiştir; bu da 2.4 mm, 1.5 mm ve 0.6 mm'ye karşılık gelmektedir. Farklı bindirme oranlarına sahip kaplama katmanlarındaki kalıntı gerilme ölçümü XRD yöntemi ile, kaplama yönüne göre 0°, 45°, 90° olacak şekilde, maksimum ve minimum asal gerilme için gerçekleştirilmiştir. Sonuçlar, kaplama yönünün 0° ölçümlerinde, ısı girdisi azalırken örtüşme oranı arttığında, nispeten düşük düzeyde kalıntı çekme gerilimi oluştuğunu göstermektedir. Artan enerji girdisi ile örtüşme oranı azaldıkça kalıntı gerilmeler bama gerilmelerine dönüşür. Kaynak ilerlemesine dik (90°) doğrultudaki kalıntı gerilmeler incelendiğinde; tüm numunelerde basma kalıntı gerilmelerinin etkili olduğu görülmüştür. Örtüşme mesafesi değeri azaldıkça (enerji girişinin artmasıyla birlikte) gerilimin değeri de azalmıştır. 45° kalıntı gerilme ölçümünde ise tüm numunelerde basma kalıntı gerilmelerinin etkili olduğu görülmektedir. Farklı örtüşme oranları için yapılan bu çalışma endüstriyel kalıpların onarım uygulamaları için uygun örtüşme oranının belirlenmesine yönelik deneysel bir çıktı sağlamaktadır.

Anahtar Kelimeler: Lazer Dolgu Kaynağı, Örtüşme Oranı, Kalıntı Gerilme

ABSTRACT

Laser cladding is one of the additive manufacturing methods for repair applications in the mold industry. It is used in the repair of large parts in the mold industry thanks to its high scanning speed and high coating efficiency features. Residual stresses occurring in the coating layer can create deformation and cause crack defects, so it needs to be investigated. In this study, 42C martensitic stainless steel powder material was coated on FGS600-3A ductile cast iron with laser cladding technology. By keeping the welding parameters constant as 1.3 kW for laser power and 8 mm/s for feed speed, 3-layer production was carried out for different overlap rates. The overlap ratio was varied from 20% to 50% to 80%; which corresponds to 2.4 mm, 1.5 mm and 0.6 mm. Residual stress measurement in coating layers with different overlap ratios was carried out by the XRD method for at 0°, 45°, 90°, maximum and minimum principal stress depending on the coating direction. The results show that at 0° measurements of the coating direction, relatively low levels of residual tensile stress are developed as the overlap ratio increases while the heat input decreases. As the overlap ratio decreases with increasing energy input, residual stresses turn into compressive stresses. It was observed that compressive residual stresses were effective in all samples in the direction perpendicular (90°) to the welding progress. As the overlap distance value decreased, the stress value also decreased. In the 45° residual stress measurement, it is seen that compressive residual stresses are effective in all samples. This study provides an experimental output to determine the appropriate overlap ratio for repair applications of industrial molds.

Keywords: Crash Analysis, Crash Box, Advanced High-Strength Steels

TEMASSIZ ENERJİ SİSTEMİ İLE ÇALIŞAN 70 TON TRANSFER ARABASI (13)

Yalçın GÜLER, *yalcin.guler@kumsan.com.tr*, KM Kümsan Vinç Sistemleri, 41455, Kocaeli

Mehmet KOÇHİSARLI, *mehmet.kochisarli@kumsan.com.tr*, KM Kümsan Vinç Sistemleri, 41455, Kocaeli

Aydoğan AKÇA, *aydogan.akca@kumsan.com.tr*, KM Kümsan Vinç Sistemleri, 41455, Kocaeli

Ece KARSLI, *ece.karsli@kumsan.com.tr*, KM Kümsan Vinç Sistemleri, 41455, Kocaeli

Engin TEKİN, *engin.tekin@kumsan.com.tr*, KM Kümsan Vinç Sistemleri, 41455, Kocaeli

Sibel SAİN ÖZDEMİR, *sibel.ozdemir@alpdanismanlik.com.tr*, Alp İnovasyon ve Danışmanlık Hiz. Ltd. İstanbul

ÖZET

Ağır yük istiflenen çelik servislerindeki yüklerin yatay şekilde ray hattı boyunca taşınmasını sağlayan, bunu yaparken temassız enerji sistemini kullanan bir transfer arabası tasarlanmıştır. Böylece mevcut sisteme göre enerji verimliliğinin %50 artırılması, temassız enerji sistemi kullanıldığından %80 daha uzun ömürlü olması ve transfer arabası üzerindeki kablo karmaşıklığı önlenerek alan avantajı sağlanması amaçlanmıştır.

70 ton transfer arabası, endüstriyel tesislerde (demir-çelik, maden, liman ve tersane vb. endüstrilerde) ağır malzeme taşıma işlemlerinde kullanılan büyük taşıma araçlarından biridir. Bu transfer arabaları genellikle elektrikli, hidrolik veya pnömatik güç sistemleriyle çalışır. Elektrikli modeller genellikle kablolu/akülü olabilir ve uzun mesafelerde taşıma işlemlerini gerçekleştirebilirler. Hidrolik sistemler, yüksek basınçlı sıvıların kaldırılması/taşınmasında çalışırken, pnömatik sistemler basınçlı havayla hızlı ve hassas taşıma işlemlerine kullanılır.

Bu araçlar raylar üzerinde hareket eder ve programlanabilir kontrol sistemleriyle yönlendirilir. Böylece, belirli bir rotada otomatik olarak hareket edebilir ve yükleri istenilen konumlara taşıyabilirler. Ayrıca, güvenlik sensörleri ve acil durdurma sistemleri gibi önlemlerle donatılmış olabilirler.

Anahtar Kelimeler: Ağır Yük Transfer Arabası, Tasarım, Enerji Verimliliği, Temassız Enerji Sistemi

ABSTRACT

A transfer car has been designed that allows the loads in heavy-duty stacked steel services to be transported horizontally along the rail line, using a contactless energy system. Thus, it is aimed to increase energy efficiency by 50% compared to the current system, to have an 80% longer lifespan since the contactless energy system is used, and to provide space advantage by preventing the cable complexity on the transfer car.

70 tons transfer car is one of the large transportation vehicles used in heavy material transportation operations in industrial facilities (iron-steel, mining, port and shipyard etc. industries). These transfer cars usually operate with electric, hydraulic or pneumatic power systems. Electric models can often be corded/battery powered and can carry long distances. While hydraulic systems work in lifting/transporting high pressure liquids, pneumatic systems are used for fast and precise transportation operations with compressed air. These vehicles move on rails and are guided by programmable control systems. Thus, they can automatically move along a specific route and transport loads to desired locations. They may also be equipped with measures such as safety sensors and emergency stop systems.

Keywords: Heavy Duty Transfer Cart, Design, Energy Efficiency, Contactless Energy System

YÜKSEK HACİMLİ TALAŞ KALDIRMA KAPASİTESİNE SAHİP FREZE TEZGAHI İÇİN TAKIM DEĞİŞTİRME SİSTEMİNİN GELİŞTİRİLMESİ (79)

Can TUNCER, *can.tuncer@gri.com.es*, Gesbey Enerji Türbini Kule Üretim San. ve Tic. A.Ş., 10680, Balıkesir

Talat Yiğit GENCEL, *talatyigit.gencel@gri.com.es*, Gesbey Enerji Türbini Kule Üretim San. ve Tic. A.Ş., 10680, Balıkesir

Enver YALÇIN, *eyalcin@balikesir.edu.tr*, Balıkesir Üniversitesi, 10145, Balıkesir

Ali ORAL, *a.oral@balikesir.edu.tr*, Balıkesir Üniversitesi, 10145, Balıkesir

ÖZET

Günümüzde CNC tezgahlarda kullanılmakta olan farklı yapılarda otomatik takım değiştirme sistemleri mevcuttur ve bu sistemler takım değiştirme sürelerinin minimize edilmesiyle imalat sürelerinin kısaltılmasına odaklanmıştır. İmalatta, süreçlerin en iyi şekilde yönetilmesi ve kaynakların verimli kullanılması günümüzün rekabetçi ortamında ayakta kalabilmenin en önemli parametreleridir. Bu çalışmada bir pasoda 30 mm kaynak ağzı açmak amacıyla geliştirdiğimiz otomatik kaynak ağzı açma makinesi takım değiştirme sistemi geliştirilmiştir. Geliştirilen tezgahta kullanılan takım tutucu boyutlarının ve kütlelerinin geleneksel takımlara göre büyük oluşuna paralel olarak, otomatik takım değiştirme sistemi büyük takım tutucuların insan gücüyle değiştirilmesindeki ergonomik zorluklar ve hızlı takım değiştirme ihtiyacı nedeniyle terzi usulü-tezgaha özel takım değiştirme sistemi geliştirilmiştir.

Anahtar Kelimeler: Otomatik Takım Değiştirici, Takım Değiştirici, Takım Tutucu

ABSTRACT

Today, there are automatic tool change systems having different structures used in CNC machines, and these systems are focused on shortening production times by minimizing tool change times. In manufacturing, the best management of processes and efficient use of resources are the most important parameters of surviving in today's competitive environment. In this study, the automatic beveling machine tool change system, which we developed in order to open a 30 mm bevel in a pass, was developed. In parallel with the large size and mass of tool holders used in the developed machine compared to traditional tools, the automatic tool change system has been developed as a tailor-made tool-specific tool changing system due to the ergonomic difficulties in replacing large tool holders with manpower and the need for fast tool change.

Keywords: Automatic Tool Changer, Tool Changer, Tool Holder

SİSTEMATİK KONSTRÜKSİYON YAKLAŞIMIYLA LİNEER RAY TAPASI MONTAJ APARATI TASARIMI (85)

H. Aytuğ KURT, *hasankurt@yilmazmachine.com.tr* Yılmaz Makine, R&D
Department, 41455, Kocaeli, Türkiye

Alper YETER, *alperyeter@yilmazmachine.com.tr* Yılmaz Makine, R&D Department,
41455, Kocaeli, Türkiye

Mustafa BAKKAL, *bakkalmu@itu.edu.tr* Istanbul Technical University, 34367,
İstanbul, Türkiye.

ÖZET

Bu çalışmada, lineer rayların montaj deliklere takılan plastik tapaların kontrollü ve standart şekilde montajlanabilmesi için Sistematik Konstrüksiyon Yöntemiyle özel bir aparat tasarlanıp üretilmiştir. Tasarlanan aparat, ray tapalarının geleneksel metoda göre daha hızlı ve kaliteli çıkılmasını sağlamış, aynı zamanda malzeme tasarrufu sağlamıştır. Yapılan 3 öздеş 1 metrelik rayda 17 adet tapanın montaj süresi ölçülmüş, aparatsız 8,058 saniye/tapa; aparatlı olarak ise 3,23 saniye/tapa olarak ölçülmüştür. Ayrıca aparatsız, 51 tapa montajında 11 adet fire verilmiştir. Aparatla yapıldığındaysa fire oluşmamıştır.

Sonuç olarak, bu teknikle yapılan tasarımların daha verimli ve yenilikçi olduğu görülmüştür. İlaveten bu teknikle sadece portatif aparatların değil aynı zamanda diğer makinelerin de tasarlanabileceği anlaşılmıştır.

Anahtar Kelimeler: Lineer Ray, Lineer Kızak, Lineer Araba, Plastik Tapa, Sistematik Konstrüksiyon.

ABSTRACT

In this study, a special apparatus was designed and manufactured by Systematic Construction Method for controlled and standardized installation of plastic plugs inserted into the mounting holes of linear rails. The designed apparatus provided faster and higher quality fastening of the rail plugs compared to the traditional method, and at the same time saved material. The installation time of 17 plugs in 3 identical 1 metre rail was measured and it was measured as 8,058 seconds/tap without apparatus and 3,23 seconds/tap with apparatus. In addition, without apparatus, 11 wastage was given in the assembly of 51 plugs. There was no wastage with apparatus. As a result, it was seen that the designs made with this technique are more efficient and innovative. In addition, it is understood that not only portable apparatus, but also other machines can be designed with this technique.

Keywords: Linear Rail, Linear Guide, Linear Carriage, Plastic Plug, Systematic Construction.

BÜYÜK BOYUTLU FREZE TEZGAHLARI İÇİN HİDROLİK DÖNER-İŞ BAĞLAMA SİSTEMİNİN GELİŞTİRİLMESİ (96)

Mehmet UĞUR *mehmet.ugur@genba.com.tr*, Genba Group, 10100, Balıkesir, Turkey

Talha GİRĞİN *Talha.girgin@genba.com.tr*, Genba Group, 10100, Balıkesir, Turkey

O.Talha DİNÇER *talha.dincer@genba.com.tr*, Genba Group, 10100, Balıkesir, Turkey

Cengiz OĞUZER *cengiz.oguzer@genba.com.tr*, Genba Group, 10100, Balıkesir, Turkey

Ali ORAL *a.oral@balikesir.edu.tr* Balıkesir Üniversitesi, 10145, Balıkesir, Turkey

ÖZET

Rüzgar türbin kulesi gibi çok büyük kütlelere sahip yapıların imalatları için büyük ölçekli imalat makineleri kullanılmaktadır. Büyük boyutlu ve büyük kütleli asimetrik iş parçaları genellikle portal freze gibi büyük tezgahlarda işlenmektedir. Bu parçaların imatları esnasında yine büyük iş bağlama ve döndürme sistemlerine ihtiyaç duyulmaktadır. Talaşlı imalat işlemlerinin gerçekleştirilebilmesi için iş bağlama aparatlarıyla parçanın serbestlik derecesi kısıtlanarak parça sabitlenmekte ve ardından talaş kaldırma işlemleri yapılmaktadır. Tezgah tablasına sabitlenen iş parçaları, genellikle bir bağlamada işlenememekte ve çoğunlukla tezgah tablası üzerinde döndürülmektedir. Bu tür iş parçalarını döndürmek için ise vinç ve benzeri yardımcı kaldırma-taşıma araçları kullanılmaktadır. İş parçalarının vinç ile kaldırılıp döndürülmesi esnasında ergonomik problemler, iş sağlığı ve güvenliği riskleri oluşmaktadır. Ayrıca, iş parçası döndürüldükten sonra parça üzerinde tekrar referans noktaların belirlenmesi gereklidir.

Geliştirilen döndürme ve konumlandırma sistemi iş parçasının tüm yüzeyleri üzerinde işlem yapılmasına olanak sağlayacaktır. Bu amaçla öncelikle tezgah tablası üzerinde bulunan iş parçası, hidrolik tahrikli hareketli çeneler ile kavranır. Çeneler arasındaki parça, dönmenin sağlanabileceği yüksekliğe hidrolik silindirler ile çıkarılır ve istenilen açıda dönme (90°-180°) sağlandıktan sonra tekrar tabla üzerine yerleştirilir. Hareketli çeneler parçayı serbest bırakarak park konumuna geçerler ve parçanın işlenmesine başlanır.

Bu çalışmada, büyük kütleli iş parçalarının bir freze tezgahı üzerinde otomatik olarak döndürülmesini ve konumlandırılmasını sağlayacak yenilikçi bir hidrolik tahrikli bir iş bağlama sistemi geliştirilmiştir. Geliştirilen sistem ile geleneksel olarak vinçler ile yapılan kaldırma, döndürme ve konumlandırma işlemleri esnasında iş güvenliği riskleri ortadan kaldırılmış ve tekrar referanslandırma yapılmasına olan gereksinim ortadan kaldırılmıştır.

Anahtar Kelimeler: İş bağlama sistemleri, ergonomik problemler, döner eksenli iş bağlama mekanizması

ABSTRACT

Large-scale manufacturing machines are used for the manufacture of structures with very large masses, such as wind turbine towers. Asymmetrical workpieces with large sizes and large masses are usually machined on large machines such as gantry mills. During the production of these parts, large work clamping and rotation systems are also needed. In order to carry out machining operations, the part is fixed by restricting the degree of freedom of the part with work clamping apparatus and then machining operations are performed. Workpieces fixed to the machine table are usually not machined in a clamping and are often rotated on the machine table. In order to rotate such workpieces, cranes and similar auxiliary lifting-transport vehicles are used. Ergonomic problems, occupational health and safety risks occur during the lifting and turning of workpieces with a crane. In addition, after the workpiece has been rotated, it is necessary to determine the reference points on the part again.

The developed rotation and positioning system will allow processing on all surfaces of the workpiece. For this purpose, first of all, the workpiece on the table is grasped by hydraulically driven movable jaws. The piece between the jaws is raised by hydraulic cylinders to the height where rotation can be achieved, and after rotation at the desired angle (90° - 180°) is achieved, it is placed back on the table. The moving jaws release the part, move to the parking position, and the part is started to be processed.

In this work, an innovative hydraulically driven work clamping system has been developed that will enable automatic rotation and positioning of large-mass workpieces on a milling machine. With the developed system, occupational safety risks have been eliminated during lifting, rotating and positioning operations traditionally performed with cranes and the need for re-referencing has been eliminated.

Keywords: Work Clamping Systems, Ergonomic Problems, Rotary Axis Work Holding Mechanism

İNCE CİDARLI ÇELİK TÜBÜLER DİREKLERİN DİNAMİK PERFORMANSI ÜZERİNE PASİF SARKAÇ AYARLI KÜTLE SÖNÜMLEYİCİLERİN ETKİLERİNİN DENEYSEL İNCELENMESİ (5)

Sertaç ÖZDEMİR, *seozdemir@etu.edu.tr* TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Rafet AKTEPE, *rafet.aktepe@hacettepe.edu.tr* Hacettepe Üniversitesi, 06800, Ankara

Alper ALDEMİR, *alperaldemir@hacettepe.edu.tr* Hacettepe Üniversitesi, 06800, Ankara

Erdem ACAR, *acar@etu.edu.tr* TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

ÖZET

İnce cidarlı çelik tübüler (İCÇT) direkler, sismik aktiviteler ve özellikle meteorolojik olaylar nedeniyle oluşan titreşimler sonucu büyük genliklerde döngüsel yer değiştirmeler yaşayabilir. İCÇT direklerinin hizmet ömrünü ve üzerine monte edilen ekipmanların performansını artırmak için, bu direkler aşırı titreşimlerden korunmalıdır. Bu çalışma, İCÇT direği üzerine monte edilen pasif sarkaç ayarlı kütle sönümleyicilerin (P-SAKS) performansını araştırmak için kapsamlı bir deneysel çalışma sunmaktadır. P-SAKS'lı ve P-SAKS'sız İCÇT direkleri için yapılan serbest titreşim testleri, üç farklı başlangıç uç deplasman genliği kullanılarak gerçekleştirilmiştir. Ayrıca ortam titreşim testleri gerçekleştirilmiştir. Dinamik performanslar, yer değiştirme ve ivme tepkileri üzerinden işlemsel modal analiz (İMA) yöntemleri ile değerlendirilmiştir. Deneylerden elde edilen sonuçlar, P-SAKS'ın titreşimleri etkin bir şekilde azalttığını ve İCÇT direklerinin çeşitli uyarımlar altında dinamik performansını iyileştirdiğini göstermektedir.

Anahtar Kelimeler: Titreşim Kontrolü, Pasif Sarkaç Ayarlı Kütle Sönümleyici, Çelik Direk

ABSTRACT

Thin-walled steel tubular (TWST) poles may undergo significant cyclic displacements due to vibrations caused by seismic activities and especially meteorological events. To enhance the service life of TWST poles and improve the performance of mounted equipment, these poles need protection from excessive vibrations. This study presents a comprehensive experimental study to investigate the performance of passive pendulum-tuned mass dampers (P-TMD) mounted on TWST poles. Free vibration tests were conducted on TWST poles with and without P-TMD, using three different initial end displacement amplitudes. Additionally, ambient vibration tests were performed. The dynamic performances were evaluated using operational modal analysis (OMA) techniques based on displacement and acceleration responses. The results obtained from the experiments demonstrate that P-TMD effectively reduces vibrations and enhances the dynamic performance of TWST poles under various excitations

Keywords: Vibration Control, Passive Pendulum Tuned Mass Damper, Steel Pole

MONTAJ TAKIM ÜRETİM HATTI İÇİN SÜRE TAKİP VE İŞ ÇİZELGELEME MODELİ (7)

Fatma İkra AKYEL, *ikraakyel1977@gmail.com*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Ataberk Ceyhan BALCI, *ataberkceyhun@outlook.com*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Mustafa Erdi CANAN, *m.canan@etu.edu.tr*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Ayşe Melisa ÖZDEMİR, *ayseemelisa33@gmail.com*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Enes ÖZTÜRK, *enesozturk@etu.edu.tr*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Ece ZERAY, *ecezeray@gmail.com*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

Serdar YURDUSEVEN, *serdar.yurduseven@tai.com.tr*, TUSAŞ Türk Havacılık ve Uzay Sanayii A.Ş., 06980, Ankara

Ayşenur KALMAZ, *aysenur.kalmaz@tai.com.tr*, TUSAŞ Türk Havacılık ve Uzay Sanayii A.Ş., 06980, Ankara

Turgay ÖZTÜRK, *tuozturk@tai.com.tr*, TUSAŞ Türk Havacılık ve Uzay Sanayii A.Ş., 06980, Ankara

Nilgün FESCİOĞLU ÜNVER, *nfunver@etu.edu.tr*, TOBB Ekonomi ve Teknoloji Üniversitesi, 06560, Ankara

ÖZET

Montaj takımları, imalat süreçlerinde ana parçaları bir araya getirme işlemi için özel olarak tasarlanan ve kullanılan yardımcı fişktürlerdir. Her montaj takımının isterleri kullanılacağı yere göre değışiklik gösterdiği için üretim süreleri büyük farklılık göstermekte ve süreler tecrübeye dayalı olarak yaklaşık şekilde tahmin edilebilmektedir. Bir montaj takımının üretiminde ya da bakımındaki plansız gecikme, proje takviminin aksamasına neden olabilmekle birlikte bazı durumlarda projeyi dahi durdurabilmektedir. Mevcut durumda tüm montaj takımlarına, projenin belirli kriterlerine göre bir öncelik skoru tanımlanmıştır. Montaj takım üretim çizelgelemesinin proje önceliklerini değerlendirerek gerçeğe yakın sürelerde yapılması gerekir. Bu çalışmada TUSAŞ Türk Havacılık ve Uzay Sanayii A.Ş.'nin Takım Üretim Bölümü için montaj takımı üretim emirlerinin iş süresi takip ve tahmini ve iş

izelgeleme optimizasyonu iin bir karar destek sistemi sunulmaktadır. nerilen modelle planlama srelerinde %83 oranında zamandan kazanç ve tamamlanan takım emirlerinin ncelik skorlarının toplamında %20 oranında artış saėlanmıřtır.

Anahtar Kelimeler: retim Planlama, İř izelgeleme

ABSTRACT

Assembly tools are auxiliary fixtures that are specially designed and used to assemble main parts in manufacturing processes. Since the requirements for each assembly tool vary according to the location where it will be used, production times vary widely and can be approximated based on experience. Unplanned delays in the production or maintenance of an assembly tool can disrupt the project schedule and, in some cases, even stop the project. Currently, all assembly tools have a priority score defined according to certain criteria of the project. Assembly tool production scheduling needs to be done in realistic times by evaluating the project priorities. This study presents a decision support system for the Tool Production Department of TUSAř Turkish Aerospace Industries Inc., for assembly tool production order tracking, work time prediction, and job schedule optimization. The proposed model has achieved a time-saving of 83% in planning processes and a 20% increase in completed tool order priority scores.

Keywords: Production Planning, Job Scheduling,

AKILLI MÜCEVHERLERDE İNOVASYON: TEKNOLOJİ VE TASARIMIN BİRLEŞİMİ (55)

Sevban AKIN, *akinsevban@gmail.com*, Mimar Sinan Güzel Sanatlar Üniversitesi,
34427, İstanbul

Hüseyin Özkal ÖZSOY, *ozkal.ozsoy@msgsu.edu.tr*, Mimar Sinan Güzel Sanatlar
Üniversitesi, 34427, İstanbul

ÖZET

Bu bildiri, estetik ve teknolojinin buluştuğu akıllı mücevherleri kapsamlı bir şekilde incelemektedir. Giyilebilir teknolojiler hızla gelişerek günlük yaşamın bir parçası haline gelmiştir. Akıllı mücevherler hem estetik hem de fonksiyonel özellikleriyle büyük ilgi çekmektedir. Çalışmamızda, akıllı mücevherlerin tanımı, tarihsel gelişimi, teknolojik bileşenleri ve işlevleri ele alınacaktır. Ayrıca, tasarım ilkeleri, malzeme seçimi ve modayla entegrasyon tartışılacak; gelecekteki potansiyel gelişimler ve kullanıcı beklentileri değerlendirilecektir. Bu bildiri, tasarımcılar ve mühendisler için önemli öngörüler sunmayı amaçlamaktadır.

Anahtar Kelimeler: Akıllı Mücevher, Giyilebilir Teknoloji, Estetik ve Fonksiyonellik

ABSTRACT

This paper comprehensively examines smart jewellery where aesthetics and technology meet. Wearable technologies have developed rapidly and have become a part of daily life. Smart jewellery attracts great interest with both aesthetic and functional features. Our study will discuss the definition, historical development, technological components and functions of smart jewellery. Furthermore, design principles, material selection and integration with fashion will be discussed; potential future developments and user expectations will be evaluated. This paper aims to provide important insights for designers and engineers.

Keywords: Smart Jewelry, Wearable Technology, Aesthetics and Functionality

ELEKTRİKLİ TAŞITLARDA BATARYA TAŞIYICISINA FARKLI LOKASYONLARDAN ALTTAN ÇARPMANIN ÇARPIŞMA PERFORMANSINA ETKİSİ (66)

Burak AYDOĞDU, *burakaydogdu@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa, Türkiye

M. Kıvanç TURAN, *mkivancturan@metu.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa, Türkiye

Fatih KARPAT, *karpat@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa, Türkiye

Necmettin KAYA, *necmi@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa, Türkiye

ÖZET

Günümüzde elektrikli taşıtların kullanım oranının her geçen gün arttığı gözlenmektedir. İçten yanmalı motorlu taşıtlarda olduğu gibi, elektrikli araçlarda da çarpışma güvenliği önemli bir faktördür. Ancak elektrikli araçlarda çarpışma güvenliği standartları henüz tam olarak belirlenmemiştir. Firmalar kendi standartlarını geliştirmekte ve tasarım doğrulama çalışmalarını sanal olarak gerçekleştirmektedirler. Elektrikli araçların altında yer alan batarya taşıyıcı da çarpışma güvenliği açısından doğrulanması gereken en önemli bileşenlerden birisidir. Çok farklı çarpışma durumları için doğrulama gerekli olmakla beraber en önemli senaryolardan birisi de alttan darbe alınması durumudur(engel çarpması). Bu çalışmada küp geometrisine sahip bir bloğun, batarya taşıyıcısına farklı lokasyonlardan alttan çarpmasının etkileri ele alınmıştır. Çalışma nümerik olarak gerçekleştirilmiş olup sonlu elemanlar yöntemi için yazılım olarak Abaqus tercih edilmiştir. Çalışma neticesinde çarpma lokasyonunun değişiminin gerilme ve deformasyon üzerinde kayda değer etkileri olduğu gözlenmiştir. Bu sebeple batarya taşıyıcısı tasarımcılarının bölgesel iyileştirmeli tasarımlar yapması gerektiği söylenebilir.

Anahtar Kelimeler: Elektrikli Taşıt, Batarya Taşıyıcı, Alttan Çarpma, Sonlu Elemanlar Yöntemi

ABSTRACT

Nowadays, it is observed that using ratio of electric vehicles is increasing day by day. Like for internal combustion engine vehicles, crash safety is an important factor for electric vehicles. However, crash safety standards have not yet been determined. Companies are developing their own standards and performing design verification studies virtually. The battery enclosure located under the electric vehicle is also one of the most important components that needs to be verified for crash safety. While verification is required for many different crash situations, one of the most important scenarios is the case of a crash from under (obstacle crash). In this study, the effects of the obstacle crash of a cube object from different locations to battery enclosure. The study was carried out numerically, and Abaqus was preferred as finite element method software. As a result of the study, it was seen that impact location has notable effects on stress and deformation. For this reason, it can be said that battery enclosure designers should make regionally improved designs.

Keywords: Electric Vehicle, Battery Enclosure, Obstacle Crash, Finite Element Method

KARBON FİBER DESTEKLİ KOMPOZİT İLE ALÜMİNYUM ALAŞIMININ YÜZEY ENERJİLERİNİN İNCELENMESİ (94)

Y. Emre NEHRİ, *yunusnehri@balikesir.edu.tr* Balıkesir University, 10145, Balıkesir, Turkey

Kadir ÇAVDAR, *cavdar@uludag.edu.tr* Bursa Uludağ University, 16059, Bursa, Turkey

Ali ORAL, *a.oral@balikesir.edu.tr*, Balıkesir Üniversitesi, 10145, Balıkesir

ÖZET

Cıvata ve perçin gibi mekanik bağlantı yöntemlerinin dezavantajlarından dolayı yapıştırma işlemleri son yıllarda ön plana çıkmaktadır. Yapıştırma işleminde yapıştırılacak olan parçaların yüzey enerjilerinin yüksek olması yapıştırıcının yüzeye iyi bir şekilde tutunmasını sağlamaktadır. Bu çalışma karbon fiber destekli polimer kompozit ve alüminyum alaşımı malzemenin yapıştırma işlemi üzerinedir. Yapıştırıcının yüzeye iyi tutunması bağlantının dayanımının yüksek olmasını sağlamaktadır. Yüzeyler üzerine yüzey enerjisini ve ıslanabilirliğini artırmak için sıcak plazma uygulanmış ve böylelikle yüzeylerin ıslanabilirliği araştırılmıştır. Çalışmada, yanıt yüzey metodu ile oluşturulan deney tasarımına bağlı olarak 13 deney yapılmıştır. Herbir yüzey için ayrı ayrı uygulanan plazma işleminde su damlası deney sonuçları temas açılarında büyük oranda azalma olduğunu göstermektedir. Bu deneysel çalışma sonuçlarına göre sıcak plazma işleminin yüzey enerjisi üzerinde etkin olduğu değerlendirilmiştir.

Anahtar Kelimeler: Yüzey Islanabilirliği, Temas Açısı, Yanıt Yüzey Metodu

ABSTRACT

Due to the disadvantages of mechanical connection methods such as bolts and rivets, bonding processes have come to the fore in recent years. The high surface energy of the parts to be bonded in the bonding process ensures that the adhesive adheres well to the surface. This study is on the bonding process of carbon fiber supported polymer composite and aluminum alloy material. The good adhesion of the adhesive to the surface ensures that the strength of the connection is high. Hot plasma was applied on the surfaces to increase the surface energy and wettability, thus investigating the wettability of the surfaces. In the study, 13 experiments were performed depending on the experimental design created by the response surface method. The results of the water drop test in the plasma treatment applied separately for each surface show that there is a significant reduction in contact angles. According to the results of this experimental study, it was evaluated that hot plasma treatment was effective on surface energy.

Keywords: Surface Wettability, Contact Angle, Response Surface Method

ÜRÜN DOĞRULAMA VE SAHA TESTLERİNDE KULLANIMA YÖNELİK ANDROID TABANLI CANLI VERİ TOPLAMA ARAYÜZÜ GELİŞTİRME (39)

Sedat TARAKÇI, *s.tarakci@tirsankardan.com.tr* Tirsan Kardan A.S, 45030, Manisa

Oğuzhan ALDEMİR, *o.aldemir@tirsankardan.com.tr* Tirsan Kardan A.S, 45030, Manisa

Efe IŞIK, *e.isik@tirsankardan.com.tr* Tirsan Kardan A.S, 45030, Manisa

ÖZET

Otomotiv endüstrisinde araç üzerindeki sensörlerden veri toplama ihtiyacı gün geçtikçe artmaktadır. Kardan mili gibi dinamik parçalar üzerinden de araç testleri sırasında anlık olarak veri toplanmaktadır. Bu kapsamda, sensörler veya veri toplama sistemlerinden gelen verilerin gözlemlenebilmesi amacıyla veri izleme yazılımı ihtiyacı oluşmaktadır.

Bu çalışma kapsamında, kara taşıtları saha testlerinde dinamik aktarma organları üzerinden veri toplanması amacıyla geliştirilmiş bir ölçüm sisteminden gelen farklı tipteki gerçek zamanlı verilerin izlenebileceği android tabanlı bir kullanıcı arayüzü geliştirilmesi amaçlanmıştır. Geliştirilen veri izleme arayüzü yazılımının, saha testlerinde elde edilen tüm verileri cep telefonu veya tablet gibi mobil cihazlar üzerinden okunmasına yönelik kullanılması amaçlanmıştır.

Anahtar Kelimeler: Veri toplama, Kullanıcı arayüzü, android uygulama

ABSTRACT

In the automotive industry, the need to collect data from sensors on the vehicle is increasing day by day. Dynamic parts such as cardan shaft are used to collect data instantaneously during vehicle tests. In this context, there is a need for data monitoring software to monitor the data from sensors or data acquisition systems.

Within the scope of this study, it is aimed to develop an android-based user interface to monitor real-time data from a measurement system on dynamic drivetrain components in vehicle field tests. The data monitoring interface is used to read all data obtained in field tests on mobile devices.

Keywords: Data acquisition, Graphical User Interface, Android application

TESTERE MAKİNELERİNDE OLUŞAN KESME KUVVETİNİN İŞ PARÇASI YÜZEY PÜRÜZLÜLÜĞÜ VE KESİM DİKLİĞİNE ETKİSİNİN İNCELENMESİ (29)

Mahmut Berkan ALİSİNOĞLU, *berkan@bekamak.com* Bekamak Ar-Ge Merkezi, 16110, Bursa

Yunus Emre KINACI, *emre.kinaci@bekamak.com* Bekamak Ar-Ge Merkezi, 16110, Bursa

Burak KORKUT, *burak.korkut@bekamak.com* Bekamak Ar-Ge Merkezi, 16110, Bursa

Şekip Esat HAYBER, *sehayber@uludag.edu.tr* Bursa Uludağ Üniversitesi, 16059, Bursa

ÖZET

Talaşlı imalat hatlarının en başında bulunan testere makineleri, kesme işlemini gerçekleştiren makinelerdir. Testere makineleri, ham malzemelerin kesimini yaparak üretim sürecini başlatır. Bu süreçte, ham malzemeler istenilen boy ölçülerinde kesilir ve daha sonra diğer işlem adımlarına geçilir. Bu sebeple, üretim hattının verimliliğini doğrudan etkiler ve imalatla kritik rol oynar. Bu çalışmada, şerit testere makinelerinde yük hücresi kullanılarak kesim işlemi sırasında kesici takıma etkiyen kuvvetler saptanmıştır. Saptanan bu kuvvetlere göre kesme parametreleri gerçek zamanlı güncellenerek kesim süresine, iş parçası yüzey kalitesine ve dikliğine olan etkisi incelenmiştir.

Anahtar Kelimeler: Şerit Testere Makinesi, Yük Hücresi, Kesme Kuvveti

ABSTRACT

Sawing machines, which are at the first of the machining lines, are the machines that perform the cutting process. Sawing machines start the production process by cutting raw materials. Raw materials are cut to the desired length measurements and other steps are taken. Therefore, it directly affects the efficiency of the production line and plays a critical role in manufacturing. In this study, the forces acting on the cutting tool during the cutting process were determined by using a load cell in band saw machines and the cutting parameters were updated in real-time about the detected forces and their effects on the cutting time, workpiece surface quality and perpendicularity were examined.

Keywords: Band Saw Machine, Loadcell, Cutting Force

ALÜMİNYUM 7075 T6 MALZEMESİNİN FREZELENMESİNDE KESME PARAMETRELERİNİN EN İYİLENMESİ (45)

Sinan GÖKÇE, *sinangokce188@gmail.com*, *Paksan Makine Sanayi Tic. AŞ.*, 10600, Balıkesir,

Semin KAYA, *skaya@balikesir.edu.tr* Balıkesir Üniversitesi, 10145, Balıkesir

ÖZET

Bu çalışmada, Al alaşımlarında işleme parametrelerinin en doğru şekilde seçilmesine odaklanılmıştır. Taguchi yöntemi ile belirlenen 9 farklı deney, 3 farklı parametre kullanılarak yapılmıştır. Deneyler sonucunda elde edilen takım yan yüzey aşınmaları ölçülerek kayıt edilmiştir. Oluşturulan deney tasarımı ile alınan ölçüm değerleri değerlendirilmiştir. Bu çalışma sonucunda Al 7075-T6 malzemesi için takım yan yüzey aşınmasına en çok etki eden parametrenin ilerleme olduğu görülmüş, diğer parametrelerde sırasıyla kesme hızı ve talaş derinliği olarak belirlenmiştir.

Anahtar Kelimeler: Frezeleme, Taguchi Yöntemi, Takım Aşınması

ABSTRACT

This study focused on selecting the most accurate processing parameters for Al alloys. 9 different experiments were conducted using the Taguchi method and three different parameters. The tool flank wear obtained from the experiments was measured and recorded. The measurement values obtained from the designed experiments were evaluated. As a result of this study, it was observed that the parameter with the most significant effect on tool flank wear for Al 7075-T6 material was the feed rate, followed by cutting speed and then depth of cut.

Keywords: Milling, Taguchi Method, Tool Wear

SERTLEŞTİRİLMİŞ ÇELİKLERİN FREZELEME İŞLEMLERİNDE KESİCİ TAKIM KARBÜR KALİTESİ VE KAPLAMANIN İŞLEME PERFORMANSINA ETKİSİ (84)

Hasan KUŞ, *h.kus@karcan.com* Karcan Kesici Takım San. ve Tic. A.Ş., 26110, Eskişehir

Çağla GÖKBULUT AVDAN, *c.avdan@karcan.com* Karcan Kesici Takım San. ve Tic. A.Ş., 26110, Eskişehir

Çağlar YAVAŞ, *c.yavas@karcan.com* Karcan Kesici Takım San. ve Tic. A.Ş., 26110, Eskişehir

ÖZET

Sertleştirilmiş çelikler yüksek mukavemetleri ve iyi aşınma direnci nedeniyle kalıpcılık endüstrisinde yaygın kullanılır. Sert işleme, malzemenin yüksek mukavemeti nedeniyle zor bir işlem olarak kabul edilir. Bu çalışma kapsamında; 1.2379 çeliğinin frezeleme işlemleri için geliştirilen kesici takımlarda, karbür kalitesi ve kaplamanın işleme performansına etkisi araştırılmıştır. %8 Co ve %6 Co submicron karbür kalitesi bazında kıyaslanmış, %6 Co kalitenin daha iyi performans gösterdiği görülmüştür. Ardından %6 Co kaliteye (nc-AlTiN)/(a-Si₃N₄), TiSiN, AlTiN-TiSi₃N ve TiAlSiN bazlı kaplamalar uygulanarak sertleştirilmiş çeliklerin işlenmesindeki performansları test edilmiştir. Çalışma sonunda, %6 Co kalite ve Yüksek Güçte Darbeli Magnetron Püskürtme (HiPIMS) teknolojisiyle yapılan TiAlSiN bazlı kaplamanın önerilebileceği sonucuna varılmıştır.

Anahtar Kelimeler: Sertleştirilmiş Çelikler, İşlenebilirlik, Kesici Takım, Kanal Frezeleme, Karbür Hammadde Kalitesi, Kaplama Uygulamaları

ABSTRACT

Hardened steels are widely used in the mold industry due to their high strength and good wear resistance. Hard machining is considered a challenging process due to the high strength of the material. In this study, the impact of carbide quality and coating on the machining performance of cutting tools developed for milling operations of 1.2379 steel was investigated. Submicron carbide qualities containing 8% Co and 6% Co were compared, revealing that the 6% Co quality performed better. Subsequently, (nc-AlTiN)/(a-Si₃N₄), TiSiN, AlTiN-TiSi₃N, and TiAlSiN-based coatings were applied to the 6% Co quality and their performance in machining hardened steels was tested. The study concluded that the 6% Co quality and TiAlSiN-based coating made using High Power Impulse Magnetron Sputtering (HiPIMS) technology could be recommended.

Keywords: Hardened Steels, Machinability, Cutting Tool, Slot Milling, Carbide Material Quality, Coating Applications

AUTHORS INDEX

AUTHORS	Page Number
ACAR, Emre Oğuz	74
ACAR, Erdem	161
ACER, Durmuş Can	101
AKBIYIK, Denizay	122
AKÇA, Aydoğın	153
AKDENİZ, Özgür	131, 133, 134
AKIN, Sevban	165
AKKÖK, Metin	69
AKPINAR, Ece	122
AKSAÇ, İnci	128
AKTEPE, Rafet	161
AKYEL, Fatma İkra	163
AKYILDIZ, Halil İ.	120
AKYILDIZ, Öncü	112
ALDEMİR, Alper	161
ALDEMİR, Oğuzhan	171
ALHAYALİ, Othman J.	100
ALHUMMADA, Noura	97
ALİ, Sultan Abdulazeez	76
ALİSİNOĞLU, Mahmut Berkan	173
ALKAN, Ahmet H.	135
ALMASRI, Yousef	76

AUTHORS	Page Number
ALTAY, Meryem	151
ALTAY, Özkan	108
ALTINTAŞ, Yusuf	45
ANFLOR, Carla	111
ASHIZAWA, Yuya	94
ATAHAN, Ali Osman	78
ATALAY, Kutay	74
AVDAN GÖKBULUT, Çağla	177
AYDIN, Hakan	151
AYDOĞDU, Burak	103, 167
AYYILDIZ, Hanife	81
BAKAN, Aykut	71
BAKKAL, Mustafa	123, 157
BAKRAÇ, Caner	114
BALCI, Ataberk Ceyhun	163
BALDAN, Emre	117
BARANOĞLU, Besim	118
BAUMANN, Jonas	82
BAYAR, Kerem	130
BAYKASOĞLU, Cengiz	112
BAYRAMOĞLU, Melih	132
BESİR, Meliksah	135
BEUDAERT, Xavier	85

AUTHORS	Page Number
BIERMANN, Dirk	82
BİLBAY, Fahri Berk	113
BÜYÜK, Murat	115
BÜYÜKDÖĞERLİOĞLU, Mehmet Can	105
ÇAKIR, Hasan	123
ÇAKIR, Mustafa Cemal	113, 125
ÇALIŞKAN, Hakan	73, 84
CANAN, Mustafa Erdi	163
CANBOLAT, İ. Melih	135
CANKURT, Tolga	126
ÇAPOĞLU, Emre	114
CARBALLO, Rafael Garcia	82
ÇAVDAR, Kadir	169
ÇELİKCAN, Emre	133
ÇETİN, Ahmet	101
ÇETİN, Barbaros	118
ÇETİN, Barış	109, 114, 116, 118
ÇETİNKAYA, Buse	78
ÇETİNKAYA, Onur	143
CEVAHİR, Burak	110
CEYLAN, Çağlar	79
COURTY, Léo	102
DAĞSUYU, Eren	122

AUTHORS	Page Number
DELBARRE, Samuel	102
DEMİR, Damla	122
DEMİRCİ, Ercan	114
DEMİREL ÖZKUTLU, Merve	119, 120
DEMİRELLER, Engin Deniz Ege	74
DİKER, İbrahim	101
DİNÇER, O.Talha	159
DİZECİ, Şehram	107
DÖNERKAYA, Samet	141
DOYMUS, Eren	135
DURMAZ, Hafize	123
ECE, Remzi Ecmel	149
ELAZZAMI, Waleed	76
ELÇİ, Tarik Emre	76
EMİN, Ali	131, 133
EMİR, Ahmet	97
ERKORKMAZ, Kaan	85
EROL, Mustafa	134
ESİ, Mümtaz Afşin	65
FRANCO, Oier	85
FUKASAWA, Yasuji	88
GARİP, Mahmut	97

AUTHORS	Page Number
GENCEL, Talat Yiğit	155
GEREN, Necdet	101, 132
GİRGİN, Talha	159
GLEADALL, Andy	121
GÖDE, Engin	109, 116
GÖKALP, Görkem Anıl	97
GÖKÇE, Sinan	175
GÖKCİLER, O. Cem	101, 132
GÖKLER, Mustafa İ.	70
GÖLBAŞI, Umut Can	139
GÜLER, Özge	125
GÜLER, Yalçın	153
GÜLTEKİN, Mustafa	147
GÜMÜŞ, Ömer Yunus	143
GÜRLER, A. Ali	129
HAKTANIR, Umut B.	133
HASKİLİT, Emre Can	149
HAYAKAWA, Ren	88
HAYBER, Şekip Esat	173
HIRAO, Akinari	91
HIROTA, Sumire	95
HOKKAÖMEROĞLU, Cemal Emre	134
İBEKÇİ, M. Burak	132

AUTHORS	Page Number
İBRAHİMOĞLU, Fatih	107
IHLENFELDT, Steffen	87
İLME, Mert	73
INOUE, Aichi	88
IŞIK, Efe	171
ISMAIL, Abdi M. A.	124
İSMETOĞLU ÇALIŞ, Gökçe	143
JIA, Bao-Guo	86
KAFTANOĞLU, Bilgin	43, 75, 76, 104, 145
KALKAN, Hakan	79, 145, 127
KALMAZ, Ayşenur	163
KANDEMİR, Berkay	133
KARABOĞA, Furkan	119, 120
KARATAŞ, Çetin	143
KARAYAVUZ, Recep	128
KARPAT, Fatih	103, 167
KARPAT, Yiğit	71
KARŞI, Adem	151
KARSLI, Ece	153
KATMER, Şükran	143
KATO, Takeo	88, 89, 92
KAVUT, Kübra	72
KAYA, Necmettin	103, 167

AUTHORS	Page Number
KAYA, Semin	175
KAYALI, Yagiz	121
KENTEL, Behzat Bahadır	127, 128
KHABAZ-AGHDAM, Ata	107
KIDA, Yuki	92, 93
KILIÇ, S. Engin	69, 78
KILKIŞ, Birol	61
KINACI, Yunus Emre	173
KOÇ, Bahattin	55
KOÇHISARLI, Mehmet	153
KONUKSEVEN, E. İlhan	129, 135
KORKMAZ, Habip Gökay	149
KORKUT, Burak	173
KÖSEOĞLU, Nuri Bilgehan	97
KOŞTUR, Eray	119
KÜÇÜKÖZTAŞ, Korcan	74, 77, 79, 104
KURT, Berk	126
KURT, H. Aytuğ	157
KURT, Mustafa	74
KURTULDU, Hüseyin	109
KUŞ, Hasan	177
KUŞHAN, Melih Cemal	109
LAZOĞLU, İsmail	53

AUTHORS	Page Number
LEKESİZ, Hüseyin	106
LİVATYALI, Haydar	105
MATSUOKA, Kei	92
MATSUOKA, Yoshiyuki	91
MEHRTASH, Mehdi	100
MERCAN, Öykü	78
MIYACHI, Hideo	94, 95
MIYASHITA, Tomoyuki	59, 90
MUNOA, Jokin	85
NAMLU, Ramazan Hakkı	72, 78
NATORI, Teru	90
NAZLIER, Umut	133
NEHRİ, Y. Emre	169
OGAN, Tunç	74
OGI, Tetsuro	92, 93
ÖĞÜNÇ, Gökhan İbrahim	109, 116
OĞUZER, Cengiz	159
OKYAY, Salih	78
ONAY, Emre	78
ORAL, Ali	155, 159, 169
ÖRNEK, Murat	78
OTTO, Andreas	87
OYAMA, Shotaro	89

AUTHORS	Page Number
ÖZ, Yahya	119, 120
ÖZBAKIŞ, Murat	139
ÖZBAYOĞLU, A. Murat	108
ÖZBEY, Mehmet Furkan	98
ÖZBOZ, Ö. Dehan	108
ÖZDEMİR, Ayşe Melisa	163
ÖZDEMİR, Sertaç	161
ÖZDEMİR, Sibel SAİN	153
ÖZEN, Sinem	122
ÖZGÜVEN, H. Nevzat	47, 81
ÖZKADER, Mustafa Çağrı	112
ÖZKAN, Abdullah	147
ÖZKAN, Göktürk M.	101
ÖZŞAHİN, Orkun	81
ÖZSOY, Hüseyin Özkal	165
ÖZTÜRK, Enes	163
ÖZTÜRK, Fahrettin	119, 149
ÖZTÜRK, Turgay	163
ÖZTÜRKMEN, Mahide Betül	119
REN, Yuan-Yuan	86
SAĞLAM, Gökhan	114
ŞAHİN, Muzaffer	74
ŞAHİN, Yiğithan	128

AUTHORS	Page Number
SAHU, Govind	87
SALEH, Yousif A.	99
SALİMNEZHAD, Aida	124
SANTANNA, Euclides	111
SARIKAYA, Mehmetcan	78
SARTIN, Karla	111
SAVAŞ, Cihan	117
SAVAŞ, V. Emre	115
SCHÖNECKER, Raphael Isaak Elias	82
ŞEKER, Ulvi	143
ŞEN, Onur	139
ŞENSOY, Emrah	76
SERDAROĞLU, Dilek ÇÖKELİLER	128
SEZER, Barış	127
SHIBANO, Toma	95
SHIMIZU, Yuki	88
SILBERSCHMIDT, Vadim V.	121
ŞİMŞEK, Caner	116
SMOTROVA-KAYALI, Ekaterina	121
SUBAŞI, Levent	70
TANIKAWA, Tomohiro	96
TARAKÇI, Sedat	171
TAV, Abdullah	120

AUTHORS	Page Number
TEKİN, Engin	153
TEKİN, İrem	128
TEOMAN, Atanur	109, 116
TIAN, Hui	86
TİNİŞ, Fuat	63
TOKER, Abidin	114
TOM, Hanife Gülen	72
TONBUL, Kürşat	116
TOROS, Serkan	119, 120, 149
TORUK, Emre	145
TOSUN, Özgür Barış	78
TUNC, Lutfi Taner	83
TUNCER, Can	155
TURAN, M. Kıvanç	167
TURHAN, Çiğdem	104
TURHAN, Cihan	97, 98, 99
UÇAK, Yasin Burak	122
UĞUR, Mehmet	159
UĞURLU, Serhan	128
ULUER, M. Ural	69
ULUSOY, Tuna	122
ÜNAL, H. İbrahim	143
ÜNVER, H. Özgür	108

AUTHORS	Page Number
ÜNVER, Nilgün FESCİOĞLU	122, 163
UYDURAN, Sefa	122
UYSAL, Ö. Faruk	126
UZAY, Çağrı	132
WAN, Min	86
WANG, Charlie C. L.	57
WILLIAM-LOUIS, Mame	102
YALÇIN, Enver	155
YAMAN, Emre	141
YAMAN, Ulaş	69, 70, 110
YANDAYAN, Tanfer	49
YAVAŞ, Ahmet Esat	97
YAVAŞ, Çağlar	177
YAVUZ, ZelaI	119
YETER, Alper	123, 157
YILDIZ, Seda	106
YILMAZ, O. Deniz	117
YILMAZ, Servet	76
YURDUSEVEN, Serdar	163
ZERAY, Ece	163
ZEYREK, Kanay	141