19th INTERNATIONAL CONFERENCE ON MACHINE DESIGN AND PRODUCTION

CONFERENCE PROGRAMME AND BOOK OF ABSTRACTS

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umtik 2022

August 31st -September 03rd 2022

Cappadocia- TÜRKIYE

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

Dedicated to the memory of

Memiş ACAR,
Tibor TÓTH,
Emmanuel O. EZUGWU,
Günter PRITSCHOW,

and of all other IPC members we have lost in previous years.

v

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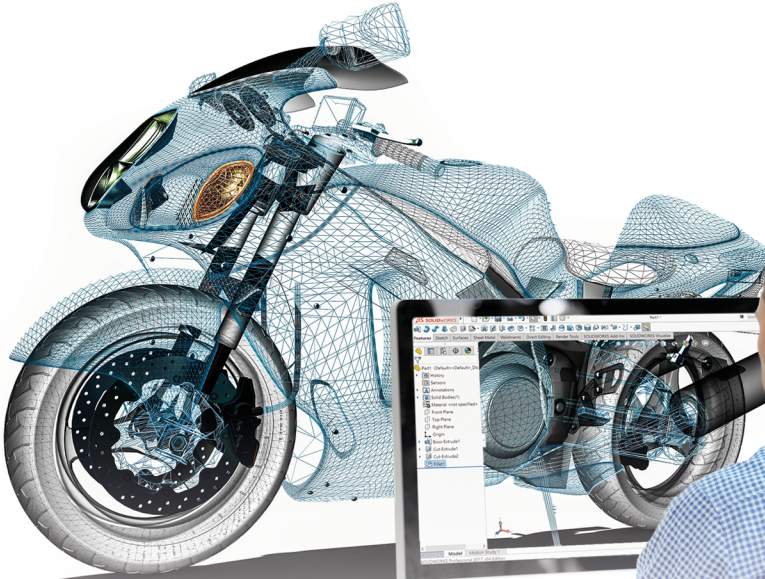
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ARMADA YAZILIM SUNDUĞU ÇÖZÜMLER İLE İŞ ORTAKLARINA HIZ KAZANDIRIYOR

Armada Yazılım, 15 yılı aşkın tecrübesi ile binlerce kullanıcıya mühendislik hizmetleri sağlıyor. Tasarımdan üretime kesintisiz hizmet anlayışını benimseyerek, geleceğin teknolojisini bugünden yakalıyor, farklı projeler ile iş ortaklarının gelişen ihtiyaçlarına uygun çözümler sunarak sizlerle birlikte daha iyi bir gelecek inşa etme yolunda emin adımlarla ilerliyor.

Farklı sektörlerden elde ettiği tecrübelerle, tasarımdan üretime satış sonrası destek ve eğitim konularına kadar çok amaçlı stratejik çözümler sunan Armada Yazılım, ARGE mühendislerinin geliştirdiği yazılımlar ile çözümde hep daha fazlasını sunuyor.

Tecrübeli ve alanında uzman mühendis kadrosu ile marka değerini atılan her adımda daha da yükseltmeyi ve sektördeki liderlik konumunu sürdürmeyi hedefleyen Armada Yazılım, Dassault Systèmes'in dünya çapında en büyük tasarım etkinliği olan 3DEXPERIENCE World etkinliklerinde bugüne kadar aldığı 30'un üzerinde ödüle; bu yıl Bilişim 500 Araştırması'nda "Yılın Sektörel Yazılım" kategori birincilik ödülünü de ekledi. Aldığı ödüller ile yeni başarılara imza atmaya devam ediyor ve başarıda hep daha fazlasını sunmayı hedefliyor.

Ürünler ve Sunduğu Çözümler:

SOLIDWORKS: Kullanıcı dostu arayüzü ve sezgisel çalışma araçlarıyla, yenilikçi ürünler tasarlamanız için mükemmel araçlar sunan SOLIDWORKS ile, ister basit montajlar ister karmaşık tasarımlar üzerinde çalışabilir; daha düşük maliyet ile daha yüksek kalitede ürünler geliştirebilirsiniz.

3DEXPERIENCE: Bulut tabanlı tasarım ve iş birliği platformu 3DEXPERIENCE, tasarımdan imalata bütün operasyon süreçlerini hızlı ve iş birliği içerisinde tek bir platform üzerinden yönetmenizi sağlar. Tasarımlarınızı dilediğiniz yerden, dilediğiniz cihaz üzerinden yönetme kolaylığı sağlaması ile projelerinizi hızlandırır.

DraftSight: Her türlü 2D ve 3D DWG dosyasını kolay, hızlı ve verimli şekilde oluşturmanıza, düzenlemenize, görüntülemenize ve işaretlemenize olanak tanır.

ArmadaWorks: Armada Yazılım tarafından geliştirilen SOLIDWORKS eklentisi bir ürün olan ArmadaWorks, SOLIDWORKS'de tasarımdan imalata giden süreci doğru ve hızlı bir şekilde yönetmenizi sağlar.

hyperMILL: 2.5D, 3D ve 5 eksenli frezelemenin yanı sıra yüksek hızlı kesim ve yüksek performanslı kesim işlemleri için de modüler esnek bir CAM çözümü olan hyperMILL, dünyanın en gelişmiş 5 eksen CAM çözümü özelliğiyle ön plana çıkıyor.

GibbsCAM: Gelişmiş takım yollarıyla, hatasız post processor ile parçaları daha hızlı programlamanız ve işleme süresini kısaltmanız için ihtiyacınız olan bütün araçları sunar.

CAMWorks: Her zaman daha hızlı, sürdürülebilir ve maliyeti düşük tasarımlarla, tasarımdan prototip üretime kadar geçen süreci kolaylaştırır.

Markforged: Dünyada ilk ve tek karbon fiber parçalar basabilen 3D baskı sistemi Markforged, tasarım ile güçlü fonksiyonel parçaların üretimi arasındaki engeli ortadan kaldırabilmek için mühendisleri ve üreticileri güçlendirebilecek printerlar sağlar.

QForm: Metal şekillendirme proseslerinin simülasyonlarını, hızlı ve gerçeğe en yakın şekilde gerçekleştirebileceğiniz profesyonel bir yazılım programı olan QForm ile; tek bir pencerede simülasyonun her adımını inceleyebilir, gerektiği yerde simülasyon parametrelerini düzenleyebilirsiniz.

İş İstasyonları ve Güçlü Donanım Ürünleri:
Lider markalarla olan partner ilişkimiz ile SOLIDWORKS veya diğer 3 boyutlu tasarım yazılımlarda tam hakimiyet kurmanızı sağlayacak iş istasyonları sunuyoruz.

PREFACE

It gives us great pleasure to welcome you to the 19th International Conference on Machine Design and Production which we could finally organize after a two-year delay due to the worldwide outbreak of the Covid 19 pandemic.

When we were about to start planning the UMTIK 2020 Conference after the UMTIK 2018 Conference in Eskişehir, we received the sad news: the death of Professor Memiş Acar due to an aggressive illness on the 8th of August 2018. Memiş was a devoted and active member of the International Program Committee (IPC) of the past UMTIK conferences. He and his wife, Professor Serpil Acar, participated in our conferences and organized numerous events such as special sessions, forums and panels. We then decided to dedicate UMTIK 2020 to the memory of Professor Memiş Acar and to name the first day of the conference "The Commemoration Day of Professor Memiş Acar". Cappadocia University was selected as the venue because Cappadocia was Memiş's hometown.

During the isolation days of the COVID 19 pandemic, we lost three more IPC members: Professor Tibor Toth of Miskolc University, Hungary, Professor Günter Pritschow of the University of Stuttgart, Germany and Professor Emmanuel O. Ezugwu of the Airforce Institute of Technology, Nigeria, whose valuable friendship and contributions to UMTIK conferences will always be remembered.

As the first-day program will start with an opening session which will be followed by the plenary session on the memory of Prof. Memiş Acar chaired by Memiş's two former students: Assoc. Prof. Dr. Volkan Esat of METU NCC and Asst. Prof. Dr. Selçuk Himmetoğlu of Hacettepe University. His family, his friends, and his colleagues will tell their memories about Memiş to share with the participants. The next session in the morning will be the Keynote Speech of Prof. Serpil B. Acar on "Automotive Safety and Development of Passive Prevention Systems". The special "4th Design for Transport Safety" organized and to be chaired by Prof. Serpil B. Acar will take place in the afternoon in two parts. The first-day program will be closed with the Wellcome Cocktail in the evening.

The second-day program starts with a plenary session of two Keynote presentations by Professor Yusuf Altıntaş of British Columbia University on mathematical modeling of machining, machine tool vibrations and control, and by Professor Charlie C.L. Wang of the University of Manchester on simulation, sensing and control of soft robots. Honorary chairmen of UMTIK 2022, presidents of 7 supporting universities, will be the panellists of the panel "The role and the responsibilities of the universities for regional development will be moderated by Mr Cengiz Ultav, Board Member of Vestel Ventures. In the afternoon, Professor Ismail Lazoğlu of Koç University will deliver his online Keynote speech and share his experience on the critical role of advanced manufacturing in society and on human life in the age of Industry 4.0. About 20 conference papers will be presented and discussed in the remaining time until 18:00 three parallel sessions. The Conference Dinner will be in the

evening as a closing event.

The third-day program starts with a plenary session. The first speaker of this session is Assoc. Prof. Tanfer Yandayan of the National Metrology Institute of Turkiye. He will deliver a perspective on the European Metrology Network (EMN) for Advanced Manufacturing. The next speech will be given by Prof. Erhan Budak of Sabancı University on "High-performance machining through process modelling". Prof. Vadim V. Silberschimidt of Loughborough University is the third speaker to talk on "Hybrid machining of advanced materials". About ten papers somehow related to the keynotes will be presented in the three parallel sessions before lunch. The afternoon session will start with the keynote speech of Prof. Matsuoka on "Design science towards integration of design". Related Special Session on "Design science and time-axis design" and other sessions comprising about 20 papers will take place in three parallel sessions until 18:00.

The fourth-day program is mainly concentrated on the implementation of Industry 4.0 in three countries: Croatia, Taiwan and Turkiye. The program starts with a plenary session of 2 keynotes: Prof. Ivica Veza of the University of Split will talk about the lean factory concept implemented at the University of Split; Dr Tzou-Liang Luo of ITRI, Taiwan will give a talk on intelligent machinery technology. Taiwanese experience in the implementation of intelligent manufacturing will be presented, discussed and shared in 5 different presentations in the following special session before lunch. Papers on automotive engineering will be presented and discussed in a parallel session. There will be a panel on "Industry 4.0 practices and case studies" as the first event in the afternoon. The panel will be moderated by Dr Doğan Hasan, CEO of UNOPro of Turkiye to present, discuss and share Turkiye's experience in Industry 4.0 implementation. The last plenary session of the day and the conference will be "5-Axis New Generation CNC Controller". It will be presented by Prof. Onur Tuncer, CEO of Milteksan, Turkiye.

We would like to express our sincere thanks to the Presidency and all members of Cappadocia University for hosting UMTIK 2022 and providing its facilities for our use as the Golden Sponsor of UMTIK 2022. We hope all the participants will feel the warm and positive atmosphere at Cappadocia University.

We highly acknowledge the Honorary Chair Persons of the Conference: Presidents of the seven universities, Professor Hasan Ali Karasar of Cappadocia University, Professor Yıldırım Üçtuğ of Atılım University, Professor Turkay Dereli of Hasan Kalyoncu University, Professor Ihsan Sabuncuoğlu of TED University, Professor Can Çoğun of Çankaya University, Professor Semih Aktekin of Nevşehir Hacı Bektaş Veli University and Professor Babür Özçelk of Konya Teknik University for their kind support and participation in our conference as the panelists in the 2nd Day Panel. We would like to express our sincere appreciation to Mr Cengiz Ultav for his hard work in organizing and moderating the 2nd Day Panel. We would like to thank all the keynote speakers, Professor Yusuf Altıntaş, Professor Charlie C. L. Wang, Professor Serpil B. Acar, Professor İsmail Lazoğlu, Professor Tanfer Yandayan, Professor Erhan Budak, Professor Vadim V. Silberschmidt, Professor Yoshiyuki

Matsuoka, Professor Ivica Veza and Professor Onur Tunçer. Fourth Day Panel Moderator Dr Doğan Hasan and the panellists, organizers of the special sessions, session chairpersons, authors and all the participants are highly acknowledged for their valuable contributions. Asst. Prof. Dr Bahram Lotfi is gratefully acknowledged for the tremendous time and effort he spent in every phase of the conference organization and in the editorial work of the Conference Proceedings and the Abstracts Book.

Last, but not least, we would also like to thank TUBITAK, "The Scientific and Technological Research Council of Turkey", Turkish Machinery Exporters Union, silver and bronze sponsors, the International Program Committee Members, our Conference Secretariat, ORIGINEMC, UMTIK Scientific Secretariat: Res. Asst. Yunus Emre Nehri, Res. Asst. Ramazan Hakkı Namlu, Res. Asst. Mehmet Furkan Özbey and all those who contributed to the success of UMTIK 2022.

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

The Organizing Committee
UMTIK 2022, August 31st - September 3rd 2022
Cappadocia, Turkiye

PREFACE

in loving memory of Professor Memiş Acar

The first day of the UMTIK 2022 Conference is dedicated to the late Professor Memiş Acar, whom we lost in 2018. Professor Memiş Acar was a keen supporter of the UMTIK conferences; and a friend, a valued colleague, a father figure to many. It gives us utmost pleasure not only to celebrate his life and achievements, but also to remember and cherish all the qualities he brought to the lives of everyone around him on the first day of the UMTIK 2022 Conference.

Professor Memiş Acar was a prominent academic and a scholar who educated successful engineers over his many years in academia, and conducted socially responsible research that saved, improved, and touched many lives. After having been educated in Türkiye, he developed and flourished for the vast majority of his academic career in the UK, establishing ties to many academic environments mainly in EU countries, the USA, and Türkiye. His research interests ranged from vehicle occupant safety, crashworthiness, child restraint systems, biomechanical modelling and design to textile engineering, nonwoven materials and its processing. He was highly productive accomplishing various research projects, publishing a great deal of international technical research papers attracting many researchers across the globe, and receiving a record number of citations. It would not be an exaggeration to say that he was undoubtedly one of the leading academics of Loughborough University, consistently a top ten UK higher education institution, with his world-class research, the roles he assumed within the University, its Council, and the Senate, and the quality he poured into teaching. One of his most valuable contributions to academia as well as to society at large was the researchers he moulded into successful academics and professionals, who are enjoying their fruitful careers in various areas in several countries.

Maybe more importantly than his academic achievements, Professor Memiş Acar was one of the finest human beings that people around him had the chance to meet and know. He was extremely polite, exceptionally thoughtful and considerate. He had unique personal qualities that brought out the best in people. He never hesitated to support not only his students, but everyone around him on and off campus, academically or personally. He had a great sense of humour, which was one of the colourful sides of his character. He had kind eyes and a comforting smile on his face which never faded whatever the circumstance. He had an undeniable impact on the community that surrounded him. He is missed dearly and remembered as a beacon of light for everyone around him.

We would like to extend our gratitude to the UMTIK Organising Committee, and Professor S. Engin Kılıç in particular, for making this commemoration and celebration event possible. A special heartfelt thanks goes to Professor Serpil Acar, the beloved wife of Memiş Hoca, for helping out to achieve a commemoration / celebration event worthy of Memiş Hoca. Last

but not least, we would like to thank everyone that attends the first day and contributes to it, making it ultimately meaningful.

Dr Volkan Esat & Dr Selçuk Himmetoğlu
Organizing Committee of "Commemoration of Professor Memiş ACAR Day"
UMTIK 2022, August 31st - September 3rd 2022
Cappadocia, Turkiye

Wednesday, August 31st, 2022		
Commemoration Day of Professor Memiş ACAR		
8:00 - 9:00	**REGISTRATION**	
9:00 - 10:00	**OPENING SESSION**	
	9:00 - 9:15	Speech by Conference Chair, Prof. Dr. S. Engin Kılıç
	9:15 - 9:30	Speech by Rector of Kapadokya University, Prof. Dr. Hasan Ali Karasar
	9:30 - 10:00	Slideshow / Presentation by Dr S Himmetoglu & Dr V Esat
10:00 - 11:00	**(I1) Hall 1** PLENARY SESSION I Celebration of the life and achievements of Prof. Dr. Memiş Acar: by: Prof. Dr. B. Serpil Acar, colleagues, students, and other people who became friends of Memis Acar through academic environments **Session Chairs:** Dr. Volkan Esat and Dr. Selçuk Himmetoğlu		
11:00 - 11:15	**COFFEE BREAK**	
11:15 – 11:45	**(I2) Hall 1** PLENARY SESSION II Automotive Safety and Development of Passive Prevention Systems **Keynote Speaker:** Professor Serpil ACAR		
11:45 – 12:30	**(I3) Hall 1** **Sponsors Session I**		
	11:45 - 12:00	Main Sponsor:	**Armada Software**
	12:00 - 12:10	Silver Sponsor:	**Assystem**
	12:10 - 12:20	Silver Sponsor:	**Haimer**
	12:20 - 12:30	Silver Sponsor:	**Marrin Makina**
12:30 – 13:30	**LUNCH**	

	Wednesday, August 31st, 2022 (Cont'd)		
13:30 - 15:10	**(I4) Hall 1**		
	Special Session:		
	In loving memory of Prof. Dr. Memiş Acar		
	Machine Design, Modeling, and Manufacturing		
	Session Co-Chairs:		Dr S. Himmetoğlu & Dr V. Esat
	13:30 - 13:50	MMM1	Emrah Demirci
	13:50 - 14:10	MMM2	Yasar A. Ozkaya
	14:10 - 14:30	MMM3	Baris Sabuncuoğlu
	14:30 - 14:50	MMM4	Yigit Tascioglu
	14:50 - 15:10	MMM5	Ferruh Erdogdu
15:10 - 15:30	**COFFEE BREAK**		
15:30 - 17:10	**(I5) Hall 1**		
	Special Session:		
	In loving memory of Prof. Dr. Memiş Acar		
	Design for Transport Safety		
	Session Co-Chairs:		Professor Serpil ACAR & Dr V. Esat
	15:30 - 15:50	DfTS1	Selçuk Himmetoğlu
	15:50 - 16:10	DfTS2	Volkan Esat
	16:10 - 16:30	DfTS3	Andrew Morris
	16:30 - 16:50	DfTS4	B Serpil Acar
	16:50 - 17:10	DfTS5	Selçuk Himmetoğlu
17:30	**WELCOME COCKTAIL**		

	Thursday, September 1st, 2022
9:00 - 10:30	**(I6) Hall 1** PLENARY SESSION III Developing mathematical models of metal cutting operations, machine tool vibrations and control **Speaker:** Professor Yusuf Altıntaş Simulation, Sensing and Control of Soft Robots **Speaker:** Professor Charlie C. L. Wang (ONLINE)
10:30 - 10:45	**COFFEE BREAK**
10:45 – 11:00	**(I7) Hall 1** **Sponsors Session II** 10:45 - 10:50 Bronze Sponsor: **Belgin Oil** 10:50 - 10:55 Bronze Sponsor: **Enginsoft Turkey** 10:55 - 11:00 Bronze Sponsor: **FNSS**
11:00 - 13:00	**(I8) Hall 1** PANEL I The Role and the Responsibilities of the Universities for Regional Development **Moderator:** Mr. Cengiz Ultav (Vestel Ventures Board Member) **Panelists:** Honorary Chairmen
13:00 – 14:00	**LUNCH**
14:00 - 14:45	**(I9) Hall 1** PLENARY SESSION IV (ONLINE) Critical Role of Advanced Manufacturing on the Society and on Human Life in the age of Industry 4.0: Sharing our Experience in the Manufacturing & Automation Research Center **Speaker:** Professor Ismail Lazoğlu

	Hall 1 **A1** **Metal Cutting I** 9, 10, 35, 58	Hall 2 **B1** **Materials Behavior I** 5, 16, 17	Hall 3 **C1** **Computational Fluid Mechanics:** 29, 46, 62, 65
14:45 - 16:00			
16:00 - 16:15	**COFFEE BREAK**		

	Thursday, September 1st, 2022 (Cont'd)		
16:15 – 16:30	**(I10) Hall 1**		
	Sponsors Session III (Turkish Presentation - Türkçe Sunum)		
	16:15 - 16:20 Bronze Sponsor: **Gesbey**		
	16:20- 16:25 Bronze Sponsor: **Paksan**		
	16:25- 16:30 Bronze Sponsor: **Yemtar**		
16:30 - 17:30	**Hall 1**	**Hall 2**	**Hall 3**
	A2	**B2**	**C2**
	Metal Cutting II	**Special Session:**	**Computational Mechanics**
	1, 15, 23, 24	Impact of energy technologies and smart systems on human's life 7, 48, 74	26, 30, 59
20:00	**CONFERENCE DINNER**		

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	Friday, September 2nd, 2022		
9:00 - 11:15	**(I11) Hall 1**		
	PLENARY SESSION V		
	European Metrology Network (EMN) for Advanced Manufacturing		
	Speaker:	Assoc. Prof. Tanfer Yandayan	
	High Performance Machining through Process Modeling		
	Speaker:	Professor Erhan Budak	
	Hybrid machining of advanced materials		
	Speaker:	Professor Vadim V. Silberschmidt	
11:15 - 11:30	**COFFEE BREAK**		
11:30 – 11:40	**(I12) Hall 1**		
	Sponsors Session II		
	11:30 - 11:35 Bronze Sponsor:	**USEL**	
	11:35 - 11:40 Bronze Sponsor:	**Van Precision Engineering**	
11:40 - 13:00	**Hall 1**	**Hall 2**	**Hall 3**
	A3	**B3**	**C3**
	Metal Cutting III	**Materials Behavior II**	**Engineering Design**
	31, 36, 42, 53, 66	37, 63, 69, 72	3, 13, 56, 57
13:00 – 14:00	**LUNCH**		
14:00 - 14:45	**(I13) Hall 1**		
	PLENARY SESSION VI (ONLINE)		
	Design Science towards Integration of Design		
	Speaker:	Professor Yoshiyuki Matsuoka	
14:45 - 15:45	**Hall 1**	**Hall 2**	**Hall 3**
	A4	**B4**	**C4**
	Special Session:	**Automotive Engineering I**	**Talaşlı İmalat**
	Design Science and Time-axis Design		
	4, 6, 11	22, 27, 60	20, 41, 70
15:45 - 16:00	**COFFEE BREAK**		
16:00 - 17:00	**Hall 1**	**Hall 2**	**Hall 3**
	A5	**B5**	**C5**
	Design of Machines	**Automotive Engineering II**	**Üretim Süreçleri ve Tasarımı**
	21, 32, 33, 67	47, 61, 64, 71	45, 49, 54, 55

Saturday, September 3rd, 2022			
9:00 - 10:30	**(I14) Hall 1** PLENARY SESSION VII Concept of Lean Learning Factory at the University of Split **Speaker:** Professor Ivica Veza Intelligent Machinery Technology **Speaker:** Dr. Tzou-Liang Luo (Derek Luo)		
10:30 - 10:45	**COFFEE BREAK**		
10:45 - 12:00	**Hall 1** **A6** **Special Session:** Intelligent Manufacturing Technology in Taiwan IMT1, IMT2, IMT3, IMT4, IMT5	**Hall 2** **B6** **Tasarımda Yaratıcılık ve Yenileşim** 38, 43, 68	**Hall 3** **C6** **Otomotiv Mühendisliği** 12, 18, 19, 52
12:00 – 13:00	**LUNCH**		
13:00 - 15:00	**(I15) Hall 1** PANEL II Industry 4.0 Practices and Case Studies **Moderator:** Dr. Doğan Hasan CEO- UnoPro Production and Consultancy		
15:00 - 15:15	**COFFEE BREAK**		
15:15 - 16:00	**(I16) Hall 1** PLENARY SESSION VIII 5-Axis New Generation CNC Controller **Speaker:** Professor Onur Tunçer		

| (I1) | Plenary Session I | HALL 1 | 10:00 – 11:00 |

Chaired by: Dr. Volkan Esat and Dr. Selçuk HİMMETOĞLU

"Celebration of the life and achievements of Professor Memiş ACAR"

| (I2) | Plenary Session II | HALL 1 | 11:15 – 11:45 |

Chaired by: Professor Abdulkadir ERDEN

"Automotive Safety and Development of Passive Prevention Systems"

__Keynote Speaker__: Professor Serpil ACAR

| (I3) | Sponsors Session I | HALL 1 | 11:45 – 12:30 |

Chaired by: Professor Ulvi ŞEKER

| (I4) | Special Session:
In loving memory of Professor Memiş ACAR
Machine Design, Modeling, and Manufacturing | HALL 1 | 13:30 – 15:10 |

Chaired by: Dr. Selçuk Himmetoğlu & Dr. Volkan Esat

Investigating Effect of Curliness on Porosity for Random Fibrous Networks (MMM1-YK-etal)
> Yagiz KAYALI, Mehmet N. BALCI, Emrah DEMİRCİ

Computational Design of An Infrared System for Hamburger Cooking (MMM2-OK1-etal)
> Ozan KARATAS, Yasar A. ÖZKAYA, Ferruh ERDOĞDU

Determination of Fiber Orientations and Stiffness Properties via Micro-CT Scan Images: Application to Composite Materials with Microvascular Channels (MMM3-BS-etal-25)
> Barış SABUNCUOĞLU, Hamed TANABİ, Jeroen SOETE, Stepan V. LOMOV

Colocated Visuo-Haptic Simulation: Challenges and Examples (MMM4-YT-etal)
> Yiğit TAŞCIOĞLU

Computational Modeling and Design of Innovative Food Process Systems (MMM5-OK2-etal)
> Ozan KARATAŞ, Ozan ALTIN, Ferruh ERDOĞDU

(I5)	Special Session: HALL 1 15:30 – 17:10
	In loving memory of Professor Memiş ACAR
	Design for Transport Safety

Chaired by: Professor Serpil ACAR & Dr. Volkan Esat

A Dynamic Characterisation of Full-Overlap Low-Speed Rear Impacts (Dfts1-SH-Etal)

Selçuk HİMMETOĞLU, Canberk BEYHAN, Elif Nur ZENGİN

Analysis of Seat Belt Use and Thorax Injuries Sustained by Female Occupants in Frontal Impacts (DfTS2-VE-BSA)

Volkan ESAT, B. Serpil ACAR

Improving the Safety of London Bus Users Through Design (DfTS3-JB-etal)

Jo BARNES, Laurie BROWN, Andrew MORRIS

E-Scooter Safety Studies and A User Trial Study (DfTS4-SM-etal)

Sally MAYNARD, Graham HANCOX, Andrew MORRIS, B. Serpil ACAR

Occupant Protection in Seats with Fixed Recliners in Rear-End Collisions (DfTS5-SH)

Selçuk HİMMETOĞLU

(I6)	Plenary Session III: Keynote Lectures	HALL 1	9:00 – 10:30

Chaired by: Professor Bilgin KAFTANOĞLU

"Developing Mathematical Models of Metal Cutting Operations, Machine Tool Vibrations and Control"

Keynote Speaker: Professor Yusuf ALTINTAŞ

"Simulation, Sensing, and Control of Soft Robots"

Keynote Speaker: Professor Charlie C. L. WANG

(I7)	Sponsors Session II	HALL 1	10:45 – 11:00

Chaired by: Mr. Barış ÇETİN

(I8)	Panel I:	HALL 1	11:00 – 13:00

"The Role and the Responsibilities of the Universities for Regional Development"

Moderator: Mr. Cengiz ULTAV (Vestel Ventures Board Member)

Panelists: Honorary Chairpersons of UMTIK 2022

(I9)	Plenary Session IV: Keynote Lecture (ONLINE)	HALL 1	14:00 – 14:45

Chaired by: Professor Ivica VEZA

"Critical Role of Advanced Manufacturing on the Society and on the Human Life in the Age of Industry 4.0 Sharing Our Experiences in the Manufacturing and Automation Research Center"

Keynote Speaker: Professor İsmail LAZOĞLU

(A1)	Session: Metal Cutting I	HALL 1	14:45 – 16:00

Chaired by: Dr. Samet AKAR

Design of An Active Magnetic Bearing Spindle for Micro-Milling Applications (9)

Kazi Sher AHMED, Bekir BEDİZ

Investigation of Dimensionality Reduction Methods for Chatter Detection with SVM (10)

Kerem Utku DEMİR, Batıhan ŞENER, Hakkı Özgür ÜNVER

Development of An Ontology Based Dynamic Process Planning and Scheduling Methodology for Discrete Manufacturing Systems (35)

Elaf Riyadh RESEN, Bahram LOTFİ, Saman AMİNBAKHSH

ON THE FINITE ELEMENT MODELING BEST PRACTICES FOR THE METAL CUTTING SIMULATIONS (58)

Ersen HATİPOĞLU, Mustafa BAKKAL, Erhan BUDAK

(B1)	Session: Materials Behavior I	HALL 2	14:45 – 16:00

Chaired by: Dr. Cemal Merih ŞENGÖNÜL

Changes on Surface Properties of Metals Due to Boron Nitride Coatings (5)

Tuğçe HACALOĞLU, Asude AYDOĞAN, Bilgin KAFTANOĞLU

Influence of Punch Properties on Contact Mechanics of Coated Substrates (16)

Mehmet N. BALCI

A Novel Ballistic Limit Velocity Theory for Woven Composites (17)

Uğur DOĞAN, Emin SÜNBÜLOĞLU

(C1)	Session: Computational Fluid Mechanics	HALL 3	14:45 – 16:00

Chaired by: Dr. Ferit SAİT

Analysis of Acoustically Actuated Sedimentation Prevention System for Syringe Pumps (46)

Arda KAYA, Güven ÖNER, Ömer Faruk ERGÜVEN, Ender YILDIRIM, F. Ginaz ALMUS

Design of An Anti-Sedimentation Syringe Pump for Microfluidics Applications (62)

Eminalp KOYUNCU, A. Tardu KOÇUM, Enes KOÇ, Cem KÜÇÜKGENÇ, Baturay KURTOĞLU, Oğuzhan KARAKAŞ, Ender KURUKAHVECI, Bülent ÖZCAN, Ender YILDIRIM, F. Ginaz ALMUS

Investigation of the Effect of Hub Curve on the Performance of Radial Compressor for High-Speed Turbomachinery (65)

Okan Deniz YILMAZ

3-Denklemli Türbülans Geçiş Modelinin Jenerik Gövde Geometrisi ile Başarim Değerlendirmesi (29)

Hediye ATİK

(I10)	Sponsors Session III	HALL 1	16:15 – 16:30

Chaired by: Mr. Ramazan Hakkı NAMLU

(A2)	Session: Metal Cutting II	HALL 1	16:30 – 17:30

Chaired by: Dr. Hakkı Özgür ÜNVER

Determination Cutting Parameters for Aggressive-High Performance Chip Removal of The Beveling Machine with Automated Workpiece Determination and Tool Path Generation System (1)

Can TUNCER, Sakıp TÜRKÖZ, Ali ORAL

Comparison of ANN and RSM in Prediction of The Tangential Force in Turning of AISI 4140 Hardened Steel Considering Flank Wear (15)

Osman ÖZTÜRK, Ali ÜNÜVAR

A Method to Obtain the Cross-Sectional Profile of the Region Swept by A Toroidal Cutter During A Screw Motion (23)

Ahmet DOĞRUSADIK

An Experimental Study of the Effects of Ultrasonic Cavitation-Assisted Machining (UCAM) on Difficult-to-Cut Materials (24)

Berkay KOÇAK, Nefise Nur ZENGIN, Halil İbrahim CANBAZ, Ata Berk MUMCUOĞLU, Mehmet Bedirhan AYDIN, Ramazan Hakkı NAMLU, Bahram LOTFİ, Sadık Engin KILIÇ

(B2)	Special Session: Impact of Energy Technologies and Smart Systems on Human's Life	HALL 2	16:30 – 17:30

Chaired by: Dr. Cihan TURHAN

Experimental Studies on Thermal Degradation, Ignition and Combustion of Low-Vulnerability Gun Propellants (7)

    Leo COURTY, Samuel DELBARRE

Effect of environmental parameters on outdoor thermal comfort of students in a university campus (74)
    Cihan TURHAN

Re-Defining Temperature Set-Point of An HVAC System Based on Thermal Comfort Zone of Students in A University Study Hall (48)

    Cihan TURHAN, Mehmet Furkan ÖZBEY

(C2)	Session: Computational Mechanics	HALL 3	16:30 – 17:30

Chaired by: Professor Özgür ASLAN

Finite Element Analysis of the Lumbar Vertebrae L4-L5 Segment with Ligaments (26)

    Adil HAMEED, Hasan Umay AKAY, Behzat KENTEL

Finite Element Analysis of All-Ceramic FGM Dental Crowns using Phase-Field Approach (30)

    Nazanin SAEIDI, Ferit SAİT, Turan KORKMAZ

An Experimental and Numerical Study of Multi-Stage Hot Forging Process of CW617N Brass Alloy (59)

ONLINE PRESENTATION

    Hakan COŞKUN, Tayfun ORHAN, Sami KURAL, Yusuf KAYNAK

(I11)	Plenary Session V: Keynote Lecture	HALL 1	9:00 – 11:15

Chaired by: Professor Erhan İlhan KONUKSEVEN

"European Metrology Network (EMN) for advanced manufacturing"

Keynote Speaker: Dr. Tanfer YANDAYAN

"High Performance Machining through Process Modeling"

Keynote Speaker: Prof. Erhan BUDAK

"Hybrid Machining of Advanced Materials"

Keynote Speaker: Prof. Vadim SILBERSCHMIDT

(I12)	Sponsors Session IV	HALL 1	11:30 – 11:40

Chaired by: Mr. Mehmet Furkan ÖZBEY

(A3)	Session: Metal Cutting III	HALL 1	11:40 – 13:00

Chaired by: Professor Vadim V. SILBERSCHMIDT

An Experimental Investigation of Aluminum Alloy with Ultrasonic Vibration-Assisted Machining and Minimum Quantity Lubrication (31)

Ramazan Hakkı NAMLU, Barış ÇETİN, Bahram LOTFİ, Sadık Engin KILIÇ

Dynamometer Design to Measure 2- Directional Cutting Forces in Turning Process (36)

Kaan Songür, Ayberk TÜRK, Özdemir Ahmet KARABABA, Samet AKAR, Suat BENGÜR

Recursive Defining of Force Coefficients in Milling Process with Accelerometer (42)

Barış ALTUN, Hakan ÇALIŞKAN, Orkun ÖZŞAHİN

Ultrasonic Assisted Drilling on Precipitation Hardened Martensite Stainless Steel (53)

Metin Berk ENİS, Mehmet YILDIRIMKARAMAN, Ramazan Hakkı NAMLU, Bahram LOTFİ, Sadık Engin KILIÇ,

A Design Improvement and Structural Analysis in A Pre-Designed Hybrid Drilling Machine (66)

Dilay ÖZDEMİR, Emirhan MERT, H. Gulin ÖZGELİK, Mert REİS, Ertan TOPAL, Alper YETER, Mahmut YILMAZ, Mustafa BAKKAL

(B3)	Session: Materials Behavior II	HALL 2	11:40 – 13:00

Chaired by: Professor Ahmet Hakan ARGEŞO

Numerical Determination of The Necking Phenomenon using Stress Wave Propagation Technique (37)

Şehram DİZECİ, Bahman PAYGOZAR

Dynamic Perforation Response of Honeycomb Sandwich Panels Under High-Velocity Impact: Effect of Tube Reinforcement (63)

Kemal ARSLAN

Design and Manufacture of a Pendulum Impact Testing Machine for Plastics (69)

Cemal Merih Şengönül, Ahmet Hakan Argeşo, Halil İbrahim Canbaz, Filiz Kiraz, Atacan Cabar, Batuhan Özkan, Canan Başkaya, Bora Noyan

Modeling and Simulation of Electromagnetic Sheet Metal Forming for Large Deformations (72)

Özgür ASLAN

(C3)	Session: Engineering Design	HALL 3	11:40 – 13:00

Chaired by: Professor Ali ÜNÜVAR

A Further Investigation for Parametric Optimization of Arched and Honeycomb Cored Sandwich Composite Panel for Aircraft Wing Buckling with Finite Element Analysis (3)

Mustafa BİLGİÇ, Metehan ERDOĞAN

Bulk Passive Sensorless Sorting of Complex Cylindrical Components with Internal Features and Symmetrical External Tapers (13)

Toby WILLIAMS, Kaddour BOUAZZA-MAROUF

Optimum Design of An Airplane Bracket using Topology and Shape Optimization Methods (56)

Betül YILDIZ

The Optimum Structural Design of Aircraft Components for Additive Manufacturing (57)

Betül YILDIZ

(I13)	Plenary Session VI: Keynote Lecture (ONLINE)	HALL 1	14:00 – 14:45

Chaired by: Dr. Besim BARANOĞLU

"Design Science towards Integration of Design"

Keynote Speaker: Prof. Yushiyuki MATSUOKA

(A4)	Special Session: Design Science and Time-Axis Design	HALL 1	14:45 – 15:45

Chaired by: Professor Takeo KATO

Systematic Classification of 3D Shape Analysis Methods using Curvature and Quantification of "Complexity" (4)

Kazuma MATSUYAMA, Takahiro SHIMIZU, Takeo KATO

Relationship Between Impression and Shape Characteristics of Texture using Computational Design (6)

Sakutaro MIYASAKA, Fumio TERAUCHI, Koichiro SATO

Keyword Generation System Based on Design Thinking Model (11)

Takeo KATO, Ryogo NOJI, Kiyotaka TAKAIRA

(B4)	Session: Automotive Engineering I	HALL 2	14:45 – 15:45

Chaired by: Dr. Bahram LOTFİ

Modeling and Simulation of Active Double-Acting Hydro-Pneumatic Suspension System Using Fuzzy Logic Controller for 6x6 Terrain Vehicle (22)

Kaan Berke ULUSOY, Bensu DEĞİRMENCİ, Erkin FİLİZ, Derin TÜREDİ, Mustafa KARAMAN, Ahmet Hamdi ALKAN, Erhan İlhan KONUKSEVEN

Design of A Two-Speed Dual-Clutch Transmission for Electric Vehicles (27)

Selahattin Can BECERİKLİ, Hatice ERDOĞAN, Mustafa Bahdır BAYRAM, Ozan TEKİN, Ramin BARZEGAR

An Investigation of The Crashworthiness of Multi-Cell Filled Battery Side Beams (60)

İsmail YAY, Emre DEMİRCİ

(C4)	Session: Talaşlı İmalat	HALL 3	14:45 – 15:45

Chaired by: Professor Ali ORAL

Daire Testere Tezgahlarında, Kesici Takım Üzerinde Oluşan Titreşimin İş Parçasına Etkisinin İncelenmesi (20)

M. Berkan ALİSİNOĞLU, Hasan Ali CİVELEK, Onur GÖKMEN, Kadir ÇAVDAR

Tavlama Benzetimi Yöntemi ve Yanıt Yüzey Metodu Kullanılarak Yüzey Pürüzlülüğü için İşleme Parametrelerinin Optimizasyonu (41)

Yunus Emre NEHRİ, Enes EZME, Gülşen AYDIN KESKİN, Ali ORAL

Isıl İşlem Uygulanan AISI 420 Pazlanmaz Çeliğin Tornalama İşlemi Üzerinde CBN Uçlar ile Yüzey Pürüzlülüğü Araştırması (70)

Hasan Safa ÇAVUŞOĞLU, Seher SEVEN, Besim BARANOĞLU

(A5)	Session: Design of Machines	HALL 1	16:00 – 17:00

Chaired by: Dr. Behzat Bahadır KENTEL

Cancellation of Singularities of RRRRP Planar Parallel Robots (21)

Mustafa ÖZDEMİR, Sinan Yalçın ÖNAL

Investigating Effects of Polarization and Dimensions of Magnetic Coupling on Transmitted Torque By Finite Element Analysis (32)

Seyed Hamed POUR RAHMATI KHALEJAN

Design and Manufacture of a Fatigue Test Machine (33)

Berk Ege AKSU, Furkan IŞIK, Hilal YÜCEL, Çağhan ATLIHAN, Hakan KALKAN

Investigation of Permanent Magnet Synchronous Motors with Three Different Slot-Pole Combinations for Scooter Application (67)

Hayatullah NORY, Serhat AKŞUN, Cansu AKSOY, Salıh ÇELİK

(B5)	Session: Automotive Engineering II	HALL 2	16:00 – 17:00

Chaired by: Dr. Şehram DİZECİ

Design and Analysis of A Lightweight Chassis for An Electric Vehicle (47)

Özgür AKDENİZ, Mert ALPAR, İsmail Utku HOROZOĞLU, Ozan TEKİN, Ramin BARZEGAR

Development of An Image Processing System for The Automatic Quality Control of Vehicle Airbag Plastic Parts (61)

Bilgin DALLI, Mustafa Cemal ÇAKIR

System Optimization of Battery Discharge State using Artificial Neural Network in an Electric Vehicle Powertrain (64)

Mehmet Onur GENÇ, Necmettin KAYA

Design of Modular Planetary Gearbox with Two-Stage Planet Gears for Use in Valve Actuators (71)

Seher SEVEN, Muhammed Mahbub İBİŞ, Evren COŞKUNER, Besim BARANOĞLU

(C5)	Session: Üretim Süreçleri ve Tasarımı	HALL 3	16:00 – 17:00

Chaired by: Dr. Hakan KALKAN

EKLEMELİ İMALAT TEKNOLOJİSİYLE ÜRETİLMİŞ INCONEL 718 VE Tİ6Al4V 'nin MİKRO FREZELENMESİNDE KESME KOŞULLARININ ETKİSİNİN ARAŞTIRILMASI (45)

Ahmet HASÇELİK, Kubilay ASLANTAŞ, Mohd DANISH

AlCrN Esaslı PVD Kaplamanın Enjeksiyon Kalıp Yüzey Kalitesine Etkileri (49)

Yusuf ASLAN, Şükran KATMER, Ulvi ŞEKER

Görsel Lazer Nokta Kaynağı Uygulamalarında Açısal Konumlandırma Hatalarının Kaynak Kalitesine Etkisinin İncelenmesi (54)

Emre ŞERİFAĞAOĞLU, Murat Erkin AKYÜZ, Barış KOYAŞ, Murat REİS

Taşıtlarda Ağırlık Azaltımında Hafif Malzeme Olarak Alüminyum Kullanımı (55)

Yahya IŞIK, Recep ÇAGLAYAN

(I14)	Plenary Session VII: Keynote Lecture	HALL 1	9:00 – 9:45

Chaired by: Dr. Doğan HASAN

"Concept of Lean Learning Factory at the University of Split"

*Keynote Speaker***:** Prof. Ivica VEZA

"Intelligent Machinery Technology"

*Keynote Speaker***:** Dr. Tzou-Liang Luo (Derek Luo)

(A6)	Special Session: Intelligent Manufacturing Technology in Taiwan	HALL 1	🖥 ONLINE PRESENTATION	10:45 – 12:00

Chaired by: Professor Yao- Yang TSAI and Professor Ming Chuyan Lu

Workpiece Defect Detection Using Mask R-CNN With Domain Knowledge Transfer Learning (IMSS1)

    Jian-Ping JHUANG, Meng-Shiun TSAI, Ting-Hua ZHANG, Zheng-WEI JIAN

Tool Wear Monitoring in Milling for Varied Cutting Conditions Using Vibration and Current Signals (IMSS2)

    Kuan-Ming LI, Yao-Yang TSAI, Yi-Yen LIN

Design of the Low-Cost IoT-Based Wireless Monitoring System for CNC Lathe Cutting Tool Vibration Monitoring (IMSS3)

    Muhamad Aditya ROYANDI, Tzu-Liang LUO, Jui-Pin HUNG

Development of the Surface Quality Monitoring System in Ending Milling Process (IMSS4)
    Tzu-Liang LUO, Jen-Ji WANG, Chien-Chih LIAO, Muhamad Aditya ROYANDI, Jui-Pin HUNG

Development of A Multi-Level Tool Wear Monitoring System in The Milling of Inconel 718 (IMSS5)

    Yu-Wei LIN, Ming-Chyuan LU

(B6)	Session: Tasarımda Yaratıcılık ve Yenileşim	HALL 2	10:45 – 12:00

Chaired by: Dr. Şükran KATMER

Bir Silah Namlusunda Kovan-Atım Yatağı Etkileşiminin İncelenmesi (38)

Muhammet Mustafa YILMAZ, Sadettin ORHAN

Düzlemsel Beş Çubuk Mekanizmasının Optimizasyon Sonucunda Elde Edilen Parametrelerin Dizayn Edilebilirliğinin İncelenmesi (43)

Deniz Kavala ŞEN, Osman KOPMAZ

İnsansı Yüz Mimiklerine Sahip Animatronik Robot Surat Tasarımı ve İmalatı (68)

Furkan TÜTÜNCÜ, Mustafa Cemal ÇAKIR

(C6)	Session: Otomotiv Mühendisliği	HALL 3	10:45 – 12:00

Chaired by: Dr. Ramin BARZEGAR

Tabakalı Kompozit Kapak Tasarımında Topografya Optimizasyonu ve Fiber Oryantasyonunun Doğal Frekansa Etkisinin İncelemesi (12)

Mehmet KATMER, Adnan AKKURT, Tolga KOCAKULAK

İş Makineleri Tasarımında Düşük Emisyonlu Alternatif Yakıt Uygulamaları (18)

Ceyhun GÜL, L. Furkan MUMCU, T. Yasin ALTINAY, M. Can KATMER, Fatma YALÇIN, Ferhan FIÇICI

Tüp Hidroşekillendirmede Yükleme Profillerinin Bulanık Mantık Kontrol Algoritması ile Belirlenmesi (19)

Yusuf Furkan YAPAN, Mevlüt TÜRKÖZ, MURAT DİLMEÇ, Hüseyin Selçuk HALKACI

PA12 Malzemesinden İmal Edilmiş 3 Katmanlı Yakıt Borusunun Sıcaklık ile Şekillendirme Analizi ve Yapılan Analizin Doğrulanması (52)

Metin ALİBAŞOĞLU, Mustafa Cemal ÇAKIR

(I15)	Panel II:	HALL 1	13:00 – 15:00

"Industry 4.0 Practices and Case Studies"

Moderator: Dr. Doğan HASAN (CEO- UnoPro Production and Consultancy)

Panelists: Mehmet Ziya ÖZBAYRAK, Burcu ÖZTÜRK, Mustafa Birol AKSEL

(I16)	Plenary Session VIII: Keynote Lecture	HALL 1	15:15 – 16:00

Chaired by: Dr. Tanfer YANDAYAN

"5Axis- New Generation CNC Controller"

*Keynote Speaker***:** Prof. Onur TUNÇER

KEYNOTE PAPERS

NO	TITLE	AUTHOR
I2	Automotive safety and development of passive prevention systems	B. Serpil ACAR
I6-1	Developing mathematical models of metal cutting operations, machine tool vibrations and control	Yusuf ALTINTAŞ
I6-2	Simulation, Sensing and Control of Soft Robots	Charlie C. L. Wang
I9	Critical Role of Advanced Manufacturing on the Society and on Human Life in the age of Industry 4.0: Sharing our Experience in the Manufacturing & Automation Research Center	Ismail Lazoğlu
I11-1	European Metrology Network (EMN) for Advanced Manufacturing	Tanfer Yandayan
I11-2	High Performance Machining through Process Modeling	Erhan Budak
I11-3	Hybrid machining of advanced materials	Vadim V. Silberschmidt
I13	Design Science towards Integration of Design	Yoshiyuki Matsuoka
I14-1	Concept of Lean Learning Factory at the University of Split	Ivica Veza
I14-2	Intelligent Machinery Technology	Tzou-Liang Luo (Derek Luo)
I16	5-Axis New Generation CNC Controller	Onur Tunçer

About the Speaker

Professor Emerita B. Serpil ACAR

Serpil Acar is the Professor Emerita of Design for Injury Prevention at the School of Design and Creative Arts, Loughborough University UK. She was born in Turkey and received BS and MS degrees in Mathematics from the Middle East Technical University (METU). After completing her PhD in Mathematics in the UK she worked in close collaboration with engineering departments as well as international automotive industry and clinical and academic members of the Medical Schools. Her current interests include transport safety, engineering design for women and modelling. Professor Acar has been the principal investigator of many major Engineering and Physical Sciences Research Council (EPSRC) and international transport projects, supported by automotive industry. She is the winner of the 2012 Enterprise award with her invention SeatBeltPlus, a device for pregnant occupant safety. It is based on the only pregnant woman computational model with a realistic fetus that was generated at Loughborough University by the team led by Professor Acar.

AUTOMOTIVE SAFETY AND DEVELOPMENT OF PASSIVE PREVENTION SYSTEMS

Globally, a large number road traffic incidents result serious injuries or fatality. Potential incidents and casualties can be predicted and prevented in certain conditions through road safety systems. One of the important elements of these systems is passive safety systems of automobiles, which aim to minimize the severity of injuries and the number of fatalities during the collision when it happens. Despite improvements in other safety systems, accidents still happen. Therefore, reliable passive safety systems in vehicles are extremely important. Passive safety systems have been advancing for several decades and their success has been strongly supported by accident data globally. This keynote speech covers the importance, history, working principles and usage of effective passive safety systems in automobiles.

About the Speaker

Professor Yusuf ALTINTAŞ

Professor Altıntaş obtained his Bachelor from Istanbul Technical University (1975), M.Sc. (1980) from 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 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 about 200 archival journal and 100 conference articles with over 27,000 citations with h index of 87 (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) 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 250 companies and research centers in the field of machining and machine tools worldwide. Professor Altintas is the fellow of Royal Society of Canada, CIRP, ASME, SME, 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 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 an Honorary Doctorate Degrees from Stuttgart University (2009) and Budapest University of Technology (2013), and holds Honorary Professor title from BEIHANG University in Beijing. He was the past president of CIRP (International Academy of Production Engineering Researchers) for term 2016 – 2017. He is designated as the Distinguished University Scholar at the University of British Columbia (2017). He currently directs NSERC CANRIMT Machining Research Network across Canada, and holds the NSERC – P&WC- Sandvik Coromant Industrial Research

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

DEVELOPING MATHEMATICAL MODELS OF METAL CUTTING OPERATIONS, MACHINE TOOL VIBRATIONS AND CONTROL

The aim of our research is to develop mathematical models of metal cutting operations, machine tool vibrations and control. The science based digital models allow the virtual design of machine tools; simulation, optimization and on-line monitoring of machining operations. The model predicts the cutting forces, torque and power consumed in machining parts by considering material properties, cutter geometry, structural flexibilities, and cutting conditions along the tool path. The structural dynamics of the machine tool can either be imported from Finite Element analysis if the machine tool is at the design stage, or from the experimental modal measurements if the machine is already built. The simulation system predicts chatter free cutting conditions within the work volume of the machine tool, or detects the presence of chatter vibrations along the tool path. The dynamics of servo drive control systems, and trajectory generation as a function of jerk, acceleration and velocity profiles of machine tools are considered in simulating the machine tool behavior. An in-house developed virtual and real time CNC system allows the design and analysis of any five-axis machine tool controller. The virtual machining system simulates the cutting forces, torque, power, chip load and deflection errors along the tool path, and adjusts the federate along the tool path in CAM environment. The system is also used in on-line monitoring and control of machine tool and machining process by communicating with CNC in real time as a digital twin. The presentation will cover the overview of basic research we conducted at our laboratory and its application in industry.

About the Speaker

Professor Charlie C. L. WANG
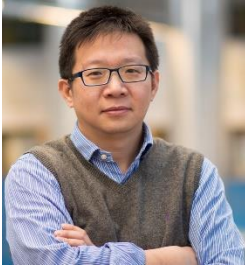
Prof. Charlie C. L. Wang currently holds a Chair of Smart Manufacturing with the University of Manchester. Before joining Manchester in 2020, he was a Chair of Advanced Manufacturing at Delft University of Technology since 2016 and an Assistant Professor / Associate Professor / Professor of Mechanical and Automation Engineering at the Chinese University of Hong Kong since 2003. He also worked as a visiting professor at University of Southern California during sabbatical leave in 2011. 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 received several awards from professional societies including the ASME CIE Excellence in Research Award (2016), the ASME CIE Young Engineer Award (2009), seven Best Paper Awards and four project-oriented innovative technology awards. He was elected to be a Fellow of American Society of Mechanical Engineers (ASME) in 2013, and is currently the Chair of Solid Modeling Association (SMA).

SIMULATION, SENSING AND CONTROL OF SOFT ROBOTS

In response to the various challenges facing the society in these days, such as environmental problem, safe and security problem, the fulfillment of emotional value, it is required to integrate all the knowledge of specialized design fields and works together on addressing the challenges. For moving toward this achievement, it is vital to form "Design Science" as a common basis. Researchers have devoted to developing a variety of soft robotic systems in the laboratory to take advantage of compliance introduced by soft materials. While being able to mimic natural systems and building compatible robots working together with humans, the challenge of lacking computational tools in design also dampens the development of soft robotics in industrial applications. Specifically, the design and control practices taken in soft robotics at present are mainly based on intuition and trial-and-error empirical tests. In this talk, I am going to introduce our recent work to overcome these challenges by simulating, sensing and control the motion of soft robots. The effectiveness of our approach has been verified on pneumatic-driven soft robots for path following, interactive positioning and target-based deformation control.

About the Speaker

Professor İsmail LAZOĞLU

İsmail Lazoğlu received his BS in Mechanical Engineering from Istanbul Technical University in 1989, M.S. and Ph.D. in Mechanical Engineering from Georgia Institute of Technology in 1992 and 1997 respectively. After his PhD, he worked as a postdoctoral researcher in the University of Illinois at Urbana-Champaing and in the University of British Columbia for 3 years. He has been working as a professor in the Department of Mechanical Engineering at Koç University since 2000. He is the founder and director of the Manufacturing and Automation Research Center (MARC) at Koc University. He has been teaching and researching in the fields of Advanced Manufacturing, Mechatronics/Automation/Robotics, and on Medical System Development and Artificial Organs. He has been closely collaborating with the national and international companies, medical doctors and surgeons in these research fields currently with about 30 PhD researchers in the MARC. He has more than 150 publications in the international journals and conferences, and several patents licensed to the companies. He received several awards including the Best Medical Industry R&D and Innovation Award of 2018 from Doktorclub-Medical Awards of Turkey for the development of the first implantable artificial heart pump of Turkey (iHeart VAD), the Gold Medal for the "Adjustable Bone Plate Patent" from the World Intellectual Property Organization (WIPO) and The Best Academic Patent Award from the International Federation of Inventor Association (IFIA) in 2016, Koc University College of Engineering Outstanding Faculty Award in 2014. He is a member of the European Society for Artificial Organs (ESAO) and a Fellow of the CIRP (The International Academy for Production Engineering). Further information is available at https://marc.ku.edu.tr/

Critical Role of Advanced Manufacturing on the Society and on Human Life in the age of Industry 4.0:

Sharing our Experience in the Manufacturing & Automation Research Center

In this talk, after briefly revisiting the development of humanity at large and summarizing the current state of the countries from the advanced manufacturing perspectives, the critical role of engineering and manufacturing will be discussed in the development of societies and human life. Potential opportunities and threats of Industry 4.0 for the society will be shortly discussed. Moreover, some of the research activities from the concept level to the high value-added products developed at the Koç University Manufacturing and Automation Research Center will be presented.

About the Speaker

Assoc. Prof. 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 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.

Some recent links & news for Tanfer's involvement:

- https://www.laser4surf.eu/optical-encoders-our-unsung-heroes/
- https://www.euramet.org/research-innovation/search-research-projects/details/?tx_eurametctcp_project[project]=1181&tx_eurametctcp_project[controller]=Project&tx_eurametctcp_project[action]=s how
- http://www.anglemetrology.com/

EUROPEAN METROLOGY NETWORK (EMN) FOR ADVANCED MANUFACTURING

Advanced Manufacturing and Advanced Materials have both been identified by the European Commission as one of six Key Enabling Technologies (KETs), the full exploitation of which will create advanced and sustainable economies. Metrology is a key enabler for progress of these KETs. EURAMET, which is the association of metrology institutes in Europe, has addressed the vital importance of Metrology for these KETs by facilitating the creation of a European Metrology Network for Advanced Manufacturing. The EMN for Advanced Manufacturing was approved by the EURAMET General Assembly in June 2021 and formally established in October 2022. The EMN comprises both National Metrology Institutes (NMIs) and Designated Institutes (DIs) from across Europe. The EMN is organized in three sections: Advanced Materials, Smart Manufacturing Systems and Manufactured Components and Products. All of these sections need to consider the sustainability of the various advanced manufacturing technologies including targeting zero defects, zero delay, zero surprises, zero waste and the recyclability and circular economy aspects. The EMN for Advanced Manufacturing is engaging with stakeholders in the field of Advanced Manufacturing and Advanced Materials (Large & SMEs, industry organisations, existing networks, and academia) as well as the metrology community to provide input for the preparation of a Strategic Research Agenda (SRA) for Metrology for Advanced Manufacturing.

This contribution will describe the EMN for Advanced Manufacturing, detailing its structures and goals, and the approach for the production and maintenance of the SRA. The EMN for Advanced Manufacturing is supported by the project JNP 19NET01 AdvManuNet.

About the Speaker

Professor Erhan BUDAK

Dr. Budak has been working on various aspects of machining processes and machine tools for 3 decades. After receiving B.Sc. (1987) and M.Sc. (1989) from the Middle East Technical University, Dr. Budak completed his Ph.D. (1994) at the University of British Columbia in Manufacturing Automation Lab. He then worked for Pratt & Whitney Canada as manufacturing development engineer until 2000 focusing on turbine engine manufacturing. He joined Sabanci University as a faculty member in 2000 and founded Manufacturing Research Lab (http://labs.sabanciuniv.edu/mrl/). In 2003, he was awarded the Taylor Medal by CIRP (www.cirp.net) for his work on high performance machining of turbine engine impellers and blisks. He was also the Mustafa Parlar "Science Award" (2018) based on his contributions to the machining research. He is the founder of a spin-off company, Maxima Manufacturing R&D, which develops and implements machining solutions for various industries. He has authored/co-authored more than 200 articles and papers in conference proceedings receiving around 10 000 citations with h-index of 45 (Google Scholar). He is a fellow of CIRP (currently Chair of Scientific Committee on Machines), associate/regional editor and editorial board member of several journals. His areas of interest include machining processes and machine tools, intelligent manufacturing, process modelling and simulation, high precision/ performance manufacturing and machine dynamics.

HIGH PERFORMANCE MACHINING THROUGH PROCESS MODELING

Machining is a commonly used manufacturing process in many industries such as automotive, aerospace, energy, die and mold, medical etc. due to its flexibility and ability to produce high quality parts. Although there have been significant advances in machine tool, control and CNC, CAD/CAM and cutting tool technologies over the last couple of decades, the productivity in these processes is still limited due to the process related problems such as excessive cutting temperatures and forces, process instability and chatter vibrations, part/tool/machine deflections etc. Current CAM systems or CNCs do not provide solutions to these problems. Process models (or digital twins), on the other hand, can be used to predict, avoid or reduce these problems through determination of the appropriate process conditions. In this talk, a brief overview of machining process modeling fundamentals such as chip formation mechanics, shearing, friction etc. will be given, and their use in calculation of process forces will be presented with examples. As one of the main and common problems in machining, cutting dynamics and stability will be explained through process-structure interactions where effects of structural dynamics and process conditions will be presented. Commonly used chatter suppression methods will be demonstrated with examples. Implementation of the models for production process simulations will be discussed, and process optimization will be demonstrated through industrial application examples. Modeling and simulation of special machining operations such as simultaneous turning/milling and turn-milling will also so be presented. The presentation will be concluded with future aspects machining process modeling and simulation.

About the Speaker

Professor Vadim V. SILBERSCHMICT

Vadim Silberschmidt was appointed to the Chair of Mechanics of Materials at the Wolfson School of Mechanical, Electrical and Manufacturing Engineering at Loughborough University, UK in 2000. Prior to this he was a Senior Researcher at the Institute A for Mechanics at Technische Universität München in Germany. Educated in the USSR, he worked at the Institute of Continuous Media Mechanics and Institute for Geosciences (both - the USSR (later – Russian) Academy of Sciences). At Loughborough, he heads the Mechanics of Advanced Materials Research Group and Research Theme "Materials and Measurement". He is a Charted Engineer, Fellow of the Institution of Mechanical Engineers and Institute of Physics. His research focus is on mechanics and micromechanics of deformation, damage and fracture in advanced engineering and biological materials, including composites and nanocomposites, biopolymers, metals and alloys, biological and biomedical materials, materials for microelectronics, sports materials and non-woven fabrics. Vadim Silberschmidt chairs the Technical Committee 14 "Integrity of Biomedical and Biological Materials" of the European Structural Integrity Society. He is Editor-in-Chief of Elsevier Series in Mechanics of Advanced Materials, Associate Editor of "Shock and Vibration" (Hindawi) and "Journal of Vibration and Control" (SAGE Publications) and a member of Editorial Boards of international journals "Materials Science and Engineering A: Structural Materials: Properties, Microstructure and Processing" (Elsevier); "Computers, Materials & Continua" (Tech Science Press); "International Journal of Automotive Composites" (Inderscience), "Advanced Manufacturing: Polymer & Composites Science" (Taylor & Francis), "Reviews on Advanced Materials Science" (De Gruyter), "Defence Technology" (Elsevier) and "Science and Engineering of Composite Materials" (De Gruyter). Vadim Silberschmidt is an Honorary Professor at Perm National Research Polytechnic University, Russia. He was a visiting professor at National Institute of Advanced Industrial Science and Technology (Japan), New Mexico State University (USA), St. Petersburg State University (Russia), University of Texas at Dallas (USA) and Griffith University (Australia). Vadim Silberschmidt has co-authored six research monographs and some 640 peer-reviewed scientific papers (including more than 370 journal papers). He has (co-)supervised more than 80 PhD students.

HYBRID MACHINING OF ADVANCED MATERIALS

The paper presents an overview of ultrasonically assisted machining (UAM) – a modern hybrid technique based on superimposition of high-frequency vibration on a movement of a cutting tool. Hybrid-hybrid techniques can also include additional enhancements - with workpiece heating (hot UAM, or HUAM) or laser preheating of a process zone (LUAM). Ultrasonic vibration with a relatively small amplitude – below 20 microns – changes dramatically the response of a machined material to a cutting process. As a result, a significant – in excess of 80% in turning of aerospace Ni- and Ti-based superalloys – reduction of average cutting forces is observed together with improvement of surface roughness. Experiments with ultrasonically assisted drilling of CFRP composites resulted in 90% reduction in the magnitude of the measured thrust forces and almost 100% reduction in the torque, decreasing manufacturing-induced delamination and improving surface finish. HUAM and LUAM can additionally improve the machining outcomes. The developed methods were successfully used to machine various materials – from ductile (e.g., aluminum alloys) to brittle (e.g., glass and rocks) and biomaterials (bones) – as well as multi-material compositions, e.g., CFRP-Ti stacks. This is achieved thanks to transformation of a continuous material-removal process of a standard cutting technique into a vibro-impact one in hybrid or hybrid-hybrid machining. The paper presents an overview of various ultrasonically assisted machining schemes and their application to various structural materials. It covers a description of experimental setups and analysis of in-house experiments focused on measurement of cutting forces, surface integrity etc. A special emphasis is on advanced numerical simulations of these machining techniques used to elucidate their effect on workpiece materials. Such simulations are the only way of adequate analysis of complex spatio-temporal processes that presuppose a use of 3D transient, fully coupled thermo-mechanical finite-element (FE) formulations for a domain with a changing boundary and complex contact conditions. The Loughborough group was the first to develop FE models of different of ultrasonically-assisted techniques.

About the Speaker

Professor Yushiyuki MATSUOKA

From 1982 to 1996, Dr. Yoshiyuki Matsuoka designed many passenger cars for the Nissan Motor Co. Ltd. and managed the design department. He also has served a president of Japanese Society for the Science of Design and a committee member of Japanese government agencies. He is currently an honorary professor at Keio University and a visiting professor at Waseda University in Japan. He presides over the DesignJuku, which provides a venue for designers, engineers, researchers and students in various areas of design. He has mainly carried out research on design science and has already constructed new theory, for instance, the AGE thinking model, the multi-space design model and the design dualism. For his research, he has received many awards such as the 2002 Liberty Mutual Best Paper Award from the International Ergonomics Association. He is also listed in Who'sWho in the World and Science and Engineering Edition.

DESIGN SCIENCE TOWARDS INTEGRATION OF DESIGN

While the design has made people's life rich, it also produced many negative legacies, for instance, resource and energy crises, global environmental issues, and safety issues. In order to solve these problems produced by the subdivided designs, the new viewpoint for the integration of them is required. Firstly, this speech summarizes the context of conventional design which results in subdivision of the design. Secondly, this speech discusses a framework for design science as the new viewpoint for the integration of the subdivided designs. Finally, in this speech, the AGE thinking model as a design reasoning model and the multi-space design model as a design theory are introduced for the integration of design based on the framework for design science.

About the Speaker

Professor Ivica VEZA

Professor Ivica Veža is the Chair of the Department of Industrial Engineering at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture of the University of Split, Croatia. He received his B.Sc. in 1975, M.Sc. in 1980 and Ph.D. in Mechanical Engineering, all from University of Zagreb. He has been a guest researcher for three years at the Fraunhofer institutes IPA in Stuttgart and IPK in Berlin and RWTH WZL in Aachen. He has been to Nagoya University, Technical University of Vienna and University of Malta as a guest professor. He has run several international projects: TEMPUS, CEEPUS, ERASMUS, two bilateral Slovenian-Croatian projects, several technology projects for BICRO, Croatian Institute of Technology and other. He has been the leader of 12 international and 11 domestic scientific projects and has participated in 46 projects on economy. He published 11 books, 14 chapters in scientific books and he was the author of 42 articles in journals and 172 conference papers. He has supervised more than 15 PhD and M.Sc. students. He is a member of the Croatian Academy of Technical Sciences since 2000, is a member European Academy of Industrial Management since 2009 and is the leader of Croatia's technological platform for the European Initiative since 2005. He was also a member of the Management Board of the Technology Centre in Split between 2000 and 2007. He also initiated and managed the introduction of Industrial Engineering study as a unique study between FESB and Faculty of Economics. From 2008 to 2013, professor led the project TEMPUS-2008-IT-JPCR 144959, a master program in Product Lifecycle Management with Sustainable Production, where a new course PLM was introduced in the graduate study of Industrial Engineering. In May 2011, at PTW in Darmstadt, he signed the agreement with the representatives of 10 European universities to start an initiative to build a Learning Factory, which aims a new paradigm for the education for engineers. He is the Vice President of Lean Management Initiative which was established in 2010 in Zagreb. Professor Veža's research areas include lean production, plant layout, computer integrated manufacturing, modeling and simulation, production management, logistics.

CONCEPT OF LEAN LEARNING FACTORY AT THE UNIVERSITY OF SPLIT

In this research, a concept of the Triple helix model connected via the Learning Factory concept is presented. Learning Factory could be placed where University, Industry and Government meet each other, share needs and expectations, and work on collaborative projects. It could be a solution to a missing link in the Triple helix model. Lean Learning Factory at FESB, based on a didactical concept emphasizing experimental and problem- based learning using tools and methods from Lean management, have true potential to play an important role in the regional development of Split- Dalmatian County and its industrial enterprises. Solution proposal for the best balance between toys and real products consider design and production line development for product "Karet". It is a traditional and original product from Croatia, so it will raise enthusiasm in the learning process in both students and industry employees. Two assembly lines will be developed, one traditionally equipped and one intelligent, networked, flexible, and fully improved by Lean tools. By deeper analysis of both assembly lines, hybrid assembly lines could be designed, to balance on one side assembly tact time according to customer demand and total cost of installation and running on the other side. Methods and tools adapted and implemented, in both design and analysis process for optimization of this hybrid assembly line would be scaled and adjusted for industry use as part of knowledge transfer from university to enterprises.

About the Speaker Dr.

Tzou- Liang LUO (Derek LUO)

Dr. Derek Luo is division director of Intelligent Manufacturing Technology Division at Intelligent Machinery Technology Center, ITRI. He is also a corporate Member of CIRP (The International Academy for Production Engineering), Full Member of CSME (Chinese Society of Mechanical Engineers), visiting Researcher of UBC (University of British Columbia) and 4th Board of Director of Tan-Ya-San Industry Association. and He got his B.Sc., M.Sc. and Ph.D. in

Mechanical Engineering all from Department of Mechanical Engineering of National Chung Hsing University, Taiwan R.O.C. Derek Luo was Engineer in Mechanical and Systems Research Laboratories in ITRI between 2012 and 2013, then he has promoted to Deputy Director of Intelligent Machine Tool Technology Center, Central Region Campus, ITRI on 2014. Later on, 2015 He became Director of Intelligence Manufacturing Technology Division, Machine Tools Technology Center, ITRI and finally since 2016 he is the Director of Intelligence Manufacturing Technology Division, Intelligent Machinery Technology Center, ITRI. He is now working on Finite element studies in natural behaviors/impact fractures/transient responses of pure solid/porous medium structures and he is a high-performance machine tool designer.

INTELLIGENT MACHINERY TECHNOLOGY

The intelligent machinery technology center has been focusing on machine tool technology, which includes machine tool design, machining process optimization and intelligent software for machine tool operator as well as shop floor managers. These technologies have been implemented and transferred to industrial partners, however for most small and medium companies in Taiwan it is still not easy to figure out what are the necessary building blocks of an intelligent manufacturing shop floor. Moreover, building such an intelligent shop floor calls for large scale investment, therefore a pilot production site is needed to integrate and demonstrate full scenario of an intelligent shop floor. The pilot production site is a government supported project with the following objectives:

- To construct a shop floor which consist of machines from Taiwan machine tool companies and controllers as well as software
- To construct a shop floor which consist of machines from Taiwan machine tool companies and controllers as well as software
- To demonstrate mixed production use cases of real industrial parts from industrial sectors such as bicycle, automotive, aerospace and other machinery
- To establish cloud computing infrastructure and collect process data from production use cases
- To help other research institutes and universities with developing data-driven applications using cloud computing infrastructure and process data base.

In order to conduct intelligent and flexible manufacturing in a shop floor, shop floor equipment must be connected with management and business system. In the pilot production site this is achieved by the IoT software system called VMX. The VMX system acts as the backbone of the information flow of the shop floor, which collect data from machine tools, robots, automated guided vehicle (AGV) as well as coordinate measuring machine (CMM). The process data from shop floor are then communicated with the manufacturing execution system (MES), which is responsible to collect production orders from enterprise resource planning system (ERP) and execute in shop floor. In addition to demonstrate current technology, the pilot production will also be used as a testbed to help research teams verifying emerging technology such as 5G for industrial application and common cloud computing solution platform for machinery industry. ITRI shall continue to update the hardware and software in the pilot production site and link with universities,

research institutes, and industry by using iot and cloud computing technology to conduct more research and development projects for intelligent manufacturing.

About the Speaker

Professor Onur TUNÇER

He was born in 1979 in İzmir and completed his secondary education in İzmir Science High School in 1997. He graduated from the Department of Mechanical Engineering at the Middle East Technical University in 2001 with honors. He received his PhD in the same field from Louisiana State University in the United States in 2006. He is still a faculty member at Istanbul Technical University, Faculty of Aeronautics and Astronautics, Department of Aeronautical Engineering, and also serves as the General Manager of MILTEKSAN CNC Technology and Control Systems Industry. He has academic and industrial studies on engineering software development, model-based design, CNC control systems.

DIGITAL TRANSFORMATION OPPORTUNITIES REGARDING MACHINE TOOLS AND INVESTIGATION OF MILTEKSAN INDIGENOUS CNC CONTROLLER DEVELOPMENT EFFORTS

In this study, first of all, the global position of the machinery manufacturing industry in Turkey is revealed and the important place held by numerically controlled benches (CNC) in the manufacturing industry is substantiated with figures. Components that create added value in CNC machines are analyzed item-by-item. It is observed that the control system comprising of electronic hardware and software create the most added value. Global trends suggest that with the advent of new generation CNC control systems this situation will further improve in favor of software. Efforts of MILTEKSAN initiative, that emerged as a co-operative role model to capitalize on digital transformation opportunities with the proliferation of new generation CNC controllers, on the development of indigenous CNC controller hardware and software are investigated and the critical role of sector clusters in this regard are emphasized.

ABSTRACTS

INVESTIGATING EFFECT OF CURLINESS ON POROSITY FOR RANDOM FIBROUS NETWORKS (MMM1)

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ABSTRACT

Fibrous materials are plentiful in nature. Moreover, fibrous materials can be both natural and synthetics. Cellulosic papers, for instance, can be an example of natural fibrous networks. Nonwoven fibrous networks, on the other hand, are an example of manmade fibrous networks. Due to the complex microstructure of the fibrous network that inherits from the fibre crimp and random distribution of fibres, fibrous networks are commonly preferred to use in filtration applications. The effect of fibre curliness on the filtration performance of fibrous networks is evaluated in this study. In addition to fibre crimp, the effect of basis weight regarding fibre crimp is also investigated within the scope of this research.

To understand the effect of curliness on porosity, two distinct types of fibrous networks – for the first type, crimp fibres are used and the second one generated with straight fibres – are created with a fully parametric in-house software written in Python® programming language. With the developed parametric fibre network generation algorithm, crimp and non-crimp fibrous networks are generated according to user-defined basis weight values. The developed in-house script, moreover, can compute the porosity for each fibrous network. In this way, the filtration performance of generated fibrous networks can predict with the porosity parameter.

In summary, the effect of fibre crimp on the filtration performance of fibrous networks is evaluated with the porosity value in the computer environment in this study. To do that, the developed in-house script can be used. The designed algorithm allows user to optimize their fibrous networks within the computer environment. In this way, maximum filtration performance can be achieved by optimising porosity parameter with respect to fibre curliness for various

basis weight values. As a result of doing optimisation in the computer environment, significant time and money can be saved to develop optimum filtration capability for fibrous networks.

Keywords: Porosity, Filtration, Fibrous networks.

COMPUTATIONAL DESIGN OF AN INFRARED SYSTEM FOR HAMBURGER COOKING (MMM2)

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ABSTRACT

This study was carried out for computational design of an infrared system for hamburger cooking. The objective was to design an infrared system and then use the manufactured system in an automated cooking process. For this purpose, a computational mathematical model was developed and experimentally validated in a pilot scale infrared system, and then the computational design studies were completed for a quick and efficient process for automation purposes. The final design is expected to be used in an automated hamburger preparation system for safe production and consumption.

Keywords: Hamburger, Optimal design, Infrared cooking, Computational manufacturing.

DETERMINATION OF FIBER ORIENTATIONS AND STIFFNESS PROPERTIES VIA MICRO-CT SCAN IMAGES: APPLICATION TO COMPOSITE MATERIALS WITH MICROVASCULAR CHANNELS (MMM3)

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ABSTRACT

Previously, a method with an in-house software was developed in KU Leuven Composite materials department, for the determination of several mechanical properties of composites from the scanned Micro-CT images. In this study, this method was used to determine the effect of microvascular channels on the mechanical behavior of composites Initially, the fiber orientation disturbance due to the channels was evaluated. Then the channel's effect on the composite stiffness is determined. The results revealed orientation disturbance in the out-of-plane direction with a maximum of about 6°. The presence of micro-channel reduced local stiffness up to 19%. Expected change in the mechanical properties were successfully determined with the proposed method.

Keywords: Composites, Micro-CT, Micro-vascular channels, Fiber orientation, Mechanical properties.

COLOCATED VISUO-HAPTIC SIMULATION: CHALLENGES AND EXAMPLES (MMM4)

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ABSTRACT

In a typical virtual reality (VR) simulation with haptic feedback, visual and haptic stimuli are not collocated. That is, the users watch interactions with virtual objects on a computer screen, but feel them via a commercial haptic device located somewhere else. For applications with a relatively small workspace, such as digital sculpting or surgical simulations, this is still a somewhat immersive experience. If the computer screen is replaced by a VR headset, then colocation is possible but with limitations. This is mainly because the haptic workspace provided by a typical commercial force-feedback device is very small compared to the visual workspace provided by the headset. So called encountered-type haptic displays (ETHDs) are better suited for haptic feedback in modern virtual-reality and/or augmented-reality (AR) environments. ETHDs are actually robot manipulators that position their end-effector at the location of the virtual object and wait for the user to "encounter". The biggest challenge here is the accurate tracking of the user's hand or tool to ensure successful encounters. Another challenge, which only applies to AR, is to remove the ETHD from the visual scene.

This presentation will also include two different examples of collocated visuo-haptic simulation environments. In the first one, users hold real tools in an AR environment and receive kinesthetic haptic feedback. The second one features barehand interaction with virtual objects having different surface properties.

Keywords: Visuo-haptic, Virtual reality, Mixed reality, Encountered-type haptic display.

COMPUTATIONAL MODELING AND DESIGN OF INNOVATIVE FOOD PROCESS SYSTEMS (MMM5)

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ABSTRACT

There has been a recent trend for the use of innovative food processing approaches to replace or combine with the conventional techniques. The use of infrared, microwave and radio frequency approaches are some of the thermal technologies found place in the industrial process lines. The purpose for introducing these systems is for efficient processing and reduced energy usage with improved quality of the final food product. To meet these challenges, design of these systems is rather important while the industry has still been approaching the problem with a trial and error interface of manufacture and see how it goes. On the other hand, the main issue for these innovative thermal processing approaches is to first know the required physics with its mathematical background. This approach provides the temperature change of the product during the process and/or the electromagnetic field distribution within the system. This is very important since the field distribution of microwave or radio frequency must be combined with the heat transfer taking place within the target product. Due to the inefficient knowledge of the industrial manufacturing in this view, the manufactures systems first resemble each other and do not demonstrate the expected efficiency. In these processes the physics of food heating, the effect of the boundaries and the resulting changes in the food quality with the energy efficiency of the manufactured system are the concerns. Therefore, the objective of this study was to present the computational designing of infrared, microwave and radio frequency systems using computational mathematical models and demonstrate the effect of the computational manufacturing approach.

Few of the recent studies presented the significance of the computational modeling on the system design and process optimization. Topcam et al. (2021) carried out process optimizations studies in continuous flow microwave systems and demonstrated the optimization of the process design and cavity geometry by indicating the flow pipe orientations within the system. With these results, a different view for an optimized manufacturing of a continuous flow microwave system was confirmed. Altin et al. (2022) signified the cavity geometry effects on the electromagnetic field distribution of microwave tunnel systems and introduce the industrial scale continuous system designs with the confirmed and improved temperature uniformity. Karatas et al. (2022) presented the design considerations of a hypothetical continuous flow system design for beer processing with the final objective of innovating the current conventional approach using an experimentally validated computational model.

With respect to this concept, this study focused on the design of an industrial scale microwave system. For this purpose, a computational model was first developed using a finite element multi-physics software (Comsol AV V.5.6, Stockholm, Sweden) where electromagnetic field distribution within the microwave cavity and a food product were simultaneously solved with the heat transfer effects. The first step was the experimental validation of this computational model. Fig. 1 shows the electromagnetic field distribution and model validation results in a computationally designed and manufactured lab-scale system. Following this, a pilot-scale continuous flow microwave system was designed, and an experimental validation was again carried out. This step for the manufactured pilot-plant scale continuous system results is given in Fig. 2. The last step was the design of industrial scale systems where the electromagnetic field distribution and effects of the magnetron orientation in the microwave cavity are shown in Fig. 3. In Fig. 3, the difference in these two designs was based on the orientation of the magnetrons placed along the top wall of the cavity. These results present a significant variation of the electromagnetic field distribution within the cavity and demonstrates the requirement of a computational model for an efficient design and following manufacturing.

Keywords: Computational modeling, Innovative food processing, Computational manufacturing.

A DYNAMIC CHARACTERISATION OF FULL-OVERLAP LOW-SPEED REAR IMPACTS (DfTS1)

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ABSTRACT

This study presents a dynamic and statistical analysis of full-overlap low-speed staged rear impacts conducted by the AGU Research Group in Switzerland. A total of 101 staged twovehicle rear impacts are analysed in which there are override/underride impacts or crashes with full engagement of the bumpers. A work-energy approach is applied to model dynamically two-vehicle full-overlap rear impacts. In the second stage of this study, regression analyses are performed to find correlations between closing speed versus coefficient of restitution, mutual crush, and the ratio of returned and absorbed energies. The presented analysis in this study can be a useful source for accident reconstruction and modelling low-speed rear impacts.

Keywords: Rear impact, Stiffness, Energy analysis.

ANALYSIS OF SEAT BELT USE AND THORAX INJURIES SUSTAINED BY FEMALE OCCUPANTS IN FRONTAL IMPACTS (DfTS2)

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ABSTRACT
Accidents involving road motor vehicles not only cause thousands of fatalities and even more injuries worldwide every year, but also bring a huge burden on the global economy. This research investigates various factors that potentially affect thorax injury types and severities sustained by female occupants in frontal impacts with a particular focus on seat belt use. A database is formed using NHTSA's Crash Injury Research Engineering Network (CIREN) data. The generated database brings together selected information of 463 female occupants who are involved in frontal vehicle collisions in the US within the period of 2005 - 2014. Statistics regarding vehicles' seat belt condition, subjects' features and conditions, and types and levels of the injuries suffered are provided. Dependence of severities of injuries on seat belt use and seating position during the accidents is investigated through descriptive and inferential statistical analysis.

Keywords: Seat Belt, Thorax Injury, Female Occupants, CIREN, Frontal Impact.

IMPROVING THE SAFETY OF LONDON BUS USERS THROUGH DESIGN (DfTS3)

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ABSTRACT

Over 5.04 billion bus passenger journeys were made in Great Britain in one year (2015-2016), and around half of the bus passengers in the UK are passengers of London buses. In 2015, 1,594 bus and coach occupant casualties were reported by the Metropolitan Police Service (MPS). However, some 6,096 incidents not requiring police intervention were also reported by London's Bus Operators to Transport for London (TfL) in 2016, suggesting that there is a more of a problem of passenger injury than is suggested by the MPS figures.

In this study, quantitative data was analyzed to derive a better understanding of the nature and circumstances of injuries and how they can be prevented and/or mitigated by design. Additionally, countermeasures were developed in consultation with designers, engineering, human factors and vehicle safety experts. These were then presented to stakeholders to determine priority solutions i.e., those that would have the most impact on preventing bus occupant injuries together with the feasibility of implementing them.

Five years-worth of police collision data were analyzed in total The data identified that bus accidents in the London area resulting in reported bus passenger injuries had increased during a five-year period, rising from a 31% share of the total STATS19 bus accidents in 2012 to 44% in 2016 Department for Transport, 2017). Most passenger injury incidents resulted from non-collision incidents. The data also allowed identification of the passenger position in the bus in one of four categories which can help to identify the bus movement at the time of the incident. The analysis identified that alighting and boarding mainly occurs when the vehicle is "waiting to go", "parked" or "moving off". However, injuries sustained while seated, which on average represent 41% of the casualties, most often occurred when the vehicle is "going ahead" or "slowing / stopping". Standing injuries, which account for half of the total casualties, occurred most frequently when the vehicle was "slowing / stopping", "going ahead", or "moving off".

Keywords: Bus Safety, Slips, Trips and Falls, Non-Collision Injuries.

E-SCOOTER SAFETY STUDIES AND A USER TRIAL STUDY (DfTS4)

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ABSTRACT

E-scooters (electric scooters) are becoming more popular around the world, as people seek
alternatives to travelling by car to reduce carbon emissions, have better mobility around
congested cities and save money. Several e-scooter rental trials are currently running in some
areas in the UK. Despite the benefits the use of e-scooters brings, there were 3 fatalities and
931 casualties in accidents involving e-scooters in the UK in 2021. Hence the safety issues
become increasingly significant.

The small footprint of the e-scooter can make the rider feel uncomfortable when sharing the
roadway with cars, however, in a similar way to e-scooter riders feeling disproportionately
vulnerable on roads compared to cars. Safety issues include e-scooter riders' erratic and
unpredictable behaviour when switching from one travel mode to another. Extensive literature
review of this study also reveals that the environmental impact of e-scooters is still subject to
debate with most e-scooter trips replacing walking rather than polluting vehicles.

A trial where 22 participants evaluated their e-scooter interaction has favourable results with
participants rating the e-scooter highly for safety in general, with some contrasting feedback
suggesting potential concerns from users.

Keywords: E-scooters, Electric scooters, Road safety, Accidents, Incidents, Safety.

OCCUPANT PROTECTION IN SEATS WITH FIXED RECLINERS IN REAR-END COLLISIONS (DfTS5)

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ABSTRACT

This paper presents the development of an energy-absorbing car seat with fixed recliner that can mitigate whiplash risk in rear-end collisions. The developed seat has a proactive head restraint and an energy-absorbing device under the seatpan. The seat produces neck shear forces lower than 120 N when subjected to the medium and high severity crash pulses of EuroNCAP. Additionally, a very high severity crash pulse with a velocity change (delta-V) of 35 km/h is applied and the largest neck-shear force at this severity is only 189 N. The developed seat gets maximum points from the dynamic whiplash assessment protocol of European New Car Assessment Programme (EuroNCAP).

Keywords: Seats with fixed recliner, Rear seat, Rear-end collisions, Integrated safety.

DESIGN OF AN ACTIVE MAGNETIC BEARING SPINDLE FOR MICRO-MILLING APPLICATIONS (9)

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ABSTRACT

The application of micro-milling for the fabrication of micro-scale parts/features from a plethora of materials has found significantly increased usage. In this fabrication process, miniaturization of mechanical components requires smaller machine tools with ultra-high rotational speeds. For such speeds, active magnetic bearing is a promising technology because it enables high-speed and contact-free rotation with active control of the spindle dynamics. Considering the application of the micro-milling process, we present the design of major components of magnetic bearing spindle including radial and axial magnetic bearing, air turbine, and rotor. Conventionally used analytical models, as well as three-dimensional finite element models, were used to aid the design process. A Pareto front using a genetic algorithm for radial magnetic bearing based on bearing force and volume is also determined to aid the selection of manufacturing dimensions based on the relative importance of bearing performance metrics.

Keywords: Magnetic bearings, High-speed micro-milling, Spindle, Air turbine, Pareto front.

INVESTIGATION OF DIMENSIONALITY REDUCTION METHODS FOR CHATTER DETECTION WITH SVM (10)

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ABSTRACT

Chatter vibrations significantly affect the quality and efficiency of machining operations. Machine learning algorithms for intelligent chatter detection are viable options when there is sensor data available at the machine tool level. Most machine learning methods require a feature engineering phase where the most valuable data should be extracted and prepared as input for a machine learning classifier. The selection of the proper dimensionality reduction method at this early stage enhances the performance of the classifier.

This study aims to investigate the effectiveness of several dimensionality reduction methods when using Support Vector Machine (SVM) as a classifier. Vibration signals collected during slot milling are binary labeled as stable (0) and chatter (1). Signals were reshaped to 0.5-second segment and 0.1-second segment. Ten-dimensional (10D) statistical time-domain features extracted from signals were reduced to three-dimensional (3D) feature space with Principal Component Analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE), and Autoencoder (AE) dimensionality reduction methods. Signals were classified by SVM classification with various training distributions.

The effectiveness of different dimensionality reduction techniques and different training distributions were compared for chatter detection. Furthermore, it was observed that dimensionally reduced features were classified quicker and more accurately than statistical time-domain features.

Keywords: Dimensionality reduction, Machine learning, Milling, Chatter.

DEVELOPMENT OF AN ONTOLOGY BASED DYNAMIC PROCESS PLANNING AND SCHEDULING METHODOLOGY FOR DISRECETE MANUFACTURING SYSTEMS (35)

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ABSTRACT

Manufacturing companies are being pushed toward flexible manufacturing systems by tough global market rivalry and constantly changing client expectations. Process planning and scheduling procedures are therefore extremely important for manufacturers. These processes become even more crucial in the case of flexible job shops with volume and product type flexibility. "Industry 4.0" introduces new possibilities by merging computer and information technologies with manufacturing systems to cope with increasing competition and improve process planning and scheduling efficiency. In this research, an ontology-based metal cutting domain model is created and the reasoning rules for generating feasible solution(s) for the process planning phase are developed. Outcoming results from this process are injected into the Lekin scheduling program to produce the most optimized scheduling solution for the problem.

Keywords: Dynamic process planning and scheduling, Ontology-based modelling, SPARQL, Lekin.

ON THE FINITE ELEMENT MODELING BEST PRACTICES FOR THE METAL CUTTING SIMULATIONS (58)

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ABSTRACT

Finite element analysis is a widely used method to analyze solid mechanics problems. This method is also popular on metal cutting simulations as cutting process results and characteristics can be obtained in great detail. Despite the modeling and results screening capabilities of this technique, the fidelity of the method is highly dependent to the modeling approach and inputs. In case of metal cutting simulations, modeling may become more challenging due to the excessive work material deformation at high strain rate levels and coupled thermal effects. Different techniques are proposed in literature studies in order to overcome modeling difficulties and improve simulation accuracy but those are mostly proposed for specific problems. The aim of this study is to establish finite element modeling best practices for the metal cutting process which are intended to be generic approaches for different type of problems. For this purpose, detailed evaluation of the tool – work material interaction is performed by considering process geometry and deformation characteristics. FE simulation results are compared with experimental results in order to determine FE modeling best practices in an efficient manner.

Keywords: Metal cutting simulation, Finite element method, Machining process modeling.

CHANGES ON SURFACE PROPERTIES OF METALS DUE TO BORON NITRIDE COATINGS (5)

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ABSTRACT
Boron nitride (BN) coatings using a physical vapor deposition system with magnetron sputtering are applied on tools, dies and implants to change their surface properties. By changing the coating parameters, different BN allotropes can be produced with different properties. Properties of cubic boron nitride include high coating hardness, good wear resistance whereas the properties of hexagonal boron nitride include low friction coefficient and low hardness. The other allotropes show properties between these extremes. The characterization of the (BN) coatings is carried out to find the thickness, nanohardness, adherence properties using a scratch test, tribometer tests to find friction and wear properties.

Keywords: Coating, Boron nitride, Magnetron sputtering, Mechanical characterization

INFLUENCE OF PUNCH PROPERTIES ON CONTACT MECHANICS OF COATED SUBSTRATES (16)

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ABSTRACT

The contact mechanics between a deformable elastic punch and a coated half-plane substrate model is examined. The half-plane substrate is made of Ti6Al4V metallic alloy and coating is the ceramics named as ZrO2. Ti6Al4V/ZrO2 coating substrate model is in contact between a deformable punch made of Si3N4. The displacement and stress expressions are derived based on theory of elasticity and the equilibrium equation. Boundary and interface continuity conditions are determined. To obtain contact and subsurface stresses, finite element method is utilized. The accuracy of the developed computational solution is tested by employing mesh independence study. Then, parametric analyses are carried out to reveal elastic punch properties, coefficient of friction and thickness of the coating on stress distributions. It is demonstrated that punch modulus has a profound impact on results, hence designing of punch material is critical to avoid surface related damages.

Keywords: Contact mechanics, Elastic coating, Deformable punch, Coefficient of friction, Finite element method.

A NOVEL BALLISTIC LIMIT THEORY FOR WOVEN COMPOSITES (17)

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ABSTRACT

Composite materials are widely used in personal armors because of their superior characteristics like high stiffness and barely lower weights. Protecting the human body against a high-velocity projectile is the primary duty of composite materials used in the military industry. Therefore, it is a vital issue to predict the highest velocity of projectile that a composite plate bears without perforation. Ballistic strengths of composite plates are defined by this velocity, called the ballistic limit velocity. In this study, a novel theory is developed to calculate the ballistic limit of composite plates with an energy-based approach. The developed formulations are applied to real and virtual ballistic impact test cases to predict the ballistic limits. A satisfying correlation between results is observed. Also, a parametric study is carried out to observe the effects of design changes on the ballistic limit. Finally, an empirical surface is generated for the ballistic limit.

Keywords: Impact, Ballistic limit, Woven composite.

ANALYSIS OF ACOUSTICALLY ACTUATED SEDIMENTATION PREVENTION SYSTEM FOR SYRINGE PUMPS (46)

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ABSTRACT

The design and analysis of a sedimentation prevention system for a syringe pump is presented in this paper. The aim of the design is to prevent sedimentation inside the syringe placed on a syringe pump by utilizing acoustophoresis technique. Analysis performed for the design of the syringe is provided. The analyses are done using COMSOL Multiphysics software. Piezo electric transducer providing 2.4 MHz with the supply of 220 V of electric potential is determined to prevent sedimentation of particles with 1100 kg m-3 density and 10 μm diameter.

Keywords: Acoustophoresis, Sedimentation, Syringe pump, Piezo electric transducer.

DESIGN OF AN ANTI-SEDIMENTATION SYRINGE PUMP FOR MICROFLUIDICS APPLICATIONS (62)

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ABSTRACT

Microfluidic systems are platforms on which small volumes of liquid samples are processed. Today, methods of directing and controlling Microfluidics have become critical. The best-defined method for pushing liquid through a microfluidic system is to use syringe pumps. Syringe pumps are benchtop equipment that creates flow by pushing the plunger of a liquid-laden syringe at a predefined rate. The expensiveness of these devices makes it challenging to find them in laboratories with limited resources. In addition, precipitation of particles in the syringe barrel is another issue to consider in microfluidic applications in particle solutions. The slow flow and the sensitive and generally long-term completion of the process are also essential factors in the formation of these sedimentations. Different solutions for this situation continue to be developed. Various open-source alternative syringe pump systems can be fabricated and created using 3D printing. This article presents a simple and economical

method to design and manufacture an open-source syringe pump that prevents particle precipitation.

Keywords: Syringe pump, Microfluid, Sedimentation, Vibration, Particle, 3D Printing.

INVESTIGATION OF THE EFFECT OF HUB CURVE ON THE PERFORMANCE OF RADIAL COMPRESSOR FOR HIGH-SPEED TURBOMACHINERY (65)

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ABSTRACT

This paper presents the design of a radial compressor with vaneless diffuser for high speed turbomachinery. The aim of this paper is to design a radial compressor with improved aero dynamic performance with better hub curve. The design process starts with the aerodynamic analysis of blade design and continue with structural and modal analysis of integrated disk and blades. A special attention is applied to meridional profile has a significant effect on surge/stall performance the compressor. The hub curve is optimized by using Bezier curve with 4 (x,y) control points and fitted to the arc segment. The verification of the aero design has been conducted using CFX software with focusing on a blade passage and vaneless diffuser. The structural integrity of blade and disk have been carried out at maximum rotational speed with Al2124-T851 material.

Keywords: Centrifugal compressor, Hub curve, Stress analysis, Computational fluid dynamics, Al2124-T851.

DETERMINATION CUTTING PARAMETERS FOR AGGRESSIVE-HIGH PERFORMANCE CHIP REMOVAL OF THE BEVELING MACHINE WITH AUTOMATED WORKPIECE DETERMINATION AND TOOL PATH GENERATION SYSTEM (1)

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ABSTRACT

The wind turbine tower has a structure consisting of sheet metal plates with welded joining. One of the important factors determining the quality of the welded joining process is the Beveling process. Today, Beveling process is carried out either manually and labor intensively or with CNC machines. The Beveling process carried out under operator control has disadvantages in terms of quality and production time. CNC machines, on the other hand, have disadvantages such as high investment cost and precise part attachment and G code preparation time. For this reason, a fully automatic Beveling machine has been developed that determines the tool path route by recognizing the sheet plate edge geometry with a unique technique. The most important advantages of the developed machine; the lack of a precise part binding method and G code creation, it has a much lower investment cost than CNC machines, it eliminates operator-induced errors despite manual machines. With the developed machine, edge milling is performed with high volume aggressive chip removal method. Within the scope of the tool wear tests carried out, the relationship between "tool life and machining quality" and "cutting and feed rates" was examined and optimum cutting parameters were determined.

Keywords: Beveling machine, Milling, Aggressive milling, High-volume machining, Edge milling, Tool life.

COMPARISON OF ANN AND RSM IN PREDICTION OF THE TANGENTIAL FORCE IN TURNING OF AISI 4140 HARDENED STEEL CONSIDERING FLANK WEAR (15)

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ABSTRACT

Turning is one of the industry's most commonly used material removal methods. A significant output of the turning process is the material's surface roughness since the design's functionality depends on the material's surface roughness. The main cutting force during turning is directly related to surface roughness and tool wear. The aim of this study was to predict cutting force by using Artificial Neural Network (ANN) and Response Surface Methodology (RSM). The trained ANN model predicts the critical values of the main cutting force and tool wear. In this model, cutting speed, feed rate, depth of cut, and flank wear were inputs, while the tangential force was output. The results were evaluated by calculating the coefficient of determination, root mean square error, and model predictive error. It was found that the ANN model was better at anticipating the cutting force. The statistical results suggest that ANN and 2nd order RSM model showed higher performance, while the 1st order RSM model indicated very low accuracy. ANN was slightly better than the 2nd order RSM model among better models. Therefore the ANN model was the most effective one among the three models at predicting the cutting force.

Keywords: Artificial neural network, Flank wear, Machining, Turning, Response surface methodology.

A METHOD TO OBTAIN THE CROSS-SECTIONAL PROFILE OF THE REGION SWEPT BY A TOROIDAL CUTTER DURING A SCREW MOTION (23)

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ABSTRACT

A model is introduced, which gives the cross-sectional profile of the swept volume of a toroidal cutter that moves along a helical path. The model considers that a milling cutter can be generated by unifying an infinite number of circles along the axis of rotation of the tool since all milling cutters can be represented by the solids of revolution. By obtaining the traces of all circles which undergo helical motion in a reference plane, the equation of the cross-sectional profile of the swept volume is derived as the envelope of these traces. An implicit equation of the cross-sectional profile of the swept volume was obtained. A CAD program was used to verify the model.

Keywords: Toroidal cutter, Helical milling, Helical groove, Profile, Ring torus.

AN EXPERIMENTAL STUDY OF THE EFFECTS OF ULTRASONIC CAVITATION-ASSISTED MACHINING (UCAM) ON DIFFICULT-TO-CUT MATERIALS (24)

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ABSTRACT

Advanced materials are often used in many advanced sectors such as aviation, defense and biomedical. However, most of these materials are called difficult-to-cut due to their poor machinability. Ultrasonic Cavitation-Assisted Machining (UCAM) is one of the recent vibration-applied cutting processes that uses high frequency and low amplitude vibrations to create cavitations in order to enhance cutting performance. There is a lack of study about UCAM of difficult-to-cut materials. In this study, an experimental investigation of UCAM on difficult-to-cut materials are examined and compared with the conventional methods. The results showed that UCAM can enhance the cutting performance in terms of surface quality.

Keywords: Ultrasonic cavitation-assisted machining, Hard-to-cut materials, Ti-6Al-4V, Surface roughness, Tool wear.

EXPERIMENTAL STUDIES ON THERMAL DEGRADATION, IGNITION AND COMBUSTION OF LOW-VULNERABILITY GUN PROPELLANTS (7)

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ABSTRACT

The development of insensitive gun propellants can lead to ignition issues. Detailed understanding of the thermal behavior of such materials is therefore necessary and is investigated in this paper to present activation energies. Laser ignition appears to be a good alternative to overcome ignition issues. These propellants are ignited in a closed reactor to obtain ignition and combustion characteristics. Experiments are performed for different initial pressures, surrounding atmospheres and laser powers. Results show that ignition and combustion characteristics are better under argon than nitrogen. Indeed, overpressures can be 42 % higher under argon for some initial pressures. For a laser power of 5 W, ignition energies are of 92.63 mJ under argon and of 107.65 mJ under nitrogen. Laser power plays a role on ignition characteristics but has little effect on combustion characteristics

Keywords: Insensitive gun propellants, RDX, Thermal analysis, Laser ignition, Activation energy, Ignition energy.

RE-DEFINING TEMPERATURE SET-POINT OF AN HVAC SYSTEM BASED ON THERMAL COMFORT ZONE OF STUDENTS IN A UNIVERSITY STUDY HALL (48)

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ABSTRACT

The main purpose of the Heating, Ventilating and Air-Conditioning (HVAC) systems is to satisfy thermal comfort to the occupants. However, thermal comfort and thermal sensation could be different due to the cultural difference, climatic adaptations, body mass index, gender and age. The gap between thermal comfort and sensation causes higher energy consumption for the HVAC systems. To this aim, this paper aims to investigate thermal comfort temperature of the occupants in temperate climate zone. The experiments are conducted on 1062 students in a university study hall in Ankara/Turkey during heating season. The Actual Thermal Sensations (ATS) of the students are collected on a developed mobile application while the objective measurements of indoor air temperature are conducted via an industrial globe thermometer. The results showed that the thermal comfort temperature is 21.03°C and 20.68°C for female and male students, respectively. According to the simulation results, 243 kWh energy could be saved if new comfort temperature of the students would be used instead of a constant 22°C set-temperature of the HVAC system.

Keywords: Thermal Comfort, Actual Thermal Sensation, Comfort Temperature, HVAC Systems.

EFFECT OF ENVIRONMENTAL PARAMETERS ON OUTDOOR THERMAL COMFORT OF STUDENTS IN A UNIVERSITY CAMPUS (74)

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ABSTRACT

Developing thermally acceptable outdoor spaces plays a vital role on students to sustain comfortable life for their leisure times. However, few studies have been conducted on outdoor thermal comfort at university campuses, especially in Csb type climate zones. This paper investigates a comprehensively research on the effect of environmental parameters such as cloud cover, sky view factor, mean radiant temperature, solar radiation, land surface temperature and wind speed on outdoor thermal comfort of students by field experiments. Four different locations (car park zone without vegetation and shade, car park zone with grey pavements and little amount of shade, resting zone with high amount of vegetation and little amount of shade and resting zone with high amount of vegetation and shade) which are the outdoor spaces most frequently used by students in a university campus in Csb climate zone are selected as a case study. The thermal comfort of the students is assessed with Physiologic Equivalent Temperature values while objective data are collected by sensors. The analysis results indicated that land surface temperature was the most significant parameter on the thermal comfort of students for each location. Additionally, the lowest impact on the thermal comfort was found in the relative humidity change with 14% sensitivity. The outcome of this study can enlighten landscape designers and planners to achieve sustainable university environments.

Keywords: Outdoor Thermal Comfort, Students, Cloud Cover, Mean Radiant Temperature, Sky View Factor.

FINITE ELEMENT ANALYSIS OF THE LUMBAR VERTEBRAE L4-L5 SEGMENT WITH LIGAMENTS (26)

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ABSTRACT

In this paper, the effects of compressive load and torsion are investigated on the lumbar segment L4-L5 and non-linear intervertebral disc L4/5 with and without ligaments. The model has been created using SolidWorks and then sent to Ansys Workbench. The finite element (FE) model is compared with the available in-vitro experimental results. The results of the axial deformation of the assembly for 500 N (corresponding 0.758 MPa pressure) showed 1.7 percent difference from the numerical and experimental results in the literature. It is concluded that the FE model described the mechanical behavior of the L4-L5 segment, adequately.

Keywords: FEM, Hyper elastic material, Intervertebral disc, Ligaments, Lumbar spine, Mooney rivlin model, Ogden-3 model.

FINITE ELEMENT ANALYSIS OF ALL-CERAMIC FGM DENTAL CROWNS USING PHASE-FIELD APPROACH (30)

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ABSTRACT

Functionally graded materials (FGMs), categorized in advanced composite materials, are specially designed to reduce the stresses and failure due to material mismatches. Advances in manufacturing techniques have brought FGMs into use in a variety of applications, however in the field of dental prosthesis, due to the complex geometries, only graded material layers are utilized in the structures. Despite the manufacturing difficulties, that hinder the preparation of the layer-wise graded prosthesis, numerous finite element simulations can be found in the literature for validating stress reduction in the material interfaces. Presenting a numerical procedure, which both facilitates the implementation of material non-linearity in geometrically complex domains and increases the accuracy of the calculation using a phase-field approach, this study is investigating the usage of FGMs in dental prosthesis. A mandibular first molar FGM crown is analyzed under the maximum masticatory bite force, and the results are compared to a crown prepared conventionally

Keywords: Dental crown, Phase-field, Functionally graded material.

AN EXPERIMENTAL And NUMERICAL STUDY OF MULTI-STAGE HOT FORGING PROCESS OF CW617N BRASS ALLOY (59)

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ABSTRACT

The multi-stage hot forging is critical as it enables the production of a large number of brass fittings. Experimental analysis is performed by examining microstructure and hardness characteristics of multi-stage hot forged specimens. Numerical simulation of this process and predicted outputs such as strain distribution through using SIMUFACT software are presented. Experimental results reveals that the metal flow lines is regular and no dead metal areas are found. The results obtained from the study will contribute to a good understanding of the forging load, the metal flow lines and the forming conditions for the designers at both forging stages.

Keywords: Multi-stage hot forging process, Metal flow line, Effective strain-stress distribution, Numerical analysis, Brass alloy.

AN EXPERIMENTAL INVESTIGATION OF ALUMINUM ALLOY WITH ULTRASONIC VIBRATION-ASSISTED MACHINING AND MINIMUM QUANTITY LUBRICATION (31)

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ABSTRACT

Al7075-T6 alloy is one of the most commonly used aluminum alloys that used in advanced engineering sectors such as aviation and automotive industries. Machining is an essential process in order to make final product in these sectors. Ultrasonic Vibration-Assisted Machining (UVAM) is one of the developed techniques to increase cutting performance efficiency. Also, coolants are another important aspect that directly affect the efficiency and Minimum Quantity Lubrication (MQL) is a technique that enhance the coolant performance. In this study, UVAM & MQL techniques are used together for slot milling operation of Al7075-T6 for the first time. Results showed that, this combination enhanced the cutting performance efficiency in terms of cutting forces and surface roughness.

Keywords: Al7075-T6, Ultrasonic vibration-assisted machining, Minimum quantity lubrication, Cutting force, Surface roughness

A DYNAMOMETER TO MEASURE 2- DIRECTIONAL CUTTING FORCES IN TURNING PROCESS (36)

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ABSTRACT

In this study, a turning dynamometer that can measure static and dynamic two directional cutting forces, feed force (Fx) and main cutting force (Fy) by using strain gauge has been designed and developed. The orientation of octagonal rings and strain gauge locations has been determined to maximize sensitivity. The developed dynamometer is connected to a data acquisition system. Cutting force signals were captured and transformed into numerical form and processed using a data acquisition system consisting of necessary hardware and software. The obtained results of machining tests performed at different cutting parameters showed that the dynamometer could be used reliably to measure cutting forces.

Keywords: Dynamometer, Cutting forces, Strain gauge, Octagonal ring.

RECURSIVE DEFINING OF FORCE COEFFICIENTS IN MILLING PROCESS WITH ACCELEROMETER (42)

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ABSTRACT

Force coefficients are required for mechanistic force calculations in machining operations. The mainstream method of identification of force coefficients relies on dynamometers. However, using dynamometers is not necessarily applicable. This paper offers a method of force coefficients identification without force measurement. A specially designed workpiece is milled. Its acceleration is utilized together with FRFs obtained on the same milling machine that the acceleration is measured. Force estimation is performed with acceleration data and FRF. Force model is curve-fit with recursive least squares method into force estimation in order to find force coefficients.

Keywords: Machine Tool Structure, Identification, Frequency Response Function, Milling, Cutting Force, Force Coefficients.

ULTRASONIC ASSISTED DRILLING ON PRECIPITATION HARDENED MARTENSITE STAINLESS STEEL (53)

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ABSTRACT

17-4 PH Stainless steel is a developed material which has desirable features such as high tensile and fatigue strength, good toughness, high hardness and excellent resistance to corrosion and due to these desirable features it is useful in defence, aviation and nuclear sectors. Drilling is one of the most commonly used machining operations in these sectors however because of the high wear resistance and hardness the drilling performace of this material is quite poor. Ultrasonic Assisted Drilling (UAD) is a recent method that facilitate the chip removal process by using high frequency and low amplitude vibrations. In this study, UAD is used for the first time in 17-4PH material. The results showed that, UAD reduced cutting forces, prevented the built-up edge and provided better chip formations compared to conventional drilling.

Keywords: 17PH4SS, Ultrasonic assisted drilling, Cutting force, Chip morphology, Built up edge, Cutting speed.

A DESIGN IMPROVEMENT AND STRUCTURAL ANALYSIS IN A PRE-DESIGNED HYBRID DRILLING (66)

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ABSTRACT

The load-bearing metal and the composite part drilling process of Al/CFRP, and Ti stacks, on the aircraft wings are crucial for the aircraft industry. During this process, problems such as rapid tool wear, extreme interface consumption, and significant subsurface damage may occur. This process needs to be done either manually or semi-automatically. In this paper, a pre-designed semi-automatical tool is improved with an additional pneumatic driving system and MQL cooling. The last part of the paper focused on the FEM analysis of the selected mechanical sections.

Keywords: Hybrid drilling, Composites, Tool design, MQL, FEM.

NUMERICAL DETERMINATION OF THE NECKING PHENOMENON USING STRESS WAVE PROPAGATION TECHNIQUE (37)

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ABSTRACT

Generally, the stress wave method is based on the propagation of the waves inside the solids which under some conditions cause the material to undergo the necking phenomenon. The numerical method by the way needs to employ dynamic explicit solver to be able to show the necking phenomenon. However, the most important step regarding the solutions in this method is to give applicable material properties to obtain the acceptable results for the time and the place of the necking. Therefore, the material properties implemented to the numerical model should be modified specifically for the points after the necking. This study compares some of the correction methods affecting the necking time and shows that without suitable correction factor, the explicit solver will not be able to define the necking appropriately.

Keywords: Stress wave propagation, Necking, Sheet metal, Correction methods.

DYNAMIC PERFORATION RESPONSE OF HONEYCOMB SANDWICH PANELS UNDER HIGH-VELOCITY IMPACT: EFFECT OF TUBE REINFORCEMENT (63)

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ABSTRACT

This study presents a comparative numerical investigation for the effect of tube reinforcement on the perforation resistance of aluminum honeycomb sandwich panels subjected to high-velocity impact by .30 caliber fragment simulating projectile. The numerical modeling procedure is performed by using the explicit finite element code, LS-DYNA®. Two different aluminum honeycomb sandwich panels, conventional and tube-reinforced, are considered for the comparative numerical analyses. Johnson–Cook plasticity model is implemented to describe the elastoplastic material behavior of the sandwich panel components. The effect of tube reinforcement on the perforation response of the sandwich panels is explored under both normal and oblique impact conditions at an impact velocity which is beyond their ballistic limits. The numerical results indicate that the tube reinforcement provides a considerable improvement to the sandwich panel by increasing the energy absorption (decreasing the residual projectile velocity) and preventing relatively excess deformation and failure of the sandwich panel components. The contribution of tube reinforcement becomes more significant under oblique impact where the unreinforced honeycomb core has a minor effect.

Keywords: Sandwich panel, Honeycomb, Tube reinforcement, High-velocity impact, Perforation.

DESIGN AND MANUFACTURE OF A PENDULUM IMPACT TESTING MACHINE FOR PLASTICS (69)

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ABSTRACT

In the context of the undergraduate capstone project, we designed and manufactured a pendulum impact testing machine that will be utilized to determine the impact strength of plastics according to ISO 8256:2004 standard. The design was mainly based on the ISO 13802:2015 standard, which is used to verify the expected properties of such a device. Pendulum impact testing machines are used to detect the fracture energy absorption capacity of a material under dynamic impact stresses. This work was achieved in collaboration with the R&D department of UTEST, which has a worldwide reputation in the manufacture of testing machines.

In this work, the design criteria were determined as the development of a bench-top, portable, and cost-effective impact testing machine that can be used in research applications. Since we are planning to test plastics and composite materials, the manufactured device is naturally light and small-scaled compared to its counterparts used in the testing of metals. Though, the total weight of the device is optimized at around 60 kg for stability issues. The impact strength tester produced a maximum of 2 J of energy. A special clamp design adapted during this project renders the testing machine to be used for both "Charpy" and "Izod" impact tests. The PLC screen used in the testing machine can provide fracture energy, friction coefficient, pendulum angle, and speed as digital data during and after the test. The stress analysis of the

structure of the device was performed by Siemens NX and Ansys software. We still continue the calibration work of this newly developed impact testing machine.

Keywords: Impact Strength, Fracture Energy, Toughness, Plastics, Charpy, Izod.

MODELING AND SIMULATION OF ELECTROMAGNETIC SHEET METAL FORMING FOR LARGE DEFORMATIONS (72)

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ABSTRACT

Electromagnetic forming (EMF) is an effective method to improve the formability of sheet metals with minimum risk of failure. This effort is dedicated to a numerical modeling and simulation of the EMF procedure and a comparison with the corresponding experimental studies carried out for an aluminum sheet metal forming. A coupled electromagnetic forming phenomena is implemented via DLOAD and UMAT subroutines in ABAQUS/Standard. The Maxwell's Equations and Lorentz Forces are calculated using finite difference method and the deformation analysis of the problem is carried out for finite element method in the large deformation frame-work. The experimental results confirms the acceptable accuracy of performed numerical analysis.

Keywords: Electromagnetic Forming, Finite Element Method, Finite Difference Method, Lorentz Force, Maxwell Equation, Electro-Magneto-Plasticity.

A FURTHER INVESTIGATION FOR PARAMETRIC OPTIMIZATION OF ARCHED AND HONEYCOMB CORED SANDWICH COMPOSITE PANEL FOR AIRCRAFT WING BUCKLING WITH FINITE ELEMENT ANALYSIS (3)

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ABSTRACT

This work dwells on a further necessity of the parametric optimization work of sandwich composite materials with FEA. The design of sandwich composite materials is not a new area, however, this work will pave the way for the engineers to design and size more effective wing panels, airframe geometries, composite fan blades, and other applications that need reduced weight. In the aerospace industry, sizing is a very important area for lightening the weight of the aircraft. Sizing operation is applied according to the buckling because it is the most critical failure mode of thin-walled structures under bending loads such as wings. However, the general investigations of sizing are done for metallic materials and simple composite panels. This work investigates and explains the optimization methodologies used in aerospace industries that are not shared with further material optimization that will have more importance in the future. Furthermore, the sizing applications do not optimize the materials. Sizing operations determine the thickness of the thin-walled structures, however, the different material combinations may have less mass when they are optimized properly. This work strategy optimizes not only the thickness of the materials but also materials. Thus, this is a further way for consideration of materials in optimization and sizing. There is a discrimination between the methodology and mostly used sizing operations in the aerospace industry. In the aerospace industry, sizing operations are done for the selected materials, also, the selected materials generally are in stock. However, the methodology is done for selecting the optimum materials, material combinations and size the minimum thickness.

Keywords: Sandwich composite material, Parametric optimization, Finite element analysis

BULK PASSIVE SENSORLESS SORTING OF COMPLEX CYLINDRICAL COMPONENTS WITH INTERNAL FEATURES AND SYMMETRICAL EXTERNAL TAPERS (13)

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ABSTRACT

In robotic assembly, manipulators can be used extensively to undertake all the different facets of the process, however, this can be expensive and space inefficient. Instead, reduced intricacy in sensing and control (RISC) can be adopted involving minimal use of manipulators with parts of the process undertaken using passive methods.

A novel tooling method has been developed to passively orientate complex shaped cylindrical components with symmetrical external tapers in bulk transit. The design of the tooling is component specific, however, this method can be applied to generic components. This technique has been successfully tested in an industrial assembly system.

Keywords: Sensorless, Bulk sorting, Orientation filtering.

OPTIMUM DESIGN OF AN AIRPLANE BRACKET USING TOPOLOGY AND SHAPE OPTIMIZATION METHODS (56)

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ABSTRACT

A design phase of products significantly impacts the entire production process when examined in terms of production and maintenance costs, product quality, and time. The efficiency of the product design process is increased by catching the optimum designs; it is aimed to reduce the cost, increase the quality and reduce the total product production time. In this study, the optimum dimensions of the airplane bracket used in airplanes were obtained by making topology and shape optimization, respectively.

Keywords: Topology optimization, Shape optimization, Bracket.

THE OPTIMUM STRUCTURAL DESIGN OF AIRCRAFT COMPONENTS FOR ADDITIVE MANUFACTURING (57)

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ABSTRACT

Today, with the development of technology, traditional production methods used in the industry have been developed and changed, or new techniques have been discovered. Additive manufacturing or 3D printing technology, which has been used frequently in recent years, is one of them. Thanks to additive manufacturing, it has become possible to manufacture parts that are difficult to manufacture, costly, and time-consuming compared to other methods. It is widely used in areas where technology is constantly developing, such as aviation and automotive. In addition, topology optimization methods have been developed to reduce the mass of the manufactured parts and thus lower material consumption. After topology optimization, another method called lattice optimization is frequently applied to change the lattice structures of the parts and make them safe for the applied loads.

Within the project's scope, the drone arm, the connecting element of an unmanned aerial vehicle, was examined. Topology and lattice optimizations were applied, and it was aimed to reduce the mass of the arm. The stress values, masses, and displacements at the initial state and after the optimization were compared.

Keywords: Additive manufacturing, Optimization, Production, Lattice structures, Topology optimization.

SYSTEMATIC CLASSIFICATION OF 3D SHAPE ANALYSIS METHODS USING CURVATURE AND QUANTIFICATION OF "COMPLEXITY" (4)

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ABSTRACT

This research aims to conduct a systematic classification of 3D shape analysis methods using curvature and quantify the impression of "complexity" based on the classification. In the systematic classification, we investigated papers using curvature to evaluate characteristics of 3D shapes and found 7 curvatures and 4 types of feature descriptor are used. To quantify "complexity", we calculated 5 curvatures: Gaussian curvature, Mean curvature, Casorati curvature, Shape Index and Curvature Index. In addition, we calculated feature descriptors considering surrounding information and occurrence probability. By the sensory evaluation experiment, we found that the feature descriptor which uses Gaussian curvature and entropy of occurrence probability has the highest accuracy to quantify "complexity".

Keywords: Curved surface, Complexity, Curvature, Feature descriptor.

RELATIONSHIP BETWEEN IMPRESSION AND SHAPE CHARACTERISTICS OF TEXTURE USING COMPUTATIONAL DESIGN (6)

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ABSTRACT

This paper describes the relationship between shape characteristics of texture using Computational design and their impressions. Specifically, we conducted the shape generation using Grasshopper and the shape output using an FDM 3D printer. We created various prototypes and sought novel textures which are appropriate to the FDM 3D printing. After that, we focused on the holes and bumpy texture using Voronoi diagram and created various textures by controlling the parameters related to the size and distribution of the holes and convex. Then, we conducted an evaluation experiment in order to explore the visual and tactile impressions from the shapes of each sample. As a result of the experiment, we interpreted that the impression was composed of three factors, "reliability", "directionality", and "peacefulness". Moreover, the relationship between impressions and shape characteristics was clarified by comparing each factor and parameters.

Keywords: Computational design, Additive manufacturing, Texture, Impression, 3D printing, Voronoi diagram.

KEYWORD GENERATION SYSTEM BASED ON DESIGN THINKING MODEL (11)

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ABSTRACT

Design is said to be an activity to solve the inverse problem and difficult to be solved. To support the design activities, many design support tools using artificial intelligence (AI) have been proposed, recently. This study focuses on the early/industrial design process in which designers utilize qualitative/linguistic data (design keywords), and proposed the keyword generation system using AutoExtend, which is a method of language creation in AI, in order to solve the problem of the ambiguity of the vector (distributed representation) of the words having multiple meanings. Additionally, we conducted the two experiments to evaluate the effectiveness of the keywords and to verify the usefulness of the proposed system in design activities (to count the number of the generated design ideas) and confirmed the applicability of the proposed system.

Keywords: Creativity, Design tool, Keyword generation, AutoExtend, Word2vec, WordNet.

Modeling and Simulation of Active Double-Acting Hydro-Pneumatic Suspension System Using Fuzzy Logic Controller for 6x6 Terrain Vehicle (22)

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ABSTRACT

Active suspension systems are widely used in terrain vehicle applications because of their outstanding road holding and ride comfort characteristics. In this paper, an active double-acting hydro-pneumatic suspension system with the fuzzy logic controller is studied. In order to compare the performance of both active and passive suspension systems, a two DOF quarter car model of a 6x6 terrain vehicle is simulated on three different road conditions. To observe more realistic results, the kinematic relations between the sprung and unsprung masses are included in the model.

Keywords: Double-Acting Hydro-Pneumatic Suspension, Active Suspension, Fuzzy Logic Control, Dynamic Modeling, Quarter Car for Rough Terrain Vehicles.

DESIGN OF A TWO-SPEED DUAL-CLUTCH TRANSMISSION FOR ELECTRIC VEHICLES (27)

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ABSTRACT

This paper deals with the design of a two-speed dual-clutch transmission (DCT) system for electric vehicles. In contrast to the two concentric clutch assembly used in conventional DCTs which is very complex and costly, in this study a novel approach was proposed in which two electromagnetic clutches were mounted on parallel shafts. The design and analysis of the transmission components were carried out by means of analytical approach. The results indicated that compared to a single-speed transmission which required 64 seconds to reach from zero to 55 km/h, the application of the two-speed transmission in the electric car resulted in the decrease of the acceleration time to 30 seconds. Also, it was found that the two-speed transmission system resulted in 37 kJ energy save during the acceleration.

Keywords: Dual-Clutch, Transmission, Electric vehicle, Acceleration, Energy saving.

AN INVESTIGATION OF THE CRASHWORTHINESS OF MULTI-CELL FILLED BATTERY SIDE BEAMS (60)

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ABSTRACT

In this study, the crashworthiness of the battery side beam structures for battery safety of electric vehicles was numerically tested. L profile was chosen for the side beam structure cross-section. Three different multi-cell geometries were investigated to examine the effect of filling multi-cell structures in the battery side beam on the crash resistance. In addition, multi-cell structures with different thicknesses and different materials are also examined. The crash analysis was carried out with a cylindrical rigid impactor. As a result, it was determined that multi-cell structures increased the crash efficiency for the battery side beam.

Keywords: Crashworthiness, Multi-cell structure, Battery side beam, Electric vehicle.

CANCELLATION OF SINGULARITIES OF RRRRP PLANAR PARALLEL ROBOTS (21)

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ABSTRACT

Parallel robots have many advantages compared to their conventional serial counterparts such
as high accuracy and precision, high rigidity, low energy consumption and high payload
carrying capacity. Their major disadvantage, however, is the existence of Type II singularities
within the workspace. When approaching to these singularities, the magnitudes of the
Lagrange multipliers and of the actuator forces and/or torques go to infinity, and hence
controllability of the robot is lost. This paper studies conditions for cancellation of Type II
singularities of the RRRRP-type planar parallel robot from its dynamic model. The RRRRP
robot belongs to the five-bar parallel robot family.

Keywords: Parallel robot, Planar parallel robot, Singularity, Singularity cancellation

INVESTIGATING EFFECTS OF POLARIZATION AND DIMENSIONS OF MAGNETIC COUPLING ON TRANSMITED TORQUE BY FINITE ELEMENT ANALYSIS (32)

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ABSTRACT

In this study, a 3-dimentional Finite Element Analysis (FEA) model is developed to investigate of the torque transmission capability of 16 radial magnetic couplings with different polarizations and magnet dimensions (height, thickness, and the gap between two sets of magnets). As theoretical model, Coulomb model is presented. The results show that increasing polarization of the magnet by 20% (from 1.11 to 1.33 T) resulted in 45% increase in the transmitted torque. In addition, 50% increase in the gap size between two sets of the magnets causes 18% decrease in the transmitted torque. On the other hand, when height or thickness of the magnet is increased 50%, the transmitted torque increases 55% and 85% respectively.

Keywords: Magnetic coupling, Finite element analysis, Torque transmission, Polarizations

DESIGN AND MANUFACTURE OF A FATIGUE TEST MACHINE (33)

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ABSTRACT

It has been observed that materials fail under fluctuating stresses at a stress magnitude which is lower than the yield strength of the material. This situation is known as fatigue failure and it depends on many parameters such as the number of cycles, mean stress, stress amplitude, stress concentration and corrosion. To determine the strength of materials under the action of fatigue loads, specimens are subjected to repeated or varying forces of specified magnitudes while the cycles or stress reversals are counted to destruction. The most widely used fatigue-testing device is the rotating-beam machine. This machine subjects the specimen to pure bending by means of loads.

In this study a fatigue test machine was developed and manufactured to establish fatigue strength of a material. The machine main body was assembled by a box profile via welding operation and the rotational motion provided by an electric motor. Manually controlled power screw and a load cell is used to adjust the desired load on the specimen. Total cycle number for the specimen is obtained with the use of a lap counter.

Keywords: Fatigue test, Rotating-beam test machine.

INVESTIGATION OF PERMANENT MAGNET SYNCHRONOUS MOTORS WITH THREE DIFFERENT SLOT-POLE COMBINATIONS FOR SCOOTER APPLICATION (67)

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ABSTRACT

In this paper, analysis of three permanent magnet synchronous motors (PMSM) has been carried out using the Simcenter Speed program, which is based on the finite element method (FEM). This motor has 500W shaft power, 9.1Nm shaft torque and 525 rpm to be used in electric scooters. Noiseless, vibration-free, smooth and efficient operation are the forefront requirements for scooters, for this reason, three different combinations of stator slot-rotor poles (36-40, 36-38 and 36-34) have been tried in this paper. The results obtained by numerical calculation and finite element method (FEM) were compared. Comparison results are given in the next sections in order.

Keywords: Design, analysis, Simcenter speed, BPM, PMSM, PM, Outer rotor, Hub motor, FEM, Analytic calculation, Back EMF, Slot, Pole.

DESIGN AND ANALYSIS OF A LIGHTWEIGHT CHASSIS FOR AN ELECTRIC VEHICLE (47)

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ABSTRACT

The purpose of this paper is to design a modular ladder frame chassis for an electric vehicle. The factors considered in the design of the chassis were obtaining a lightweight structure that not only could carry the static loads but also provide structural integrity under the dynamic loads of different crash scenarios. The analysis was carried out by means of linear FEA (Finite Element Analysis) for static loads and non-linear FEA for crash tests. Three different crash scenarios including frontal impact, side impact, and roof strength test were taken into account according to Insurance Institute for Highway Safety (IIHS) test protocols. The designed chassis provided survival space for occupants and no fracturing occurred in the structure.

Keywords: Chassis, Electric vehicle, Static and dynamic analysis, Crash tests.

DEVELOPMENT OF AN IMAGE PROCESSING SYSTEM FOR THE AUTOMATIC QUALITY CONTROL OF VEHICLE AIRBAG PLASTIC PARTS (61)

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ABSTRACT

In this study, an automatic vision-based defect inspection and sorting system has been developed for a plastic injection mold component called side passenger airbag, which is a critical component in automotive safety. In order to detect the defects on the plastic part, the necessary mechanical and automation system for the industrial image processing system has been developed. A part-specific image processing algorithm was created and faults were detected in 1.28 seconds instead of 45 seconds. Thanks to the developed system, all defects on the plastic product, which is a vital and safety component, could be detected, and the safety part was sent to the end user faultless.

Keywords: Image processing, Plastic injection, Quality control.

System Optimization of Battery Discharge State using Artificial Neural Network in an Electric Vehicle Powertrain (64)

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ABSTRACT

Nowadays electric vehicle technology considerably focuses on battery storage systems and increasing battery life in electric vehicles. In this study, the physical modeling of the real vehicle is used to create DT (Digital Twin) model by using Artificial Neural Network (ANN). Than, the obtained DT model is used as the objective function in SA (Simulated Annealing) algorithm to find optimum DoD (Depth of Discharge) value based on the defined parameters in the electric powertrain system. The electric vehicle powertrain system is modeled as 1-D and battery DoD status are observed based on system inputs. After that, the modeled battery system is subjected to Design of Experiment (DOE) study using Latin Hypercube distribution which enables to have system behavior data in wide range which provides the data pool for ANN model. Obtained data pool from DOE including the vehicle weight, roll friction coefficient and wind speed effecting DoD behavior is modeled with ANN structure in Python language. Trained ANN model, also called 'Digital Twin' of the system, then is used within System Optimization using Simulated Annealing (SA) Algorithm as objective function. Afterwards, the obtained parametric model is confirmed and compared with physical modeling. According to results of the performed methodology, ANN adaptation and System Optimization in Vehicle powertrain system enables to predict desired comfort parameters and optimized the modeled vehicle system. The methodology followed in this study makes a new contribution to the literature and an electric vehicle battery discharge behavior is first investigated based on ANN model integrated SA algorithm. The methodology provides the system estimation by using ANN called Digital Twin and system optimization using ANN as objective function, which gives the optimized DoD value controlled by BMS. The followed methodology enables to eliminate many real-vehicle testing and bench test, instead provides system parameter estimation using ANN model as 'Digital Twin' concept.

DESIGN OF MODULAR PLANETARY GEARBOX WITH TWO-STAGE PLANET GEARS FOR USE IN VALVE ACTUATORS (71)

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ABSTRACT
A method to help design a planetary gearbox for use in valve actuators is presented. In the method AGMA criteria are employed along with the assembly requirements of the gearbox. A three-arm planet system with planets split into two separate wheels is considered instead of a simple planetary gear train. A MATLAB program is coded to help the design and with this code it becomes possible to obtain two- and more staged inline gearbox system.

Keywords: Planetary Gearbox, Modular, Valve Actuator.

WORKPIECE DEFECT DETECTION USING MASK R-CNN WITH DOMAIN KNOWLEDGE TRANSFER LEARNING (IMT1)

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ABSTRACT

The Mask R-CNN model is applied to detect several kinds of defects. However, the mAP (mean average performance) of the model is not high if the amount of training pictures is not high. To enhance the mAP of model, a domain knowledge transfer learning (DKTL) is proposed which applies the domain knowledge to label the potential area of defect. This labeling method could increase the recognition targets such that the accuracy of model could be highly increased. It is found that the DKTL could achieve almost 5 times higher mAP as compared to the general transfer learning technology.

Keywords: Defect detection, Mask R-CNN, Transfer learning, Layer transfer, AI combining machining knowledge.

TOOL WEAR MONITORING IN MILLING FOR VARIED CUTTING CONDITIONS USING VIBRATION AND CURRENT SIGNALS (IMT2)

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ABSTRACT

This paper presents a random forest model for predicting tool wear under varied cutting conditions as well as a study of preprocessing of extracted signal features. The frequency domain signals were separated as features related to spindle speeds and machine tool structure. It was found that in addition to time domain signals, frequency signals induced by tool passing frequency and its multipliers were as important as frequency signals due to machine tool structure. It was also recommended that in the training data, at least two data sets, which were collected at the same spindle speed as in the testing data, were required for accurately predicting tool wear.

Keywords: Tool wear, Machine learning, Milling, Vibration signals.

DESIGN OF THE LOW-COST IOT-BASED WIRELESS MONITORING SYSTEM FOR CNC LATHE CUTTING TOOL VIBRATION MONITORING (IMT3)

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ABSTRACT

This study describes the design phases and implementation of a wireless, IoT-based, and costeffective monitoring system for evaluating the orthogonal vibration signal from the CNC lathe cutting tool. This system utilizes the MEMS sensor ADXL1002 together with its evaluation board. The Arduino DUE microcontroller is used to collect the voltage signal from the MEMS sensor. The Windows Forms-based program can then process and gather the data through the serial communication interface. This system's wireless Point to Point data connection between two points (sensor and PC) makes it safer to collect data throughout the machining process. In addition, the program has a data storage system, data processing that displays signal attributes (maximum amplitude, lowest amplitude, RMS, and maximum frequency), data visualization that displays data in two ways (time domain and frequency domain), and alert function which connected with WhatsApp application in a mobile device. This inexpensive monitoring system can attain a sample rate of around 350 samples per second and provide close agreement with the data accessible by the commercialized sensor and monitoring system. It shows that an effective monitoring system can also be made with affordable systems and materials.

Keywords: Monitoring, Lathe, Vibration, Wireless, Affordable.

DEVELOPMENT OF THE SURFACE QUALITY MONITORING SYSTEM IN ENDING MILLING PROCESS (IMT4)

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ABSTRACT

High surface quality is an important indicator for high performance machining in the manufacturing process. Whereas, surface roughness generated in machining can be affected by cutting parameters and machining vibration. To achieve processing efficiency, monitoring the surface quality within the desired range is of importance and worthy of investigation. This study was aimed to develop a surface roughness prediction system for a milling process. The predictive model was established based on data collected from machining experiments by response surface methodology. The surface roughness can be related to the independent variables, including cutting parameters and machining vibration, in terms of nonlinear functions by regression analysis. To be implemented in CNC milling machine for online application, the predictive model was established based on the IIOT-VMX platform, which can acquire the cutting parameters from controller via OPCUA interface as well as the vibration features from sensory module. The system can predict the roughness based on these data, and issue alert when the predicted value exceeds the preset threshold or abnormalities of vibration are detected.

Keywords: Cutting conditions, Machining vibration, Surface quality.

DEVELOPMENT OF A MULTI-LEVEL TOOL WEAR MONITORING SYSTEM IN THE MILLING OF INCONEL 718 (IMT5)

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ABSTRACT

In this study, a multi-level tool wear monitoring system is proposed to provide information regarding the level the tool wear has reached before the limit of tool wear assigned in metal cutting. The sensors installed include an accelerometer, an acoustic emission (AE), and a MEMS microphone. The levels of tool wear, including the sharp tool, 100-150µm, 200-250µm, and 350-400µm, were defined based on the analysis of the variation of signal features collected. To develop the system, a Recurrent Hidden Markov Model (RHMM) is established as the classifier first for each chosen adjacent level and a multi-level monitoring system is integrated together with models referring to each chosen adjacent level. To improve the system performance and robustness, the multi-sensor feature fusion and decision fusion, as well as the Self-Organizing Map (SOM), were integrated into the original model. Considering the system performance with only adopting the RHMM classifier, the system with features fusion or decision fusions could improve the classification rate up to 90%, compared to the lower value with the model using only a single sensor signal. Finally, by integrating the SOM into the above-mentioned multi-sensor system, a 100% classification rate could be obtained in this study with the feature or decision fusion.

Keywords: Tool wear monitoring, Vibration, Audible sound, Acoustic emission, Sensor fusion.

TÜRKÇE BİLDİRİLER

(İngilizce Özetler)

PAPERS IN TURKISH

(with English Abstracts)

3-DENKLEMLİ TÜRBÜLANS GEÇİŞ MODELİNİN JENERİK GÖVDE GEOMETRİSİ İLE BAŞARIM DEĞERLENDİRMESİ (29)

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ÖZET

Reynolds-ortalamalı Navier Stokes (RANS) denklemlerine dayalı laminar-türbülans geçiş modelleri arasında bulunan 3-denklemli *k-kl-ω* ismiyle adlandırılan geçiş modelinin incelenmesi, hava ve su araçlarının gövdesini temsil eden jenerik gövde modeli kullanılarak gerçekleştirilmiştir. Bu modelin değerlendirilmesi 6.5 x 106 Reynolds sayısında ve 5 derece hücum açı koşulunda, en yaygın kullanılan γ-ReΘ türbülans geçiş modeli analiz sonuçları ve halihazırda mevcut deneysel veri sonuçları kullanılarak yapılmıştır. Eksenel kuvvet ve normal kuvvet katsayılarının yüzey çözüm ağı büyüklüğünden kaynaklı ayrıklaştırma belirsizlik bandı Ağ Yakınsama Endeks (İng. Grid Convergence Index, GCI) metoduyla bulunmuştur. Geometrinin hesaplanan integral aerodinamik katsayı parametrelerinin yanı sıra yüzey basınç ve sürtünme katsayılarının değişimi de incelenmiştir. *k-kl-ω* türbülans geçiş modeli γ-ReΘ modeline göre eksenel kuvvet katsayısını yaklaşık %50, normal kuvvet katsayısını ise yaklaşık %30 fazla tahmin etmektedir. *k-kl-ω* türbülans geçiş modeli ile elde edilen sonuçlar etrafındaki belirsizlik bandı tahmini ise normal kuvvet katsayısında daha fazla iken γ-ReΘ modeli eksenel kuvvet katsayısı etrafındaki bandı daha büyük bulmaktadır.

Anahtar Kelimeler: Türbülans Geçiş Modeli, Ayrıklaştırma Hatası, Küremsi Geometri, Türbülans Geçiş Yeri, Aerodinamik Katsayı.

PERFORMANCE EVALUATION OF A 3-EQUATION TURBULENT TRANSITION MODEL WITH GENERIC BODY GEOMETRY

ABSTRACT

One of the Reynolds-averaged Navier Stokes (RANS) based transition model, which is called k-kl-ω model, is investigated using a generic body geometry of air/water vehicles. This model evaluated at 6.5 x 106 Reynolds number at 5-degree angle of attack with the results obtained with widely accepted γ-ReΘ transition model and an available experimental study. Discretization uncertainty band around the axial and normal force coefficients due to surface mesh sizes are found using Grid Convergence Index (GCI) method. Besides integral aerodynamic coefficients, variation of surface pressure and friction coefficients are evaluated. The k-kl-ω transition model finds axial force coefficient approximately 50%, and normal force coefficient approximately 30% larger than the γ-ReΘ transition model results. While the k-kl-ω transition model gives greater uncertainty band around normal force coefficient, γ-ReΘ transition model gives larger uncertainty band around axial force coefficient.

Keywords: Transition Model, Discretization Error, Spheroid Geometry, Transition Location, Aerodynamic Parameters.

DAİRE TESTERE TEZGAHLARINDA, KESİCİ TAKIM ÜZERİNDE OLUŞAN TİTREŞİMİN İŞ PARÇASINA ETKİSİNİN İNCELENMESİ (20)

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ÖZET

Testere tezgâhları, üretimde kullanılacak metal iş parçalarını kesme işlemi ile istenilen ölçülere getiren makinelerdir. Endüstride yaygın olarak kullanılan testere tezgâhları, üretim hatlarının ilk kısmında yer almaktadır. Bu sebeple, iş parçasının istenilen toleranslarda kesilememesi durumunda ciddi üretim ve malzeme kayıpları oluşmaktadır. Bu çalışmada, kesici takım üzerinde oluşan titreşimin, ölçü toleransına ve yüzey pürüzlülüğüne olan etkisi incelenmiştir.

Anahtar Kelimeler: Testere Tezgâhı, Ölçü Toleransı, Yüzey Pürüzlülüğü, Titreşim.

INVESTIGATING THE EFFECTS OF GENERATED VIBRATIONS ON THE CUTTING TOOL ON THE WORKPIECE IN CIRCULAR SAW MACHINES

ABSTRACT

Saw benches are machines that bring the workpieces to be used in production to the desired dimensions by cutting. Saw benches, which are widely used in the industry, are located in the first part of the production lines. For this reason, if the workpiece cannot be cut within the desired tolerances, serious production and material losses occur. In this study, the effect of vibration on the cutting tool on perpendicularity tolerance and surface roughness was investigated.

Keywords: Saw Bench, Length Tolerance, Surface Roughness, Vibration.

TAVLAMA BENZETİMİ YÖNTEMİ VE YANIT YÜZEY METODU KULLANILARAK YÜZEY PÜRÜZLÜLÜĞÜ İÇİN İŞLEME PARAMETRELERİNİN OPTİMİZASYONU (41)

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ÖZET

Üretimin temel yapı taşlarından biri talaşlı imalattır. Üretilen parçaların kendilerinden beklenen fonksiyonları yerine getirebilmesi için yüzey kalitesi ve toleransların önemi bilinmektedir. Endüstride yaygın şekilde kullanılan AISI 304L paslanmaz çelikler tornalanırken kesme parametrelerinin optimizasyonu üzerinde çok fazla çalışma bulunmamaktadır. Bu çalışmada, AISI 304L paslanmaz çelikler tornalama işlemine tabi tutulmuştur. Kesme parametreleri optimize edilerek en iyi yüzeyin elde edilmesi yani yüzey pürüzlülüğünün minimum seviyede tutulması amaçlanmıştır. Çalışmada kullanılan kesme parametreleri olarak kesme hızları, ilerleme ve paso değerleri alınmış olup bunların sonucunda oluşan yüzey pürüzlülük değerleri ölçülmüştür. Giriş parametreleri için tam faktöriyel deney tasarımı oluşturulmuştur. Giriş parametrelerinden yüzey pürüzlülüğü üzerinde etkin olan parametre ilerleme olarak belirlenmiştir. Minimum yüzey pürüzlülüğü için tavlama benzetimi yöntemi kullanılmış ve optimum kesme parametreleri olarak 132 m/dak kesme hızı, 1,5 mm paso ve 0,11 mm/dev değerleri elde edilmiştir.

Anahtar Kelimeler: AISI 304L Paslanmaz Çelik, Yüzey Pürüzlülüğü, Optimizasyon, Tavlama Benzetimi Metodu.

OPTIMIZATION OF MACHINING PARAMETERS FOR SURFACE ROUGHNESS USING SIMULATED ANNEALING METHOD AND RESPONSE SURFACE METHOD

ABSTRACT

One of the basic elements of production is machining. The importance of surface quality and tolerances is known so that the manufactured parts can perform the functions expected from them. There are not many studies on optimization of cutting parameters when turning AISI 304L stainless steels, which are widely used in the industry. In this study, AISI 304L stainless steels were machined. By optimizing the cutting parameters, it is aimed to obtain the best surface, that is, to keep the surface roughness at a minimum level. Cutting speeds, feed, and depth of cut values were taken as the cutting parameters used in the study, and the resulting surface roughness values were measured. A full factorial experimental design was created for the input parameters. The parameter that is effective on the surface roughness was determined as the feed. Simulation Annealing method was used for minimum surface roughness and optimum cutting parameters were obtained as 132 m/min cutting speed, 1,5 mm depth of cut and 0,11 mm/rev.

Keywords: AISI 304L Stainless Steel, Surface Roughness, Optimization, Simulated Annealing Method.

ISIL İŞLEM UYGULANAN AISI 420 PAZLANMAZ ÇELİĞİN TORNALAMA İŞLEMİ ÜZERİNDE CBN UÇLAR İLE YÜZEY PÜRÜZLÜLÜĞÜ ARAŞTIRMASI (70)

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ÖZET

Bu araştırmada ısıl işlem görmüş AISI-420 paslanmaz alaşımlı silindirik şaft malzemenin CBN kesici uçları ile işlenerek kesici uç ve yüzey pürüzlülüğünü incelenmiştir. İşlemlerde kullanılan iş parçasının yüzeyden indüksiyon ısıl işlem ile sertleştirmesi yapılarak bu işlem sonrasında yüzey sertliği 55 HRC olarak ölçülmüştür. İşlemler belirlenen matrislere uygun olarak farklı ilerleme, kesme hızı/devir ve talaş miktarları ile gerçekleştirilmiş ve bu parametrelerin yüzey kalitesine etkisi incelenmiştir. Yapılan işlemler ve incelemelere göre devir hızı arttıkça yüzey pürüzlülüğünün azaldığı, bunun yanında ilerleme ve talaş kaldırma miktarı arttıkça ise pürüzlülüğün buna doğru orantılı olarak arttığı gözlemlenmiştir.

Anahtar Kelimeler: CBN, CNC Tornalama, Yüzey Pürüzlülüğü.

AN INVESTIGATION OF SURFACE ROUGHNESS OBTAINED BY CBN INSERTS IN THE TURNING PROCESS OF HEAT-TREATED AISI 420 STAINLESS STEEL

ABSTRACT

In this study, heat-treated AISI-420 stainless steel cylindrical shaft material's are machined (turned) with CBN cutting tools and the surface roughness were observed. The workpiece utilized in the operations was hardened from the surface using induction heat treatment, and the surface hardness after this process was measured to be 55 HRC. Inline with the specified matrices, the operations were carried out with varying feed, cutting speed/revolution, and depth of cut, and the impacts of these factors on the surface quality were investigated. According to the procedures and research, the surface roughness lowers as rotation speed increases, whereas it grows correspondingly when feed and chip removal quantity increases.

Keywords: CBN, CNC Turning, Surface roughness.

EKLEMELİ İMALAT TEKNOLOJİSİYLE ÜRETİLMİŞ INCONEL 718 VE Ti6AI4V 'nin MİKRO FREZELENMESİNDE KESME KOŞULLARININ ETKİSİNİN ARAŞTIRILMASI (45)

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ÖZET

Eklemeli imalat teknolojileri, karmaşık geometriye sahip parçaların kolaylıkla üretilebilmesine imkan tanıyarak geleneksel imalat yöntemlerine göre ön plana çıkmaktadır. Fakat yetersiz yüzey kalitelerinden dolayı iş parçasının son bir yüzey düzeltme işleminden geçirilmesi gerekmektedir. Bu çalışmada Seçici Lazer Ergitme (SLM) yöntemi ile üretilen Inconel ve Ti6Al4V iş parçalarının 4 farklı kesme koşulunda (kuru, MQL, boryağı ve soğutulmuş CO_2) mikro frezelenmesi durumunda kesme kuvvetleri, yüzey pürüzlülüğü ve takım aşınmasındaki farklılıklar incelenmiştir. Her iki iş parçası için de en iyi sonuçlar MQL şartlarında elde edilmiştir. Inconel iş parçasındaki takım aşınmasının, kesme kuvvetlerinin ve yüzey pürüzlülüğünün Ti6Al4V'a göre daha fazla olduğu gözlenmiştir.

Anahtar Kelimeler: Seçici Lazer Ergitme, Mikro Frezeleme, Kesme Kuvvetleri, Takım Aşınması, Yüzey Pürüzlülüğü.

INVESTIGATION OF THE EFFECT OF CUTTING CONDITIONS ON MICRO MILLING OF INCONEL 718 AND TI6AI4V MADE WITH ADDITIVE MANUFACTURING TECHNOLOGY

ABSTRACT

Additive manufacturing technologies stand out compared to traditional manufacturing methods by allowing parts with complex geometries to be produced easily. However, due to insufficient surface qualities, the workpiece has to undergo a final surface finishing process. In this study, the differences in cutting forces, surface roughness and tool wear were investigated in case of micro-milling of Inconel and Ti6Al4V workpieces produced by Selective Laser Melting (SLM) method under 4 different cutting conditions (dry, MQL, coolant and chilled CO2). The best results for both workpieces were obtained under MQL conditions. It has been observed that tool wear, cutting forces and surface roughness in Inconel workpiece are higher than Ti6Al4V.

Keywords: Selective Laser Melting, Micro Milling, Cutting Forces, Tool Wear, Surface Roughness.

AlCrN ESASLI PVD KAPLAMANIN ENJEKSİYON KALIP YÜZEY KALİTESİNE ETKİLERİ (49)

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ÖZET

Farklı PVD kaplamaların (TiN, ZrN, Ti-Al-N, WC-C, CrN, TiCN, DLC, vb.) ve bunların tek veya çok katmanlı uygulamalarının, kalıpların yüzey kalitesi, korozyon direnci, aşınma direnci gibi özelliklerine etkileri, son yılların araştırma konularından biridir. Bu çalışmada, AlCrN esaslı bir PVD kaplamanın bir plastik enjeksiyon kalıbının yüzey kalitesine etkisi, yüzey pürüzlülüğü üzerinden deneysel olarak araştırılmıştır. Kalıplama malzemesi olarak PA6/GF30 ve PA6/GF50 malzemeler kullanılmıştır. Sonuçlar, PVD kaplamanın, kaplama sonrasında yüzey pürüzlülüğünü artırdığını, ancak sağladığı aşınma dayanımı ile enjeksiyon kalıplama sürecinde yüzey pürüzlülüğünün artışını sınırlandırdığını ortaya koymuştur.

Anahtar Kelimeler: PVD Kaplama, Plastik Enjeksiyon Kalıplama, Yüzey Pürüzlülüğü, Baskı Sayısı.

EFFECTS OF AlCrN BASED PVD COATING ON INJECTION MOLD SURFACE QUALITY

ABSTRACT

In recent years, it is one of the research topics that effects of different PVD coatings (TiN, ZrN, Ti-Al-N, WC-C, CrN, TiCN, DLC, etc.), and their single or multi layers applications on the surface quality, the corrosion resistance, the wear resistance etc. of moulds. In this study, it was investigated that the effects of a PVD coating, which is based on AlCrN, on surface quality of a plastic injection mould via surface roughness, experimentally. PA6/GF30 and PA6/GF50 were used as the moulding materials. The results showed that the PVD coating limited the increasing of surface roughness during injection moulding process because of its wear resistance although it made increasing the surface roughness after the coating.

Keywords: PVD Coatings, Plastic Injection Moulding, Surface Roughness, Cycle Counts.

GÖRSEL LAZER NOKTA KAYNAĞI UYGULAMALARINDA AÇISAL KONUMLANDIRMA HATALARININ KAYNAK KALİTESİNE ETKİSİNİN İNCELENMESİ (54)

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ÖZET

Paslanmaz ince malzemelerin görsel kusur oluşturmayacak şekilde birleştirilmesi için gerekli kaynak parametrelerinin belirlenmesi oldukça hassas bir işlemdir. Zira, kaynak işleminin görsel kusur olmayacak kadar narin olması istenirken, diğer yandan da bağlantının cihazın ömrü boyunca dayanacak kadar güçlü olması beklenir. Bu çalışmada paslanmaz (inox) mutfak ve otel ekipmanlarının mikro lazer punta kaynak uygulamalarında açısal konumlandırma hatalarının kaynak kalitesine etkisi deneysel olarak incelenmektedir. Manuel kaynak işlemlerinde en yaygın operatör hatası, lazer ışını ile plaka yüzeyi arasındaki açısal konumlandırma hatasıdır. Çalışmada lazer sinyali şiddet ve süresi gibi diğer kaynak parametreleri sabit tutulmuş, farklı lazer ışın açıları için kaynak numuneleri hazırlanmış ve numunelerde her bir kaynak noktasının taşıyabileceği maksimum yükler ölçülmüştür. Deneyler, kritik kaynak açısından daha küçük açılarda ince paslanmaz sac üzerinde yeterince geniş bir kaynak alanı oluşturulamayacağını, buna karşın kritik kaynak açısından büyük açılarda ince paslanmaz malzemenin görünür yüzeyinde ısı kaynaklı izler veya mikro deformasyonlar oluştuğunu göstermektedir. Deneysel sonuçlar kullanılarak, mevcut lazer kaynak parametreleri için optimum torç açısı aralığı belirlenmiştir. Sonuçlar, görsel lazer kaynak uygulamalarında, lazer ışını açısının, operatörün gözle ayarlayamayacağı kadar dar bir açı aralığında doğru bir şekilde kaynaklanabileceğini göstermektedir.

Anahtar Kelimeler: Inox, Paslanmaz, Sac, Mikro Lazer, Kaynak.

INVESTIGATION OF THE EFFECT OF ANGLE POSITIONING ERRORS ON WELD QUALITY IN VISUAL LASER POINT WELDING APPLICATIONS

ABSTRACT

It is a very sensitive process to determine the necessary welding parameters for joining stainless thin materials in a way that does not create visual defects. Because while it is desired that the welding process be delicate enough to not have visual defects, on the other hand, the connection is expected to be strong enough to last for the life of the device. In this study, the effect of angular positioning errors on welding quality in micro laser spot welding applications of stainless (inox) kitchen and hotel equipment is investigated experimentally. The most common operator error in manual welding processes is the angular positioning error between the laser beam and the plate surface. In the study, other welding parameters such as laser signal intensity and duration were kept constant, welding samples were prepared for different laser beam angles and the maximum loads that each welding spot could carry were measured in the samples. Experiments show that a sufficiently large weld area cannot be formed on the thin stainless sheet at angles smaller than the critical weld angle, whereas heat-induced traces or micro-deformations are formed on the visible surface of the thin stainless material at angles greater than the critical weld angle. Using the experimental results, the optimum torch angle range was determined for the available laser welding parameters. The results show that in visual laser welding applications, the laser beam angle can be welded accurately in an angle range that is too narrow for the operator to adjust with the eye

Keywords: Inox, Stainless, Sheet Metal, Micro Laser, Welding.

TAŞITLARDA AĞIRLIK AZALTIMINDA HAFİF MALZEME OLARAK ALÜMİNYUM KULLANIMI (55)

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ÖZET

Teknolojinin gelişmesi ile birlikte başta güvenlik gereksinimleri olmak üzere konfor ve performans talepleri gibi artan istekler, araçların ağırlığını artırmıştır. Bu çalışmada taşıt ağırlığının zamanla artma nedenleri ve artan taşıt ağırlığı nedeniyle oluşan sorunlar ve ağırlık azaltmada en çok kullanılan hafif metal olarak alüminyum incelenmiştir. Alüminyumun taşıtlarda kullanımı ile sağlanan avantajlar araştırılmıştır. Ağırlık azaltmada alüminyum kullanımının yanında bilgisayar destekli optimizasyon teknikleri, daha iyi sonuçlar elde edilmesini mümkün kılmaktadır. Bu çalışmada örnek model olarak otomobillerde kullanılan salıncak kolu tasarımında, St 37 çelik malzeme yerine Al 5754 alüminyum alaşımı kullanımı ile hafifletme sağlanması incelenmiştir. Yapılan analizler, çelik malzeme yerine alüminyum malzeme kullanımı ile %59 ağırlık azaltımı sağlanmıştır.

Anahtar Kelimeler: Alüminyum, Ağırlık, Yakıt Tasarrufu, Taşıt Ağırlığı, Salıncak Kolu.

USAGE OF ALUMINUM AS A LIGHTWEIGHT MATERIAL FOR WEIGHT REDUCTION IN VEHICLES

ABSTRACT

With the development of technology, increasing demands such as comfort and performance demands, especially safety requirements, have increased the weight of the vehicles. In this study, the reasons for the increase in vehicle weight over time and the problems caused by the increased vehicle weight and aluminum as the most used light metal in weight reduction were examined. The factors caused by the use of aluminum in vehicles were investigated. In addition to the use of aluminum in weight reduction, computer-aided optimization techniques make it possible to obtain better results. In this study, the use of Al 5754 aluminum alloy instead of St 37 steel material in the design of the swing arm used in automobiles as an example model, was examined. The analyzes showed that 59% weight reduction was achieved by using aluminum material instead of steel material.

Keywords: Aluminum, Ağırlık, Fuel Saving, Vehicle Weight, Wishbone.

BİR SİLAH NAMLUSUNDA KOVAN-ATIM YATAĞI ETKİLEŞİMİNİN İNCELENMESİ (38)

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ÖZET

Bu çalışmada 30 mm x 173 kalibre NATO standartlarında mühimmat atabilen bir silah namlusu için atım yatağı-kovan etkileşimi incelenmiştir. Deneysel bir yöntem kullanılarak namlunun iç balistik analizi yapılmıştır. İç balistik analizi neticesinde namlu içerisinde, zamana göre basınç değişiminin grafiği elde edilmiştir. Sonrasında kovan ve namlu malzemelerinin mekanik özellikleri belirlenmiştir. Namlu, kalın cidarlı basınçlı kap; kovan, ince cidarlı basınçlı kap kabul edilerek, kovanın namlu ile radyal yönde olan etkileşimi incelenmiştir. Çalışmada "Bilinear Kinematic Hardening" modeli kullanılarak deformasyonlar incelenmiştir. Model kullanılarak ortalama atım yatağı-kovan boşluğu ve deformasyon değeri hesaplanmıştır. Atış yapılmış kovan ve atış yapılmamış kovanın ölçüm sonuçları model sonuçlarıyla kıyaslanmıştır. Sonuçların hesaplama ile elde edilen değerlerle uyumlu olduğu görülmüştür.

Anahtar Kelimeler: İç Balistik, Namlu, Atım Yatağı, Mühimmat, Kovan, Ateşli Silah, Sevk Barutu.

INVESTIGATION OF CASE-CHAMBER INTERACTION IN A GUN BARREL

ABSTRACT

In this study, the interaction between the barrel chamber-cartridge case for a gun barrel capable of firing 30 mm x 173 NATO standard ammunition was investigated. Internal ballistic analysis of the gun barrel was carried out by using an experimental method. As a result of the internal ballistic analysis, the graph of the pressure change in the gun barrel versus time was obtained. Afterwards, the mechanical properties of the cartridge case and the gun barrel material were determined. The gun barrel and cartridge case were considered as the thick- walled pressure vessel and the thin-walled pressure vessel, respectively. With this assumption, the interaction between the cartridge case with the gun barrel in radial direction was investigated. In the study, deformations were investigated using the "Bilinear Kinematic Hardening" model. Mean clearance between the barrel chamber and cartridge case and the amount of deformation were calculated by using model. The obtained measurements from the fired cartridge and the unfired cartridge were compared to the results obtained from the model. The results were found to be compatible with the values obtained by the calculation.

Keywords: Internal Ballistic, Gun Barrel, Barrel Chamber, Ammunition, Firearms, Cartridge Case, Propellant.

DÜZLEMSEL BEŞ ÇUBUK MEKANİZMASININ OPTİMİZASYON SONUCUNDA ELDE EDİLEN PARAMETRELERİN DİZAYN EDİLEBİLİRLİĞİNİN İNCELENMESİ (43)

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ÖZET

Düzlemsel beş çubuk mekanizmaları iki serbestlik dereceli paralel manipülatörler olup sanayide kullanılagelmektedir. Böyle bir mekanizmada iş organın (örneğin lazer kesim kafası) bağlı olduğu noktaya dairesel bir yörünge çizdirilmesi durumunda ortaya çıkan sarsma kuvvetleri ve momentlerinin en aza indirgenmesi konusu ele alınmıştır. Bu amaçla parçacık sürüsü optimizasyonu kullanılmıştır. Burada tasarım parametrelerinin tamamı optimizasyon sürecine tabi tutulmuştur. Uzuv kütleleri ve atalet momentleri bağımsız parametreler olarak hesaba katıldığından optimizasyon sonucu elde edilen parametre değerlerine göre mekanizmanın fiziki olarak dizayn edilebilirliği, bir CAD programıyla kontrol edilmesi önem arz etmektedir. Önceki çalışmalardan farklı olarak bu bildiride fiziki gerçeklenebilirlik konusu ayrıntılı olarak ele alınmıştır.

Anahtar Kelimeler: Sarsma Kuvveti, Sarsma Momenti, Dengeleme, Optimizasyon, 3D Dizayn.

INVESTIGATION OF THE DESIGNABILITY OF THE PARAMETERS OBTAINED BY OPTIMIZATION OF THE PLANE FIVE BAR MECHANISM

ABSTRACT

Planar five-bar mechanisms are parallel manipulators with two degrees of freedom used in industry. In such a mechanism, the issue of minimizing the shaking forces and moments that occur when a circular trajectory is drawn at the point of attachment of the workpiece (e.g., laser cutting head) is discussed. For this purpose, particle swarm optimization was used. Here, all design parameters have been optimized. Since the bar masses and moments of inertia are considered independent parameters, it is essential to check the physical design of the mechanism according to the parameter values obtained as a result of optimization and to check it with a CAD program. Unlike previous studies, this article discusses the issue of physical realizability in detail.

Keywords: Shaking Force, Shaking Moment, Balancing, Optimization, 3D Design.

İNSANSI YÜZ MİMİKLERİNE SAHİP BİR ANİMATRONİK ROBOT SURAT TASARIMI VE İMALATI (68)

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ÖZET

Bu çalışmada, günümüzde önemi her geçen gün artan ve üzerine yeni çalışmalar gerçekleştirilen insansı robotlar geliştirmek, insan mimiklerini gerçekçi şekilde simüle edecek mekanizmalar tasarlamak ve bu tasarımları gerçekçi boyutlarda bir araya getirerek insansı bir yapı oluşturmak amaçlanmıştır. Bu bağlamda düşük maliyet hedefi ile üç boyutlu yazıcı ve giriş seviyesi elektronik komponentler ile yüz kaslarını simüle edecek mekanizmalar tasarlanmış ve bunlar hareket ettirilerek yüz mimikleri simüle edilmiştir. Çalışma sonucunda herkes tarafından aynı şekilde algılanabilecek seviyede gerçekçi yüz mimikleri elde edilmiş ve amacı doğrultusunda başarılı bir sonuç elde edilmiştir. Türkiye'de benzer konudaki araştırmalar çok kısıtlı sayıda olduğundan, bu proje öncü proje niteliği taşımaktadır.

Anahtar Kelimeler: İnsansı Robot, Mimik, Animatronik, Duygu, Mekanizma.

THE DESIGN AND MANUFACTURING OF AN ANIMATRONIC ROBOT FACE WITH HUMAN FACE MEMICS

ABSTRACT

In this study, it is aimed to develop humanoid robots, the importance of which is increasing day by day and on which new studies are carried out, to design mechanisms that will simulate human mimics realistically, and to create a humanoid structure by bringing these designs together in realistic dimensions. In this project, mechanisms to simulate facial muscles were designed with a three-dimensional printer and entry-level electronic components because of the goal of low cost, and facial expressions were simulated by moving them. As a result of the study, realistic facial expressions that can be perceived by everyone in the same way were obtained and a successful result was obtained in line with its purpose. Since there are very limited number of studies on similar subjects in Turkey, this project is a pioneering project.

Keywords: Humanoid Robot, Expressions, Animatronic, Gestures, Mechanism.

TABAKALI KOMPOZİT KAPAK TASARIMINDA TOPOGRAFYA OPTİMİZASYONU VE FİBER ORYANTASYONUNUN DOĞAL FREKANSA ETKİSİNİN İNCELEMESİ (12)

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ÖZET

Bu çalışmada Unigraphics NX programında hazırlanan tabakalı kompozit kapak tasarımı GENESİS programına aktarılarak topografya optimizasyonu yapılmıştır. Optimizasyon sonucuna göre parçanın tasarımı güncellenerek ANSYS ile modal analizi yapılmıştır. Sonuçlara göre; yeni tasarıma ait doğal frekans değerinin (mod 2) başlangıç tasarımına göre yaklaşık 1.6 kat artış gösterdiği görülmüştür. Daha sonra yeni tasarım ile aynı kütleye sahip geleneksel tasarımlar kıyaslanmıştır. Ayrıca nihai tasarımın dinamik karakteristiği farklı fiber serim açılarına göre incelenmiştir.

Anahtar Kelimeler: Topografya, Optimizasyon, Kompozit Malzeme, Tasarım, Modal Analiz.

INVESTIGATION ON THE EFFECTS OF TOPOLOGY OPTIMIZATION AND FIBER ORIENTATION IN NATURAL FREQUENCY OF LAYERED COMPOSITE COVERS

ABSTRACT

In this study, the laminated composite cover design prepared in Unigraphics NX was transferred to the GENESIS and topography optimization was made. According to the optimization result, the design of the part was updated and modal analysis was performed with ANSYS. According to the results, it was seen that the natural frequency value (mode 2) of the new design increased approximately 1.6 times compared to the initial design. Then, traditional designs with the same mass were compared with the new design. In addition, the dynamic characteristics of the final design were examined according to different fiber orientation angles.

Keywords: Topography, Optimization, Composite Materials, Design, Modal Analysis.

İŞ MAKİNELERİ TASARIMINDA DÜŞÜK EMİSYONLU ALTERNATİF YAKIT UYGULAMALARI (18)

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ÖZET

Bu çalışmada küresel iklim değişikliğinin en temel nedenlerinden biri olan karbon emisyonunun azaltılması için alternatif yakıt kullanımı üzerine araştırma yapılmıştır. Yapılan çalışmada öncelikle mevcut alternatif yakıt teknolojileri hakkında güncel bilgiler paylaşılmıştır. Daha sonra iş makinesi tasarımında alternatif yakıt teknolojileri uygulama örnekleri; ekskavatör, kazıcı- yükleyici ve yükleyici makinelerinde ayrı ayrı incelenmiştir. Araştırmalar değerlendirildiğinde; otomotiv sektörü gibi iş makinesi sektöründe de alternatif yakıt kullanımının yaygınlaşarak büyümeye devam ettiği ve yakın gelecekte tamamen fosil yakıtların yerini alacağı açıkça görülmektedir.

Anahtar Kelimeler: İş Makineleri, Alternatif Yakıtlar, Elektrikli / Hibrit Araçlar.

LOW EMISSION ALTERNATIVE FUEL APPLICATIONS IN CONSTRUCTION MACHINE DESIGN

ABSTRACT

In this study, research was conducted on the use of alternative fuels to reduce carbon emissions which one of the main causes of global climate change. At the beginning of the study, up-to-date information about current alternative fuel technologies was shared. Then, alternative fuel technologies application examples in construction equipment design; excavator, backhoe-loader and loader machines were examined separately. When the studies are evaluated; It is clearly seen that the use of alternative fuels in the construction equipment sector, like the automotive sector, continues to expand and grow and will completely replace fossil fuels in the near future.

Keywords: Construction Equipment, Alternative Fuels, Electric / Hybrid Vehicle.

TÜP HİDROŞEKİLLENDİRMEDE YÜKLEME PROFİLLERİNİN BULANIK MANTIK KONTROL ALGORİTMASI İLE BELİRLENMESİ (19)

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ÖZET

Bu çalışmada, dövme yöntemiyle üretilmesi problemli olan otomobil salıncak bağlantı parçasının Tüp Hidroşekillendirme (THŞ) prosesiyle üretilmesi için gerekli basınç ve eksenel besleme yükleme profilleri, sonlu elemanlar analiziyle birlikte Bulanık Mantık Kontrol Algoritması (BMKA) ile elde edilmiştir. 3 mm kalınlıklı St 37 malzeme borudan salıncak parçası üretilecek şekilde THŞ sonlu elemanlar modeli ve bulanık mantık kontrol algoritması oluşturulmuştur. Hasar kriteri olarak; yüzde incelme, kalıp dolum oranı ve yüzde buruşma yüksekliği olmak üzere üç adet giriş değişkeni kullanılmıştır. Çıkış değişkeni basınç artış miktarı olarak belirlenmiştir. BMKA ile elde edilen yükleme profili ile deneme-yanılmayla elde edilen profil karşılaştırılmıştır. BMKA ile elde edilen eğrinin avantajları ve parça kalitesine etkisi ortaya konulmuştur.

Anahtar Kelimeler: Bulanık Mantık, Tüp Hidroşekillendirme, Yükleme Profili.

DETERMINATION OF LOADING PROFILES IN TUBE HYDROFORMING BY FUZZY LOGIC CONTROL ALGORITHM

ABSTRACT

In this study, the pressure and axial feeding loading profiles required for the production of the automobile suspension bushings inner tube part, which is problematic to be produced by the forging method, were obtained with the Fuzzy Logic Control Algorithm (FLCA) together with the FEA by the Tube Hydroforming (TH) process. FEA and FLCA of the TH were created to produce bushing part with 3 mm thick St 37 material pipe. As a damage criterion; three input variables were used: % thinning, die filling ratio and % wrinkling height. The output variable is determined as the amount of pressure increase. The loading profiles obtained by FLCA and the profile obtained by trial and error were compared. The advantages of the curve obtained with FLCA and its effect on the part quality were presented.

Keywords: Fuzzy Logic, Tube Hydroforming, Loading Profile.

PA12 MALZEMESİNDEN İMAL EDİLMİŞ 3 KATMANLI YAKIT BORUSUNUN SICAKLIK İLE ŞEKİLLENDİRME ANALİZİ VE YAPILAN ANALİZİN DOĞRULANMASI (52)

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ÖZET

Binek araçlarda yakıtın iletimi ve geri beslemesi, yakıt taşıma sisteminin bir parçası olan yakıt boruları ile gerçekleştirilmektedir. Günümüzde plastik ve fluoraplastik yakıt boruları yaygın olarak kullanılmaktadır. Çalışma kapsamında PA12 malzemesi kullanılarak imal edilmiş üç katmanlı yakıt borusunun sıcaklık girdisi ile şekillendirilmesi ile analiz edilmesi ve gerçekleştirilen analizin ürün doğrulaması amaçlanmıştır. Modelleme ve analiz programı olarak Solidworks tercih edilmiştir. Analiz sonrası elde edilen model ile fiziki üretimi yapılıp tersine mühendislik ile taranarak datası elde edilen model çakıştırılarak kıyaslama yapılmıştır. Elde edilen sonuçların, fiziki üretimlerde uygulanması gereken sıcaklık değerini vermesi ile zaman ve maliyet tasarrufu sağlaması amaçlanmıştır.

Anahtar Kelimeler: Yakıt Borusu, Modelleme, Ürün Doğrulama, Solidworks.

ANALYSIS AND VERFICATION OF THE 3-LAYERED FUEL PIPE MADE OF PA12 BY TEMPERATURE FORMING

ABSTRACT

In passenger cars, the feeding and feedback of the fuel is carried out by fuel tubes, which are a part of the fuel system. Today, plastic and fluoroplastic fuel tubes are widely used. Within the scope of the study, it is aimed to analyze the three-layer fuel tube manufactured using PA12 material by shaping it with temperature input and to verify the product of the analysis performed. Solidworks was chosen as the modeling and analysis program. The model data which is obtained with analyze is compared by superposed with the model data which is obtained by reverse engineering after physical production. It is aimed that the results obtained will provide time and cost savings by giving the temperature value that should be applied in physical productions.

Keywords: Fuel Tube, Modelling, Product Verification, Solidworks.

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