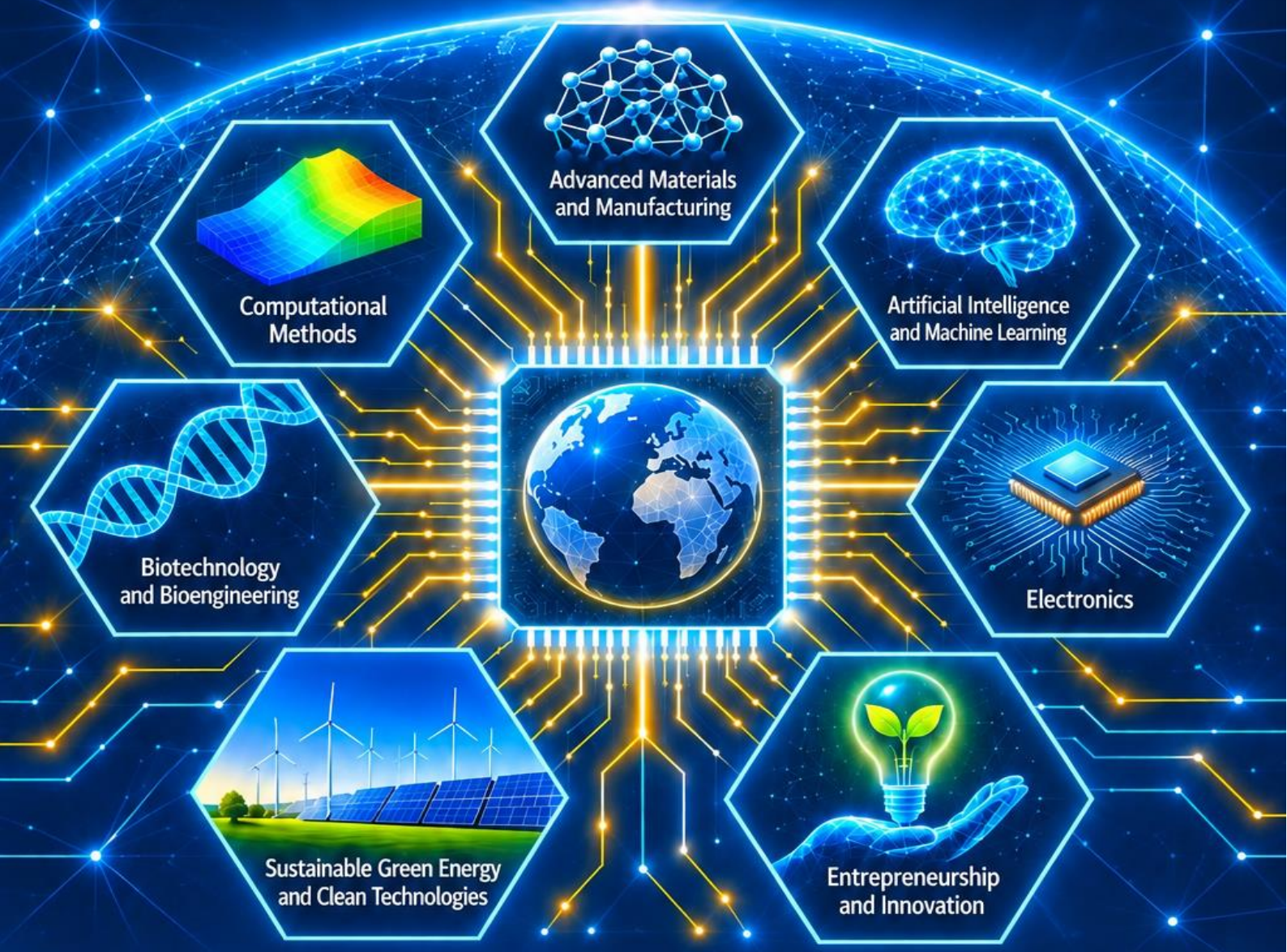
A-SIDE

DeepTech Connect 2026

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April 24, 2026

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The First DeepTech Connect International Conference 2026

April 24, 2026

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Contents

ADVANCED MATERIALS AND MANUFACTURING 27

Additive Manufacturing and Architected Materials 28

Design of Lattice Based Nitinol Actuators for Optimal Displacement and Load Bearing Capability 29

Yvonne Omowunmi-Kayode[1, 2] , Deeksha Hota[1,3] , Andrea Villano[1,3], Ajai Sankar[1,3], Ian Kiernan[1,2], Mehran Bahramyan[1,2,*] and Dermot Brabazon [1, 2] 29

Inducing the Two-Way Shape Memory Effect in Additively Manufactured NiTi Wires 37

Gavin Chapman[*a,1,2], Thomas Gillick[b,1,2], Ankur Majumdar[c,1,2], Meris Ikiz[d,1,2], Merve Nur Dogu[e,1,2], Neha Agarwal[f,1,2], Dermot Brabazon[g,1,2] 37

Review of Phase Transformation Behaviour in NiTi Lattice Structures Fabricated via Wire-Based Directed Energy Deposition 45

Terence Bowden[1,2,*], Ronan McCann[1,2], Dermot Brabazon[1,2] 45

Forensic Challenges in Additively Manufactured Materials: Reliability of 3D-Printed Evidence 49

Aleksandra Mitrovic[1], Nenad Mitrovic[2], Svetlana Pelemis[3] 49

3D Printed Porous Filters for Sustainable Water Treatment Applications 53

Nikola Kotorčević[1], Dušan Milojević[1], Fatima Živić[1] 53

Comparing 3D-printed Part Mesh Design Techniques for Thermoforming 57

Živana Jovanović Pešić[1], Strahinja Milenković[2], Nenad Petrović[3], Nenad Marjanović[3], Vesna Marjanović[3] 57

Advanced Materials, Microstructure, and Functional Materials 62

Microstructural Engineering and Mechanical Behavior of KNN and KNN-Ta Ceramics Sintered by Spark Plasma Sintering 63

Jade Clément[1], Isabelle Monot-Laffez[1], Micka Bah[1], Caroline Richard[1] 63

Solid lubricant coatings based on chromium nitride and metal sulfide deposited by reactive magnetron sputtering 67

Rubenson Mareus[1,2], Amaël Caillard[2], Caroline Richard[1], Anne-Lise Thomann[2], Loïc Gimenez[2] 67

Electromagnetic Shielding of Biochar-Coated Drywall Panels: a Performance Overview from 1 to 27 GHz 72

Isabella Natali Sora[1], Giuseppe Ruscica[1], Patrizia Savi[2] 72

Orientation Dependent EMI Shielding Performance of CFRP Laminates ... 76
Maria Vlacha[1], Angelos Voudouris Itskaras[1], Christos Vazouras [2], Alkiviadis S. Paipetis[1] ... 76
Mechanical Behavior, Structural Design, and Joining ... 80
Dimensional Optimization of a Cantilever Structure with Stress–Strain Analysis ... 81
Nebojša Arsić[1*], Nenad Kostić[1], Nenad Marjanović[1], Vesna Marjanović[1] ... 81
Shear Strength Testing of Adhesively Bonded Joints: Experimental and Numerical Analysis ... 85
Vladimir Milovanović[1], Veljko Kanjevac[1], Miloš Pešić[2], Gordana Jovičić[1] ... 85
Graphical representation of adhesive joints in technical drawings for railway industry ... 89
Srdjan Samardzic[1], Aleksija Djuric[1] ... 89
Investigation of the bond strength of laser-textured interference-fit joints ... 94
Meris Ikiz [*1,2], Merve Nur Dogu [1,2], Muhannad Obeidi[2,3], Dermot Brabazon[1,2] ... 94
Improvement of thin-walled semi-rigid beam-to-column connections in rack structures ... 101
Mirjana Piskulic[1], Rodoljub Vujanac[1*], Snezana Vulovic[2] ... 101
Microvoid nucleation mechanisms in cold forming metal components ... 106
Milija Kraišnik[1], Mladomir Milutinović[2], Jelica Anić[1] ... 106
Manufacturing Processes and Process Optimization ... 111
Force analysis for incremental forming of metal sheets ... 112
Jelica Anić[1], Mladomir Milutinović[2], Milija Kraišnik[1] ... 112
Laser Engraving of Submillimeter Text ... 117
Petar Todorović[1] ... 117
Radiotracers as Advanced Tools for Industrial Process Diagnostics and Optimization ... 122
Srđan Vuković[1*], Danijela Vuković[1], Aleksandar Vuković[2], Vesna Gojković Cvjetković[1], Svetlana Pelemiš[1] ... 122
Closing the Loop of the EURO-TITAN Process: Residue Valorisation, Wastewater Recycling and Development of Functional Materials ... 126
Mitar Perušić[1], Duško Kostić[1], Nebojša Vasiljević[1], Jelena Vuković[1], Srećko Stopić[2], Maria Teresa Bellver Baca[3], Radislav Filipović[1,4], Vladimir Damjanović[4], Bengi Yagmurlu[5], Konstantinos Sakkas[6] ... 126
Tribology, Wear, Lubrication, and Surface Engineering ... 131
An Enhanced Pin-on-Disc Tribometer with Integrated Lubrication and Digital Positioning System ... 132

Stefan Čukić[1], Anđela Perović[1], Slavica Miladinović[1], Miloš Matejić[1], Blaža Stojanović[1] ... 132

Influence of intermittent friction cycles on tribocorrosion behavior of 316L stainless steel in 5% $NaHCO_3$ ... 136

Kaouthar Bouguerra[1], Yan-Ming Chen[2], Alexandre Romaine[3], Nadege Ducommun[3], Pierre François Cardey[4], Alexis Fontaine[5], Caroline Richard[1] ... 136

Influence of Linear Reciprocating and Rotational Modes on Wear Track Width of Brass ... 142

Dragan Dzunic[1], Milan Eric[1], Vladimir Kocovic[1], Jelena Djusic[1], Zivana Jovanovic Pesic[1], Slobodan Mitrovic[1], ... 142

Influence of Organic and Inorganic Based Lubricating Greases on the Tribological Characteristics of Contact Pairs ... 146

Stefan Miletić[1], Dragan Džunić[1], Milan Ivković[1], Slobodan Mitrović[1] ... 146

Manufacturing Quality, Inspection, and Structural Monitoring ... 150

Visual Inspection Systems for Tool Wear Monitoring in Machining ... 151

Milan Ivković[1], Julija Bošković[1], Nadica Stojanovic[1], Strahinja Đurović[2], Stefan Miletić[1], Goran Devedzic[1], Suzana Petrović Savić[1], ... 151

Benchmarking a wireless strain gauge monitoring system against DFOS in CFRP ... 156

Maria Xenidou[1], Andreas Kalogirou[1], Kyriaki Tsirka[1], Dimitrios Fakis[1], Alkiviadis S. Paipetis[1] ... 156

Flexible Sensor Development for Smart Packaging via CeraPrinter F-Series System Technologies 160

D. A. Exarchos, P. T. Dalla, P. Pantazis, I. Angelopoulos and T. Matikas ... 160

Engineering Applications and Human-Centered Design ... 164

The Impact of Seatback Angle on Driver Discomfort: A Systematic Review ... 165

Slavica Macuzic Saveljic[1], Igor Saveljic[2] ... 165

When it comes to silence, it is necessary to face the opposite concept: noise insulation ... 169

Dragutin Tijanić[1], Tamara Dimitrijević[2] ... 169

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ... 172

Foundations, Methods, and AI/ML Algorithms ... 173

The Predictive Power of Genomic Damage: A Machine Learning Approach to Endometrial Cancer Biomarkers ... 174

Aleksandra Marković[1], Bogdan Milićević[1], Marija Živković Radojević[2,3] ... 174

Data-Driven Prediction of Master's Degree Enrolment Using Explainable Machine Learning ... 178

[1]University of East Sarajevo, Faculty of Education, Bosnia and Herzegovina, 0000-0002-8119-5190 178

The importance of k-fold cross-validation in evaluating machine learning models for biomass gasifier output prediction. 183

Kadriye Deniz Olca[1], Özgün Yücel[1] 183

Stylistic Adaptation of a Pre-trained Language Model via Fine-tuning on a Slavic Literary Corpus 188

Aleksandr Uchaev and Vladimir Milovanović 188

Methodological framework for automated solving of mathematics competition problems in Serbia using LLMs 192

Marina Svičević[1], Aleksandar Milutinović[1], Nemanja Vučićević[1], Aleksandar Milenković[1], Miloš Pavković[2] 192

Implementation of an 8-bit Floating-Point Coprocessor for Deep Learning Applications 196

Isidora Grujić[1], Marija Božilov[1], Aleksandar Kondić[1], Vladimir M. Milovanović[1] 196

Decision-Making Algorithm for Intuitionistic Fuzzy Soft Sets 203

Nemanja Vučićević[1], Nenad Stojanović[1], Marina Svičević[1] 203

Clustering of the Zeros of Orthogonal Polynomials on the Semicircle 207

Marija P. Stanić[1], Tatjana V. Tomović Mladenović[1], Aleksandra S. Milosavljević[1] 207

Turning the Sky into a Tool for Peace 210

Mikel Espiga 210

Computer Vision, Image Analysis, and Pattern Recognition 214

Few-Shot Approach for Mouse Lung Segmentation in Synchrotron X-Ray Tomography 215

Andjela Blagojevic[1,2], Tijana Geroski[1,2], Nenad Filipović[1,2] 215

Development of a YOLOv11-Based Desktop Application for Concrete Crack Detection 220

Jovana Nikolic[1], Velibor Isailovic[1] 220

An affordable webcam-based real-time hand gesture recognition system using simple multilayer perceptron deep learning models 225

Ana Jovanović and Vladimir Milovanović 225

Di<Au>logues: Gesture-Based Navigation in Archaeological Museum of Thessaloniki. A Case Study using MediaPipe and p5.js. 230

Nikolaos Konstantinou[1], Nikolaos Papadimitriou[1], Michail Semoglou[2], Dimitrios Traperas[1] 230

Graph and Recurrent Neural Networks for MRI-Based Parkinson's Disease Analysis: A Short Review and Confidence-Driven Pruning Framework 234

Vasileios Stergiou[1], Angelos Giotis[1], Michail Vrigkas[2], Loukas Astakas[3], Spyridon Konitsiotis [3], Christophoros Nikou[1] 234

Speech, Language, and Human–AI Interaction 238

Real-Time Speech Analysis and Vowel Classification Using Linear Predictive Coding 239

Sava Todorović 239

Speech Emotion Recognition with LSTM: Cross-Lingual Transfer to Serbian 243

Nikola Radovanovic[1], Velibor Isailovic[1] 243

Automated Detection of Business Email Compromise Attacks in Serbian Language Using Linear Probabilistic Models 248

Miljan Koturović[†], Uroš Deljanin[†] and Vladimir Milovanović 248

Semestrify: A Cross-Platform System for Intelligent Academic Schedule Extraction and Calendar Integration 252

George Tzanopoulos[1], Vasileios Ralis[1], Christos Gogos[1] 252

How Do Translators Learn to Use AI? A Constructivist Approach 257

Airidas Kairys 257

Friendly Foes: Metaphorical conceptualization of AI based on the source domain of PERSON in English 263

Tatjana Grujić[1] 263

AI for Healthcare, Medicine, and Assistive Technologies 268

Building a Transnational AI-Health Innovation Network for Predictive Medicine and Health Crisis Preparedness: the HERACLES Project 269

Yorgos Goletsis[1], Konstantina Christogeorgou[1], Nikolaos Alexandros Theodorou[1] 269

AI-Guided 3D-Printed Meander-Line Antenna for Non-Invasive Bone-Tumor Detection 273

Tarlan Mahouti[1], Hakan Yılmazer[1], Mehmet Ali Belen[2] 273

Virtual Reality and Haptic Simulation in Dental Clinical Skills Development 277

Andrija Brkić[1], Marija Branković[2], Jelena Popović[3] 277

WellPet.ai: Edge AI-Powered Smart Collar for Real-Time Canine Health and Behavior Monitoring 281

Aleksandar Milutinović[1], Nikola Milanović[1], Branko Ilić[1] 281

Assistive app for BVI people BegIA 286

Oier Arano Urrutia and Alain Ordoñez Alvaro[1] 286

AI for Engineering, Manufacturing, and Industrial Systems 288

Decision-Boundary Instrumentation: Deployer-Side AI Monitoring for European Industry 289

Dorleta Urrutia-Onate[1], Asier Perallos[2], Enrique Onieva[3] 289

Development of an AI-Supported Optimization and Decision-Support Industrial SaaS Platform for FMEA Risk Management 294

Nikola Komatina[1], Nikola Banduka[2], Pavle Rvović[2], Kristina Mojsić[2] 294

Application of AI tools in analyses of Welded Structure 298

Aleksija Đurić[1], Miodrag Milčić[2], Srđan Samardžić[1], Dragan Milčić[2], Biljana Marković[1] ... 298

Application of artificial intelligence to predict and optimize driver comfort based on anthropometric data 301

Slavica Macuzic Saveljic[1], Igor Saveljic[2] 301

Data-Driven Artificial Intelligence Applications in Energy Production Systems 305

Mert Akin INSEL[1,2,*], Hasan SADIKOGLU[1,2], Ozgun YUCEL[3] 305

Predictive Modeling of Ignition Quality in Diesel-Biodiesel-Alcohol Systems for Sustainable Fuel Design 309

Kaan YEŞİLOVA[1], Özgün YÜCEL[2], Başak TEMUR ERGAN[3], Ümran ÜNLÜ[4] 309

AI for Energy, Environment, and Smart Infrastructure 313

Empowering Industrial Cooling through Predictive Intelligence 314

Jimena Castrillo, Álvaro Enriquez, Francisco Javier Enriquez 314

VodostAI – AI-based Flood Prediction and Prevention Platform ID 53122, Innovation Fund of Serbia – GovTech Program, 2024–2025 316

Boban Stojanović[1,2], Vladimir Bačanin[1], Boško Laković[1], Tomislav Mrđa[1], Dušan Stefanović[1], Miroljub Krstić[1] 316

Vodena - Next Gen Water and Energy software solutions 320

Miroljub Krstić[1], Dušan Stefanović[1] 320

Substrate Effects on Plant Metabolism: A Machine Learning Perspective 324

Nenad Zlatić & Milan Stanković 324
AI Applications in Mobility and Smart Systems 328
HAL Mobility AI: AI-Assisted Urban Mobility Orchestration for Local Taxi Ecosystems 329
Milovan Ostojić[1], Dragutin Ostojić[2], Mihajlo Čekerevac[1], Lazar Avramović[3] 329
COMPUTATIONAL METHODS 333
Analytical and Numerical Modelling Fundamentals 334
Modeling and Simulation of Shear in Shape Memory Alloys 335
Natalija Milićević[1], Aleksandar Bodić[1], Vladimir Dunić[1]* 335
Comparative Numerical Study of Two Interface-Capturing Methods for a Rising Bubble Problem 339
Aleksandar Bodić[1], Slobodan Savić[1*], Miloš Pešić[2], Marko Topalović[2] 339
Finite Element Analysis of Geotechnical Engineering Problems 346
Jovana Minić[1], Dragan Rakić[1] 346
Computational Modeling of Manufacturing and Processing 350
Analytical Modelling of Track Formation in Laser Powder Bed Fusion of IN939 351
Sampreet Rangaswamy[1,2], Merve Nur Doğu[1,2], Dermot Brabazon[1,2] 351
Determining the influence of process parameters during ironing using FEA 355
Marko Delić[1], Vesna Mandić[2], Dušan Arsić[1], Đorđe Ivković[1], Nada Ratković[1], Anđelka Ilić[1] 355
Computational Optimization and Engineering Design 360
Geometry Optimization of a PVDF-Based Piezoelectric Impact Sensor Using a Hertz-Contact-Informed Axisymmetric Finite Element Model 361
Strahinja Milenković[1,2], Nenad Grujović[1], Fatima Živić[1], ... 361
Optimizing Titanium Hip Implant Performance Through Surface Topography and Numerical Analysis 365
Aleksandra Vulović[1], Živana Jovanović Pešić[1], Đorđe Ilić[1], Strahinja Milenković[2], Dragan Džunić[1] 365
Structural, Dynamic, and Biomechanical Simulation 369
Structural dynamic simulation of an iconic railway infrastructure under a Multiple Moving Load scenario 370
Michele Guerini[1], Rosalba Ferrari[1], Giuseppe Cocchetti[2], Egidio Rizzi[1] 370

Virtual and Digital Twin Modeling ... 374

Virtual Twin Modeling of Bio-Inspired Butterfly Wing Flapping ... 375

Julija Boskovic[1], Milan Ivkovic[1], Ivan Grujic[1], Goran Devedzic[1], Suzana Petrovic Savic[1] ... 375

Advanced Mathematical and Theoretical Methods ... 380

Molecular Nanogears as Quantum Brownian Rotators ... 381

Jasmina Jeknic-Dugic[1], Igor Petrovic[2], Momir Arenijevic[3], Miroljub Dugic[3] ... 381

On the construction of multiple orthogonal polynomials with nearly diagonal multi-indices with respect to bilinear forms ... 386

Nevena Z. Petrović[1] ... 386

BIOTECHNOLOGY AND BIOENGINEERING ... 390

Natural Resources, Food Biotechnology, and Biological Systems ... 391

Biopotential of Autochthonous Lignicolous Mushrooms for Nutraceutical Applications ... 392

Aleksandra Novaković[1], Mirjana Šipovac[2], Milan Vukić[2], Neda Gavrić[1], Maja Karaman[3], Aleksandar Marić[4], Jelena Vulinović[2], Nataša Vojnović[5], Vesna Šolaja[3], Neda Ubiparipović[2], Enisa Musić[2] ... 392

The application of herbs and spices in the food industry ... 398

Vesna Gojković Cvjetković[1], Milenko Smiljanić[1], Željka Marjanović-Balaban[2], Milan Vukić[1], Dragan Vujadinović[1] ... 398

Integrated Non-Invasive Multi-Sensor Approach for Monitoring Fish Community Dynamics: A Case Study in Gruža Reservoir ... 402

Aleksa B. Cvetković[1]*, Tijana Z. Veličković[1,2], Vladica M. Simić[1] ... 402

Host–microbiota interactions in *Drosophila*: composition, regulatory mechanisms and translational relevance ... 407

Enisa Musić[1], Mirjana Šipovac[1], Aleksandra Novaković[2], Maja Palangetić[1] ... 407

Biomaterials, Scaffolds, and Tissue Engineering ... 411

PCL vs. PLA in Bone Regenerative Scaffolds: Current Potential and Challenges ... 412

Jana Baščarević[1], Marija Branković[1], Katarina Virijević[1] ... 412

Polymeric Scaffolds Based on PCL/PEG and Chitosan/PLA for Osteogenic Applications ... 416

Katarina Virijević, Jana Baščarević[1], Nenad Filipović[1] ... 416

Engineered Living Materials: Advanced Approaches for Biomedical Engineering ... 420

Marija Branković[1], Jana Baščarević[1], Fatima Živić[2] ... 420

Molecular and Cellular Biomedical Research 424

Can ATP Citrate Synthase Be Potential Biomarker For Breast Cancer Progression? 425

Jovana Jovankić[1], Milena Milutinović[1], Stefan Blagojević[1], Danijela Nikodijević[1], Aleksandra Nikezić[1], Danijela Cvetković[2] 425

Genetic Polymorphism and CGM-Based Glucose Prediction in Type 1 Diabetes 431

Daphne N. Katsarou[1,2], Eleni I. Georga[2], Stelios Tigas[3], Costas Papaloukas[1,2] and Dimitrios I. Fotiadis, Fellow, IEEE[2,4] 431

Biomedical Instrumentation and Laboratory Automation 435

Automated Cytogenetic Chromosome Spreading Device with Real-Time Environmental Control .. 436

Seyfettin Kazanır Alanya Alaaddin Keykubat University (ALKÜ) Antalya, Türkiye
Seyfettin.kazanir@alanya.edu.tr 436

Cancer Care, Clinical Management, and Digital Health 442

Improving quality of life after breast cancer 443

Iratxe Sobera 443

An Interdisciplinary Approach for the Management of the Elderly Multimorbid Patient with Breast Cancer Therapy-Induced Cardiac Toxicity 445

Alexandros Mitsis[1], Georgia Karanasiou[1,2], Dimitrios I. Fotiadis[1] 445

Smart Mirrors supporting healthier lives of Adolescents and Young Adults after cancer 449

Alexandros Mitsis [1], Georgia Karanasiou [1,2], Dimitrios I. Fotiadis[1] 449

Reway – Restoring Mobility, Redefining Care 452

Sara Milosevic, Jana Jankovic, Marija Velickovic, Jana Cvetkovic, Marko Ilic, Nikola Nikolic[1] 452

ELECTRONICS 456

RF, Antennas, and Electronic Circuit Design 457

A Cylindrical Dielectric Lens–Loaded Microstrip Patch Antenna With Enhanced Gain for 3.5-GHz Sub-6-GHz 5G 458

Tarlan Mahouti[1], Hakan Yılmazer[1], Mehmet Ali Belen[2] 458

Mathematical Model of a Ring-Based Digitally Controlled Oscillator for Frequency Range and Resolution Prediction 462

Đorđe Gačić[1], Lazar Ilić[2], Dejan Petković[3], Vladimir Milovanović[4] 462

Embedded Electronics and Sensor Systems 466

Arduino Temperature Monitoring System 467

Luka Virijević[1], Tijana Dimitrijević[2], Milan Čabarkapa[3] 467

Digital Communication and Signal Processing 471

Equalization and Carrier Recovery for Downstream Data Over Cable Service Interface Specification (DOCSIS) 3.0 Modems 472

Dejan Rakić, Milan Čabarkapa, Vladimir Milovanović 472

Wireless Networking and Positioning 478

A hardware/software platform for precise client device positioning in IEEE 802.11-based Wi-Fi communication networks 479

Zoran Đorđević[1], Nedeljko Stefanović[1], Vladimir Milovanović[2] 479

Connected Vehicles, V2X, and Automotive Cybersecurity 484

IoT and V2X Communications in Autonomous and Electric Vehicles 485

Sandra Antanasijevic[1], Milan Čabarkapa[1], Tijana Dimitrijević[1,2] 485

Cybersecurity of IoT-Based CAN Systems in Autonomous and Electric Vehicles 489

Ema Radovanović[1], Tijana Dimitrijević[2], Milan Čabarkapa[3] 489

Robotics 493

Industrial robots: global trends in exports, dynamics, and challenges 494

Anelia Stoikova 494

Integrating Advanced Robotic Solutions into Lean Industrial Systems: A Human-Centered Approach 498

Nastasija Nikolic[1], Marko Djapan[2], Arso Vukicevic[3], Djordje Milojevic[4], Ivan Macuzic[5] 498

SUSTAINABLE GREEN ENERGY AND CLEAN TECHNOLOGIES 502

Waste Management, Circular Economy, and Resource Recovery 503

Evaluating municipal waste management efficiency in the context of sustainable development: A DEA-based analysis 504

Angelina Cvetanović[1], Goran Bošković[1], Nebojša Jovičić[1] 504

Co-Digestion Plants and Production Assessment 512

Nikola Rakić[1], Vanja Šušteršič[2] 512

Composting of Food Waste in the Hospitality Sector: Lessons from Vrnjačka Banja 517

Sonja Veljović[1], Marija Kostić[2], Milica Luković[3] 517

Sustainable Hydrogen Production from Food Waste Using Integrated Gasification and Sorption-Enhanced Reforming 521

Ali Atas[a,b,*], Nader Javani[b], Betul Colak Karadag[b,c], Ozgun Yucel[d] 521

Sustainable Buildings, Energy Efficiency, and Water Systems 526

Integrated Monitoring and Determination of Showering Parameters in Residential Buildings 527

Natalija Aleksić[1], Vanja Šušteršič[2], Strahinja Milenković[3] 527

Assessing Building Energy Efficiency in Kragujevac (Serbia): Insights from a Retrospective Research Analysis 533

Nebojša Jurišević[1], Minja Velemir[2], Natalija Aleksić[3], Dušan Gordić[4] 533

Improving the Energy Efficiency of Water Hydraulic System Components within Sustainable Energy Plant 539

Nenad Todić[1], Slobodan Savić[1], Blaža Stojanović[1], Saša Milojević[1] 539

IT-Based Feasibility Assessment of a Shallow Geothermal System in a Renovated Educational Building in Kragujevac 543

Filip Nastić, Dubravka Živković, Davor Končalović, Vladimir Vukašinović, Mladen Josijević, Dušan Gordić 543

Environmental Monitoring and Clean-Technology Assessment 548

Assessing The Potential of Citizen-Installed PM2.5 Sensors for Air Pollution Prediction and Mapping 549

Filip Nastić 549

Assessment of PVGIS Accuracy Against EnergyPlus Simulations in Europe 553

Novak Popović[1], Novak Nikolić[1], Nebojša Lukić[1], Minja Velemir Radović[1] 553

Renewable Energy and Solar Technologies 560

Performance Enhancement of $FASnI_3$ Perovskite Solar Cells with CBTS Hole Transport Layer: A SCAPS-1D Study 561

Khadija BOUGHANBOUR*[1] https://orcid.org/0009-0000-3905-4741, Mustapha SAHAL[1] http://orcid.org/0000-0003-0528-8413 561

Digital Infrastructure for Collective Solar Self-Consumption: Enabling Scalable Energy Communities through Data, Algorithms and Governance Platforms 566

Mikel Ubiria Pérez 566

Sustainable Materials, Coatings, and Corrosion Protection 569

Development and Optimization of Water-Based Acrylic Coatings for Enhanced Corrosion Resistance of Metallic Materials 570

Milorad Tomić[1,2], Nebojša Vasiljević[1], Marija Mitrović[1], Regina Fuchs-Godec[3], Jelena Bajat[4] 570

Application of Thyme Extract as a Steel Corrosion Inhibitor in HCl and NaCl Solutions 574

Marija Mitrović[1], Nebojša Vasiljević[1], Regina Fuchs-Godec[2], Milorad Tomić[1,3] 574

ENTREPRENEURSHIP AND INNOVATION 578

Entrepreneurship, Start-ups, and Entrepreneurial Development 579

Opportunities for young Entrepreneurs 580

Maider Beitialarrangoitia[1], Laida San Sebastian[2] 580

Fostering the Growth of Deep-Tech Enterprises Through Enterprise Europe Network 584

Milan Vukic[1], Vesna Gojković Cvjetković[1] 584

Prototypes in the Innovation Development 589

Saša Vasiljević[1], Jelena Domanović[1], Jasna Glišović[2] 589

A Scientific Coordinator Enabling Industry Access to Laboratory Services 593

Panagiotis Pantazis[1] 593

Innovation Ecosystems, Technology Transfer, and Competitiveness 597

Understanding Governance and Capabilities in Technology Transfer Offices: Patterns of Efficiency 598

Konstantina Christogeorgou[1], Maite Couto-Ortega[2], Nikolaos Alexandros Theodorou[1], Maider Beitialarrangotia[2], Maria Vivar-Simon[2], Giovanna Campopiano[3], Nikolaos Mylonidis[1], Yorgos Goletsis[1] 598

Competitiveness, internationalization, and innovation in the creative and cultural industries, COMP-ICC project's presentation 603

Maite Couto-Ortega[1], Maria Vivar-Simón[1] 603

Green Innovation and Innovation Ecosystem Participation on Family and Non-family SMEs Performance 607

Samuel Ashong[1], Giovanna Campopiano[1], Mara Brumana[1] 607

Identity-based Legitimacy Buffering and Organizational Attention Triggering Strategic Distinctiveness in Family Businesses 612

Qiuyang Xu[1], Tommaso Minola[1], Nadine Kammerlander[2] 612

Entrepreneurship, Teams, and Management 616

Teampreneurship for Climate Action: An Open Approach to Green Entrepreneurship Education 617

Lander Jimenez Ocio[1], Jerémy Legardeur[2], Maialen Mendizabal[1], Mar Rubio-Varas[3] 617

Beyond Time, Cost and Scope: Managerial Skills in Achieving Contemporary Dimensions of Project Success 621

Mirjana Jokanović Đajić[1], Danijela Ćirić Lalić[2], Milica Radovanović[1], Ranka Sudžum[3] 621

Adapting Quality Management Models to Local Organizations: A Literature Review on EFQM and Hybrid Decision-Making Approaches 625

Tijana Petrovic[1] 625

Innovation, Education, Skills, and Workforce Development 629

The Leaky Pipeline in STEM careers: Gender Segregation and the Shift Toward Pedagogical Careers 630

Sanja Milić[1], Svetlana Pelemiš,..... 630

AI4DLG: Establishing a Joint International Master's Programme in Artificial Intelligence for Digital Learning and Gamification and Developing Its Digital Presence 634

Jenny Pange[1], Eugenia I. Toki[2]..... 634

Integrating Digital and Green Skills in Higher Education 638

Jenny Pange[1], Dimitrios Panagiotou2, Ioannis Fudos[3] 638

Developing a European VET Model for Rural Destination Managers- A Competence-Based Approach to Sustainable Tourism 642

Soultana Demirtzioglou1, Yorgos Goletsis2, Naoum Mylonas3, Luca Reitano4 642

Green, Social, and Sustainable Innovation 645

Spontaneous Ecosystems in Rural Areas: A Case Study (*Espacio Comün*, Nalda, Spain) 646

Sofía Moreno-Domínguez[1] 646

Mara Stanojević[1], Jelena Nešić[1], Marta Jovanović[1], Mentors: Kristina Cvetković, Bojana Đurković 650

Multi-Criteria Decision Analysis for ESG measurement: A Systematic and Bibliometric Review .. 654

Yorgos Goletsis[1], Vasiliki Spyridonos[2] 654

Strengthening University Disaster Preparedness: Cross-Country Intervention Strategies from the DRU Project 658

Konstantinos Plachouras[1], Zoi Nikiforidou[2], Dimitrios Panagiotou[3], Jenny Pange[4] 658

User-Driven, Digital, and Cultural Innovation 661

Rethinking Personal Safety Through User-Driven Innovation 662

Ivan Martin[1] 662

The role of Avatar in Business – the case study of a company Priče iz Kanca 665

Jelena M. Pavlović Jovanović[1], Nataša Spasić[2], Milan Todorović[3] 665

InTransparency - Verified Talent Marketplace 669

Fabio Chefane[1] 669

DeCiTeL (Democratic Citizenship Teaching and Learning) 675

Jenny Pange[1], Zoi Nikiforidou[2] 675

#DanceMuse: A Phygital Hybrid Museum for the Multisensory and Interdisciplinary Interpretation of Traditional Dance in Epirus 678

Aikaterini Vasilaki[1], Melina Papadopoulou[1], Christina Nika[2], Dimitrios D. Vergados[2], Stavros Papapanagiotou[3], Apostolos Karalis[3], Christos Papakostas[1] 678

Prototypes in the Innovation Development

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Abstract

Prototyping is an important step in the development of innovative solutions. Prototypes can often indicate the very quality and functionality of the product itself that is currently being developed. The development itself or the product development process is also accompanied by this process. Prototypes can often indicate the very problem that exists in the design itself, but they can also indicate the shortcomings related to the development of innovative solutions, but also the functions that the innovation itself has. In this paper, an overview of some of the most important processes during the creation of prototypes was made, as well as examples of prototypes in the development of vehicles. The work is based on achieving and advancing the Sustainable Development Goals, specifically Goal 9.

Keywords: Prototype; Innovation and Industry; Development, automotive.

1. Introduction

The importance of prototyping is particularly evident in the context of driving innovation in one of the most competitive industries in the world. In the automotive industry, where customer expectations are constantly changing, regulatory requirements are becoming more stringent, and technological progress is developing at an unprecedented speed, prototypes provide a necessary framework for experimentation, verification, and improvement. They allow engineers to test structural strength, optimize aerodynamics, integrate modern electronic systems, and evaluate user experience, transforming abstract ideas into tangible and tested results. The development of digital technologies such as virtual simulations, 3D printing and artificial intelligence has significantly improved the prototyping process. These innovations shorten development cycles, reduce costs and minimize risks, allowing manufacturers to respond more quickly to market demands. Prototyping is not only a technical necessity but also a strategic tool that allows automotive companies to combine creativity with reliability, and innovation with feasibility, in order to create vehicles that meet the highest standards of performance, sustainability and customer satisfaction.

The aim of this paper is to present the role and importance of prototyping in the vehicle development process, as well as to analyze different methods and technologies for prototyping, with an emphasis on their contribution to innovation, quality improvement and risk reduction before serial production. The subject of the paper covers

the process of creating and applying prototypes in the automotive industry, including physical and virtual prototypes, the materials and technologies used, as well as the way in which prototypes affect the vehicle development process, safety, functionality and user experience.

2. Phases of prototyping and the basics of prototyping

Bringing a prototype to life is a complex process that combines engineering, software development, and thorough testing. Whether it's a new car prototype, an advanced vehicle prototype, or a futuristic autonomous system, the journey from concept to reality involves several key steps. Every car prototype follows a structured development process to ensure it meets performance, safety, and usability standards [1]. There are a few key stages:

- Concept development and feasibility study, where before any prototype car begins, engineers define key requirements, including target market and use case, performance (speed, efficiency, emissions), powertrain type (ICE, hybrid, electric), software and hardware specifications [1]. Once the feasibility study confirms that the concept is feasible, the project moves into the design phase;
- Design and engineering, where this phase, for example in vehicle development, includes the design of a prototype car, including mechanical design (vehicle chassis, suspension and powertrain layout), electrical systems (installation, battery management and connectivity solutions), embedded software (ECU, safety functions and control algorithms);
- Prototyping Systems involves creating a functional prototype of a vehicle and requires the integration of mechanical, electronic and software components into a working model. During this phase, engineers assemble prototype automotive solutions into a functional unit for initial testing;
- Prototype testing and validation because no vehicle prototype is complete without thorough testing. Engineers evaluate performance, safety, and compliance through:
    - Performance Testing – Confirms speed, efficiency and power output;
    - Crash Testing – Ensures passenger safety;
    - Software Validation – Tests ECU and embedded software;
    - Environmental Testing – Checks durability in extreme conditions [1].

The best approach would, of course, be to prototype every new part, but this is not economically viable. Therefore, some innovative solutions or custom-made systems should be prototyped to ensure they do not fail [2]. As consumer demand changes, automakers respond by creating designs that are both functional and beautiful. Without the prototyping process, design and function would rarely have the qualities needed to convince consumers to buy new vehicles [3].

Prototyping in the automotive industry represent a key segment of vehicle development, as they enable conceptual solutions to be transformed into tangible models that serve to verify, improve and confirm the quality of the future product. This process is important not only from the point of view of technical feasibility, but also to ensure safety, efficiency and adaptation of the vehicle to user needs [4]. The following are the basic functions of prototyping in industry, which include different phases - from design verification and validation, through pre-production, testing and feedback collection, to the final verification of the production process [4]. Thus, these prototyping functions in different areas and phases of innovation development.

3. Technology and uses benefits from making portotypes

Just a decade ago, manufacturing was based solely on mass production with numerous efficient production lines, but with little flexibility. Today, we can find many flexible rapid manufacturing technologies for the production of individual parts and small series production [2]. Rototyping uses a variety of tools and techniques for manufacturing, such as CNC machining for high-precision components, 3D printing for rapid model creation, and vacuum casting for detailed replicas. This provides manufacturers with a comprehensive set of tools for design validation and iteration [5].

Today, various techniques are used in prototyping, most of which are related to the use of computer systems or computer-programmed machines. This section explains some of the techniques and systems used in prototyping. All of these techniques reduce prototyping time and costs. Rapid prototyping is increasingly used today. Rapid prototyping is the process of quickly creating a physical 3D model or prototype of a product based on a digital CAD (computer-aided design) model. Examples of some of the technologies used in prototyping are shown in Figure 1.

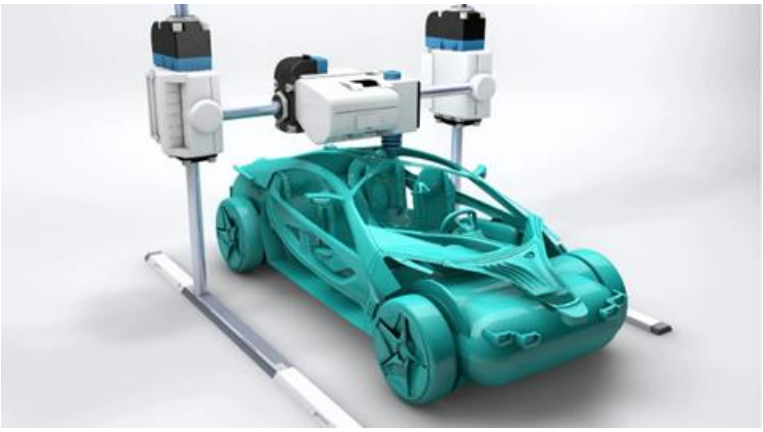


Figure 1. An example of technology for making prototypes, i.e. rapid prototyping technology [6].

The choice of materials for automotive prototyping is crucial because it directly affects the performance, durability, and aesthetics of the final product. Manufacturers must consider factors such as strength, weight, heat resistance, and cost when selecting a prototype material. The most commonly used materials in automotive prototyping are plastics, metals, and composites, each offering specific advantages and limitations [5]. It is most important that the materials support the functionality of the product while being easy to assemble, especially since production in the automotive industry is generally mass-produced, and production speed affects efficiency. In addition to cellular plastics and foams, adhesives and tapes can be used to make assembly as simple and convenient as possible [7].

Car manufacturers are faced with the dilemma of how to test their new prototypes in real conditions, on public roads, without revealing the actual appearance of the car to the market too early. As a solution, they use camouflage of the prototype. In this way, they draw attention to their still-secret prototype. The camouflage

must be very effective in confusing the eye, and even give the effect of the random application of poor camouflage materials [8].

5. Conclusions

Prototyping is one of the most important steps in the development of modern vehicles, as it enables the translation of conceptual solutions into tested and functional models. Analysis of historical examples has shown that prototypes have always been a driver of innovation, allowing manufacturers to test new concepts and technologies before serial production.

Prototypes play an important role in all phases of vehicle development – from design and material selection, through chassis and component manufacturing, to testing on public roads. The paper shows that different manufacturing techniques and materials contribute to process optimization, but that each technique has its own advantages and limitations.

Also, masking and prototype testing play an important role in protecting competitive ideas and verifying functionality in real-world conditions. All of the above confirms that prototyping is not only a technical necessity, but also a strategic development tool, which allows for increased quality, reduced risk, and improved innovation in the automotive industry.

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