

# ISIEA 2024

3<sup>rd</sup> International Symposium on Industrial Engineering & Automation 2024  
*Latest Advancements In Mechanical Engineering*

19<sup>th</sup> – 21<sup>st</sup> June 2024, Bozen/Bolzano, Italy

## MAIN CHAIRS

Franco Concli, Lorenzo Maccioni, Renato Vidoni, Dominik Matt

ISIEA is an annual event that takes place in Bolzano and is organized by the Industrial Engineering and Automation macro-area of the Free University of Bozen/Bolzano. It aims at bringing together academic and industry, researchers in Mechanical Engineering and their worldwide partners in a stimulating environment. The main theme of the 2024 edition will be "Latest Advancements in Mechanical Engineering" and will cover all major areas of R&D and innovation in advanced mechanical engineering. Topics of interest are those listed below and included in the special tracks reported at the bottom of this call for papers. Research contributions could be submitted and published as full papers in Springer's Lecture Notes (Scopus-indexed) or presented either as extended abstracts or posters. Authors of selected papers will have the possibility to submit an enhanced version of their work to the Springer journal *Forschung im Ingenieurwesen / Engineering Research* in the special issue "Best of ISIEA".

Website: [isiea.events.unibz.it](https://isiea.events.unibz.it) Email: [info.isiea2024@unibz.it](mailto:info.isiea2024@unibz.it)

### Tribology and Materials

Tribology & Lubrication  
Material Characterization, Fatigue & Wear  
Experimental Mechanics  
Metamaterials & Lattice

### Modelling and Simulations

Numerical Approaches in Mechanical Engineering  
Modelling & Simulations for Digital Twins  
Design for Additive Manufacturing  
Finite Element & Computational Fluid Dynamics

### Powertrains

Sustainable Energy, Technologies and Systems  
Engines & Drives  
Gearing & Transmissions  
Thermo-Mechanical Measurements

### Applied Mechanics and Robotics

Health Monitoring & Predictive Maintenance  
Robotics & Mechatronics  
Noise, Vibration & Harshness  
Multibody Dynamics

### Participation Modalities

#### Full Paper

Paper with recommended length of 8 pages in Springer format that will be published in the conference proceedings. It may be:

- Eligible for the best paper award;
- Invited for an extended version in a Journal publication.

The work will be presented with a 15-min talk.

#### Extended Abstract

The extended abstract is a document of a maximum of 2 pages. Authors can present their work either through a 15-min talk (as in a full paper presentation) or via a poster presentation. The poster will be visible to attendees throughout the conference. In both scenarios, the work will be distributed to conference participants but not included in the proceedings.

#### Attendee

It is possible to participate as an audience member in the conference by having the opportunity to interact with the authors and exhibitors.

### How to reach Bolzano

#### Train Tickets

[Trenitalia](#)  
[Italo](#)  
[DB Italien](#)  
[ÖBB](#)

#### Bus Tickets

[FlixBus](#)

#### Closest Airports

Bolzano – IT (BZO)  
Innsbruck – AT (UNN) 122 km to BZ  
Verona – IT (VRN) 125 km to BZ  
Venice – IT (VCE) 134 km to BZ  
Bergamo – IT (BGY) 235 km to BZ  
Bologna – IT (BLQ) 282 km to BZ  
München – DE (MUC) 317 km to BZ  
Milan – IT (LIN-MXP) 320 km to BZ

### Important Dates

First Submission

**18<sup>th</sup> February**

First Revision

24<sup>th</sup> March

Final Submission

14<sup>th</sup> April

Final Decision

28<sup>th</sup> April

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## SCIENTIFIC COMMITTEE

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*Chalmers University of Technology – Sweden*

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*RPTU University of Kaiserslautern-Landau – Germany*

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*Montanuniversität Leoben – Austria*

**Prof. Eric Coatanea**  
*Tampere University – Finland*

**Prof. Hartmut Zadek**  
*Otto-von-Guericke-Universität Magdeburg – Germany*

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## SPECIAL TRACKS

Titles	Chairs
Life and Efficiency of Rolling Bearings	Prof. Oliver Koch <i>RPTU University of Kaiserslautern-Landau – Germany</i>
Cycloidal Speed Reducers	Prof. Mirko Blagojevic <i>University of Kragujevac – Serbia</i>
Advancements in Aerospace Technologies	Prof. Valery G. Chernoray <i>Chalmers University of Technology – Sweden</i>
Infrared Thermography for Industrial Applications	Prof. Francesca Curà <i>Politecnico di Torino – Italy</i>
Multi-physics Modeling Approaches for the Simulation of New Generation Propulsion Systems	Prof. Augusto Della Torre <i>Politecnico di Milano – Italy</i> Prof. Gianluca Montenegro <i>Politecnico di Milano – Italy</i>
Innovative Solutions for Safer and More Sustainable Mobility	Prof. Luca Pugi <i>Università degli studi di Firenze – Italy</i> Dr. Lorenzo Berzi <i>Università degli studi di Firenze – Italy</i> Prof. Qing Wu <i>Central Queensland University – Australia</i>
Mobile Field Robotics: Recent Achievements in the Aerial, Ground and Marine Domains	Dr. Alessandro Ridolfi <i>Università degli studi di Firenze – Italy</i> Prof. Karl von Ellenrieder <i>Free University of Bozen/Bolzano – Italy</i>
Advanced Trajectory Planning for Robotic and Mechatronic Systems	Dr. Lorenzo Scalera <i>Università degli Studi di Udine – Italy</i> Prof. Pedro Neto <i>Universidade de Coimbra – Portugal</i> Prof. Stijn Derammelaere <i>Universiteit Antwerpen – Belgium</i> Dr. Andrea Giusti <i>Fraunhofer Italia – Italy</i>
Formulations and Applications of Structural and Multibody Dynamics	Dr. Andreas Zwölfer <i>Technical University of Munich – Germany</i> Dr. Veit Gufler <i>Free University of Bozen/Bolzano – Italy</i> Prof. Johannes Gerstmayr <i>Universität Innsbruck – Austria</i>
Modelling, Planning and Control of Underactuated Systems	Prof. Dario Richiede <i>Università degli studi di Padova – Italy</i> Dr. Iacopo Tamellin <i>Università degli studi di Padova – Italy</i> Prof. José Mário Araújo <i>Instituto Federal de Educação, Ciência e Tecnologia da Bahia - Brasil</i>
Artificial Intelligence in Manufacturing and Mechanical Engineering	Prof. Eric Coatanea <i>Tampere University – Finland</i> Prof. Yuri Borgianni <i>Free University of Bozen/Bolzano – Italy</i>
Innovative Engineering Education	Dr. Margherita Molinaro <i>Free University of Bozen/Bolzano – Italy</i> Prof. Bernd M. Zunk <i>Graz University of Technology – Austria</i> Dr. Manuel Woschank <i>Montanuniversität Leoben – Austria</i>
SME 5.0 - Intelligent, Sustainable and Human-Centred SMEs	Prof. Erwin Rauch <i>Free University of Bozen/Bolzano – Italy</i> Dr. Emmanuel Francalanza <i>University of Malta – Malta</i>

## SPECIAL TRACKS

### Life and Efficiency of Rolling Bearings

*Prof. Oliver Koch*

*Sustainability is the defining issue of our time. Rolling bearings are used wherever relative motion takes place under high loads and are very efficient nowadays. Due to the high quantities of rolling bearings, they make a non-negligible contribution to global CO2 emissions despite their high efficiency. In this session, the following topics will be highlighted: how to better calculate or reduce the friction of bearings; how bearing damage can be better predicted through better calculation approaches; how power density can be increased*

### Cycloidal Speed Reducers

*Prof. Mirko Blagojevic*

*In accordance with modern development trends at complex industrial systems, High Power Density (HPD) speed reducers with high gear ratio (GR) and good efficiency are becoming a necessity. The most famous representatives of HPD speed reducers are planetary, cycloidal and harmonic solutions. The cycloidal reducers belongs to a group of new generation planetary gears. They are broadly used in the modern industry (robot industry, satellite technology, CNC machines, process industry, medical equipment, electric vehicle, renewable energy systems, human robot collaboration, etc). One of the most important application of cycloidal speed reducers is in the field of robotics because the each robot joint has one HPD reducers and these reducers participate with 25% in the total cost of industrial robot. For these reasons, the investigation in cycloidal speed reducer area is very important for modern industrial trends.*

### Advancements in Aerospace Technologies

*Prof. Valery G. Chernoray*

*The aerospace industry is currently undergoing a transformation towards a sustainable and climate-neutral future towards the EU's ambition of climate neutrality by 2050. This special topic welcomes participants from the industry and academia developing cutting-edge technologies for a transformational leap in aircraft performance. The topic includes new airframe design and system-level concepts, novel aero-engine technologies and heat management solutions, electrification, biofuels and cryogenic fuels, drones and UAVs, numerical and experimental methods for aerospace applications.*

### Infrared Thermography for Industrial Applications

*Prof. Francesca Curà*

*This special track involves recent industrial applications of Infrared Thermography in Active and Passive configurations. Active Thermography (AT), also called stimulated thermography, is a Non Destructive Technique (NDT) that requires an external excitation source (flash lamps, halogen lamps, laser, electro-magnetic coils) as well as an infrared thermocamera as response sensor. AT is widely used to detect defects, concentrated and distributed, and to generally characterize damaging conditions and residual stress in materials and components. AT may be satisfactorily applied to welded joints, gears, bearings, thermal barrier coatings, AM components, and so on. On the contrary, Passive Termography (PT) doesn't require an external source, but just an infrared thermocamera to monitor the surface temperature during the time. The thermal contour variation may provide both onset and evolution of classical damaging phenomena as fatigue, wear, etc.*

## SPECIAL TRACKS

### Multi-physics Modeling Approaches for the Simulation of New Generation Propulsion Systems

*Prof. Augusto Della Torre, Prof. Gianluca Montenegro*

*In recent years, the automotive industry has experienced a significant transition towards innovative and alternative propulsion technologies. Novel hybrid electrified internal combustion engines (ICE) have become the standard solution for new production vehicles. Simultaneously, the first generation of battery electric vehicles (BEV) has been deployed for mass production and fuel cell (FC) vehicles have been demonstrated to be a viable solution for a multi-technology decarbonization path. Within this scenario, Computational Fluid Dynamics (CFD) tools have assumed a pivotal role in the design and implementation of new advanced technological solutions, leading to a significant benefit in terms of time and cost saving. This required a significant improvement in the modeling capabilities, in order to deal with the complexity of the different physical problems involved, which are often coupled together, leading to a complex multi-physics framework. This special track aims at gathering innovative contributions in the development and application of multi-physics CFD approaches for the modeling of future power units based on hybrid ICEs, batteries and fuel cells. Contributions could cover advancements including, but not limited to: thermal management of electric motors and batteries, electrochemical simulation of fuel cells and batteries, innovative combustion processes and after-treatment systems in internal combustion engines. Simulation approaches could be addressed at the single component, system or vehicle scale. Moreover, multi-scale analyses are encouraged.*

### Innovative Solutions for Safer and More Sustainable Mobility

*Prof. Luca Pugi, Dr. Lorenzo Berzi, Prof. Qing Wu*

*Mobility and Transportation of Peoples and Goods are currently responsible for a relevant part of direct CO2 emission especially in crowded urban areas or logistic nodes. Electrification of road, rail, marine and aerial means of transportation offers the possibility of a drastic reduction of direct emissions and more generally of global emissions if the primary sources adopted to generate electric energy will be renewable. The path for a safer and more sustainable mobility is open since technology of high-performance electric motors and drives is available and still improving. However, a lot of research work must be done to define new ways in which these electrical solutions can be implemented (new vehicle layout, definition of new vehicles etc.), and to sustain the technology of storage systems which still represent a fundamental issue as a vector to carry transfer and store the energy both on vehicles and infrastructures. Storages play a key role not only in determining performances, autonomy, and industrial feasibility of vehicles, but also in supporting the exploitation of sustainable but intermittent renewable energy sources. Finally, storages are fundamental to stabilize energy distribution systems compensating power fluctuations arising from variability of both sources and loads. So this special session is mainly focused on development of innovative solutions for electrical mobility and to the presentation of new technologies and methodologies able to improve performances, reliability of mobility solutions by accelerating development, testing and assessment of electrical storage solutions.*

### Mobile Field Robotics: Recent Achievements in the Aerial, Ground and Marine Domains

*Dr. Alessandro Ridolfi, Prof. Karl von Ellenrieder*

*Mobile robots are increasingly popular and used in various applications. They can be exploited for monitoring and intervention missions. This is true: in different domains, i.e. aerial, ground and marine domains, and even in a multi-domain mode; In a single-agent configuration and in multi-agent (swarm) configuration. This special track would like to invite papers with recent achievements in this field. Both theoretical and experimental contributions are welcome and possible topics could be: robot design; mechatronic design; robot modelling; robot control and navigation; data processing; AI techniques; autonomous behaviour.*



## SPECIAL TRACKS

### Advanced Trajectory Planning for Robotic and Mechatronic Systems

*Dr. Lorenzo Scalera, Prof. Pedro Neto, Prof. Stijn Derammelaere, Dr. Andrea Giusti*

Nowadays, trajectory planning is a relevant and challenging problem for research on intelligent robotic and mechatronic systems, especially in the context of Industry 4.0. For instance, the design of a proper motion law can be evaluated in relation to the energy consumption of a robotic or mechatronic system, and, therefore, optimal trajectories can be determined based on the best performance of the robot in terms of time-energy consumption. Additionally, path optimization strategies aimed at minimizing movement time are essential for maximizing machine throughput, effectively allowing faster task completion. Another attractive field of application is that of vibration reduction since many automatic machines and mechatronic applications require smooth and jerk-limited trajectories during the prescribed operation. Furthermore, developing advanced robotics applications, such as collaborative robotics and human-robot interaction, necessitate novel strategies for the planning of robot trajectories to ensure smoothness, safety, and fluency, or to promptly adapt to changes of the environment during the execution of a task. With reference to this context, this special track welcomes contributions about advanced path and trajectory planning, dynamic modelling, energy efficiency, time-minimized path optimization, vibration suppression, motion profile optimization, collaborative robotics, and motion planning for human-robot interaction.

### Formulations and Applications of Structural and Multibody Dynamics

*Dr. Andreas Zwölfer, Dr. Veit Gufler, Prof. Johannes Gerstmayr*

This special track is dedicated to the accurate and efficient analysis of structures, machines, and mechanisms under dynamic conditions. Submissions are welcome in the areas of structural and rigid/flexible multibody dynamics, including theoretical and computational aspects as well as their application and validation. Topics of interest include, but are not limited to: formulations and algorithms for rigid and flexible multibody system dynamics; dynamics of solids and slender structures undergoing large deformations; nonlinear dynamics; experimental dynamics; contact and impact mechanics; vibration analysis; model order reduction; machine learning; software implementation; sensitivity analysis, design optimization, and control; real-time digital twins of mechanical systems, industrial and biomechanical applications.

### Modelling, Planning and Control of Underactuated Systems

*Prof. Dario Richiede, Dr. Iacopo Tamellin, Prof. José Mário Araújo*

Underactuated robotic and multibody systems are characterized by less independent actuators than the number of degrees of freedom, thus making challenging their precise motion control. Underactuation is usually caused by the presence of passive joints or by flexibility in links or joints, as a consequence of lightweight or cost-driven design. On the other hand, it can arise in the case of actuator or link failures. Due to the challenges and the growing interest in this area, this track is aimed at collecting theoretical, applicative, and experimental studies on the topic, with particular interest to modeling, design approaches, motion planning, methods for inverse dynamics, feedback and feedforward control techniques. Studies on various kinds of underactuated robotic and multibody systems are welcome, including linear and nonlinear systems, non-minimum phase systems, systems with time delay, and other related issues.

## SPECIAL TRACKS

### Artificial Intelligence in Manufacturing and Mechanical Engineering

*Prof. Eric Coatanea, Prof. Yuri Borgianni*

*The special track welcomes contributions that focus on the use of Artificial Intelligence (AI) in engineering and the industry. Fields of application include, but are not limited to, prediction of mechanical performances, selection of materials and manufacturing operations, production scheduling, quality inspection. Of particular interest are those contributions that show comparisons between engineering tasks supported by AI and performed by humans. Critical analyses of the support of AI in engineering are also relevant for the special track. As well, the chairs invite authors to submit reviews of AI applications for specific industrial tasks and niche engineering domains. Those papers oriented to the development of the discussion of AI tools and algorithms for engineering applications might consider the following non-comprehensive list as a set of illustrative areas of interest. Explainable vs. non explainable AI (pro and cons); Safe AI conditions and consequences for dataset collection, bias detection, training and validation; Dataset collection and use of metadata, AI for modelling and simulation or for online control (consequences, difficulties and limitations); AI and multi-disciplinary optimization; AI vs. classical modelling techniques (differences and similarities); Different types of training (supervised, unsupervised, semi-supervised, auto-supervised, and new training paradigms); AI learning with small and imperfect datasets; Reconstruction techniques for missing data.*

### Innovative Engineering Education

*Dr. Margherita Molinaro, Prof. Bernd M. Zunk, Dr. Manuel Woschank*

*Economic, health and geopolitical trends, combined with technological innovations and sustainability issues, are driving specific areas of job growth and decline. Employers estimate that 44% of workers' skills will be disrupted in the next five years and workers will require massive reskilling and training before 2027. This special track, organized within the cross-cutting action "Education & Lifelong Learning" of the iNEST project (funded by the European Union NextGenerationEU - PNRR), will be focused on the development of knowledge, skills, attitudes and values that enable people to contribute to and benefit from an inclusive and sustainable future. In particular, the track will deal with tools, methods, and formats for Engineering Education. Examples of topics that will be included in the track are: New (digital) tools for Engineering Educations; The role of Learning Factories in Engineering Education; Serious Games for Engineering Education; Problem-Based Learning in Engineering Education; Engineering Curricula Design; Integrating Digitalization and Sustainability in Engineering Education; Life-Long Learning in the Engineering field.*

### SME 5.0 - Intelligent, Sustainable and Human-Centred SMEs

*Prof. Erwin Rauch, Dr. Emmanuel Francalanza*

*In this track, we invite researchers to submit the latest results of research related to the adoption of Industry 5.0 in small and medium-sized enterprises (SMEs). This includes topics on smart SMEs such as AI, biointelligence or cybersecurity, on sustainable SMEs such as green manufacturing, resilience and ethics as well as human-centered SMEs such as future work and competence profiles, inclusivity and diversity in manufacturing and technology for empowering workers. This special track is organized by the European project SME 5.0 but appreciates any submissions by other researchers or research consortiums.*