



RESEARCH GROUPS CATALOGUE

DEPARTMENT OF MECHANICAL
ENGINEERING AND NAVAL ARCHITECTURE

Split, 2026

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GROUP FOR NAVAL ARCHITECTURE (NARC)

Head of the Group:

Branko Blagojević

<https://www.croris.hr/osobe/profil/5747?lang=en>

Scientific Field:

Engineering Sciences / Naval Architecture and Marine Engineering

Brief Description of the Research Group:

The research group focuses on the ship design, marine structures, and advanced marine vehicles. The activities include conceptual and detailed design, hydrodynamic performance analysis, development of innovative propulsion systems, application of advanced manufacturing technologies, and assessment of structural reliability and safety. By combining theoretical and numerical approaches, the group contributes to the development of innovative and sustainable solutions for modern shipbuilding and the maritime industry.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Prof. Dario Ban, PhD
- Prof. Boris Ljubenković, PhD
- Assist. Prof. Josip Bašić, PhD

Other faculty researchers:

- Martina Bašić, PhD

2. EXPERTISE AND KNOW-HOW

- Ships, offshore, and advanced marine vehicles design
- Hydrodynamics and propulsion
- Shipbuilding technologies
- Structural analysis

3. RESEARCH INFRASTRUCTURE

Laboratories

- Shipbuilding Technology Laboratory (a)
- Numerical Hydrodynamics and Advanced Marine Vehicles Laboratory (b)

Equipment

- Complete equipment for the manufacturing of composite vessels up to 6 m in length (a)
- Workstations and software tools (both proprietary and licensed)

4. KEY PROJECTS AND REFERENCES

- Autonomous Adaptive Control of Underwater Vehicles.
- Advanced procedure for Design of Energy Saving Devices on Existing Ships.
- Design and Hydrodynamic Performance of Autonomous SWATH Craft.
- Development of an Innovative Augmented Reality-Based Approach to Ship Outfitting Processes
- Advanced Ship Design for Pollution Prevention.

5. COLLABORATION OPPORTUNITIES

The research group offers a wide range of collaboration opportunities with industry partners, shipyards, maritime companies, and research institutions in the field of naval architecture. The group is focused on development and application of advanced numerical tools for ship hydrodynamics and propulsion analysis, and design of advanced marine vehicles like AUVs and SWATH crafts. The group has developed novel meshless CFD methods (e.g. LDD method), tools for vessel geometry interpolation techniques based on Radial Basis Functions (RBF), and advanced numerical models that enable rapid and reliable hull-form optimization, hydroelasticity assessment, and fluid–structure interaction (FSI) simulations. These approaches are complemented by machine-learning methods for ship motion control. The group is also actively involved in the application of augmented reality technologies for ship production, outfitting, and inspection processes. Collaboration can be established through joint research and development projects, expert studies, consultancy and testing services, as well as joint applications for national and EU-funded projects related to sustainable and innovative shipbuilding and maritime technologies.

6. CONTACT

Head of Research Group: Branko.Blagojevic@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR ADVANCED EXPERIMENTAL MECHANICS AND INTELLIGENT STRUCTURES (AEMIS)

Head of the Group:

Prof. Lovre Krstulović-Opara, PhD

<https://www.croris.hr/osobe/profil/7306?lang=en>

Scientific Field:

Engineering Sciences / Mechanical Engineering

Brief Description of the Research Group:

The research group develops advanced experimental mechanics and non-destructive testing methods using infrared thermography, Digital Image Correlation (DIC), and artificial intelligence. Research activities focus on deformation assessment, the development and characterization of auxetic, TPMS (Triply Periodic Minimal Surface), and hybrid cellular structures, together with the analysis of energy absorption properties of polymer composites, and the development of thermographic data processing methods for non-destructive evaluation. The group also conducts biomechanical testing of bone structures and applies machine learning algorithms for the classification and identification of building structures based on thermographic imagery.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Prof. Lovre Krstulović-Opara, PhD
- Assist. Prof. Petra Bagavac, PhD
- Željko Domazet, PhD, Professor Emeritus

Other faculty researchers:

- Alen Grebo, MEng, Research Assistant
- Juraj Radačić, MEng (Industrial Engineering), Senior Laboratory Technician, Teaching and Research Assistant
- Ante Medvidović, MEng, Teaching and Research Assistant

2. EXPERTISE AND KNOW-HOW

- Development of advanced deformation evaluation methods based on machine learning through the correlation of thermographic data and Digital Image Correlation (DIC).
- Development, dynamic testing, and thermographic/DIC evaluation of novel auxetic, TPMS, and hybrid cellular structures.
- Evaluation of energy absorption characteristics of polymer composites manufactured using additive manufacturing and polymer injection molding technologies.
- Non-destructive testing of metals and composites using active infrared thermography.
- Development of advanced thermographic image processing and filtering techniques for non-destructive evaluation.
- Biomechanical testing and analysis.
- AI-based classification of thermographic images for building structure identification and characterization.

3. RESEARCH INFRASTRUCTURE

Laboratories

- FESB B111, C706/A, C707

Equipment

- INSTRON servo-hydraulic dynamic testing machine
- Instrumented INSTRON 9450 drop tower (impact energy up to 1.8 kJ, impact velocity up to 24 m/s)
- FLIR SC5000 cooled mid-wave infrared camera
- 6 kJ Xenon flash system
- HBM MGCplus multi-channel measurement amplifier for strain gauges and thermocouples
- Non-destructive testing equipment: ultrasonic testing, liquid penetrant testing, magnetic particle inspection, and UV lamp
- NextEngine 3D scanner
- Prusa i3 MK3S fused filament fabrication (FFF) 3D printer, Prusa SL2 Speed stereolithography (SLA) 3D printer
- Krautkramer DM4 thickness gauge
- Krautkramer USM Go ultrasonic flaw detector with straight-beam, angle-beam, and composite testing probes
- AlphaDur Mini UCI hardness tester
- DynaRock II rebound hardness tester
- FLIR E96 long-wave infrared camera (thermal sensitivity 0.04 K, resolution 640 × 420 pixels)

4. KEY PROJECTS AND REFERENCES

- STRENGTH INTERREG Italy-Croatia
- AIRSTRUCT Institutional Research Project

5. COLLABORATION OPPORTUNITIES

- Thermographic inspection and analysis of equipment, industrial plants, buildings, and engineering structures.
- Detection, assessment, and remediation recommendations for moisture and condensation-related issues in buildings.
- Static and dynamic testing of structures (using strain gauge measurements and thermoelastic stress analysis) and materials (using a servo-hydraulic dynamic testing machine).
- Impact testing at velocities up to 24 m/s (drop tower testing).
- Ultrasonic testing and inspection.
- Liquid penetrant and magnetic particle testing.
- Visual inspection.
- Measurement of protective coating thickness on metal structures.
- In-situ material hardness testing.
- Finite Element Analysis (FEA).
- CAD modeling and design.
- 3D scanning and digitization.

6. CONTACT

Head of Research Group: Lovre.Krstulovic-Opara@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR ENERGY EFFICIENCY, RENEWABLE ENERGY SOURCES, AERODYNAMIC MODELLING, AND AERO-ENERGY SYSTEMS (EOAS)

Head of the Group:

Prof. Sandro Nižetić, PhD

<https://www.croris.hr/osobe/profil/252?lang=en>

Scientific Fields:

Engineering Sciences / Basic Engineering Sciences

Brief Description of the Research Group:

The research activities of the group encompass thermodynamic and numerical modelling of fluid flow and thermo-fluid phenomena, as well as experimental investigations of energy transformations and conversion processes in hybrid energy systems and individual technologies based on renewable energy sources. Additional research areas include improving the efficiency and durability of photovoltaic systems, developing novel waste-based phase change materials, aerodynamic modelling of unmanned aerial vehicles (UAVs), and the development and application of smart technologies to enhance thermal comfort and reduce energy consumption in buildings. The overall objective of the group's research is to develop innovative solutions for more efficient energy utilization while minimizing adverse environmental impacts.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Prof. Sandro Nižetić, PhD
- Assist. Prof. Mišo Jurčević, PhD

Other faculty researchers:

- Ivan Čorić, MEng (Mechanical Engineering)
- Jelena Bošnjak, MEng (Industrial Engineering)

2. EXPERTISE AND KNOW-HOW

- Thermodynamic and numerical modelling of fluid flow and thermo-fluid phenomena
- Analysis of energy conversion and transformation processes across various applications
- Analysis of hybrid renewable energy systems
- Aerodynamic modelling of unmanned aerial vehicles (UAVs)
- Enhancement of the energy efficiency and durability of photovoltaic technologies
- Energy efficiency in buildings
- Development and application of smart building technologies for improving thermal comfort
- Development of waste-based phase change composite

3. RESEARCH INFRASTRUCTURE

Laboratories

- Laboratory for Thermodynamics and Energy Efficiency (LTEF)
- Laboratory for Aero and Hybrid Energy Systems (LAHES)

Equipment

- THW-L1 – Thermal conductivity measurement device for liquids and pastes
- Thermtest HFM-100 (100 Series) – Heat Flow Meter
- Hot Disk TPS 500 S – Thermal Constants Analyzer
- ViscoQC 300-L – Viscometer
- Data loggers for monitoring process parameters (temperature, pressure, flow velocity, heat flux)
- FLIR E76 – Infrared thermal imaging camera

4. KEY PROJECTS AND REFERENCES

- Research and Application of Novel Phase Change Composites for Operating Temperature Regulation of Silicon Photovoltaic Panels (IP-2022-10-3971)
- Smart Hybrid Cooling Techniques for Silicon Photovoltaic Panels (IP-01-2018-2814)
- Application of Biosensors for Investigating Thermal Comfort Conditions in Public Office Buildings with the Aim of Optimizing Energy Consumption and Integrating Data into the ESCO MONITOR Platform
- Development and Research of Ice Platforms, DIV Group Ltd.
- UNDP Project: Removing Barriers to Energy Efficiency in Croatia
- New Aspects of Solar Energy Utilization in Solar Chimney Power Plants (023-0231751-3011)
- Significant Reduction of Solar Chimney Power Plant Height, Ministry of Science, Education and Sports
- IR-103 (IRI2): Development of a Zero-Emission Passenger Sailing Vessel, European Regional Development Fund (ERDF)
- Numerical Simulations of the Welding Process for Thick-Walled Reactor Heat Exchangers, EU Industrius (Technical Study)
- Techno-Economic Assessment for the Conceptual Design of the Thermal Energy System for the Poljud Swimming Pools Complex
- Development of Multi-Purpose Heat Pumps with a Proposal for Industrial Production (Technical Study)
- Preliminary Assessment of the Jelina Draga 850 kW Solar Power Plant (Technical Study)
- Thermodynamic Assessment of Rapid Thermal Shock Potential, Interdisciplinary Expert Working Group Investigating the Kornati Island Fire (Expert Report)
- Thermal Energy Consumption Study for the Following Facilities: Poljud Swimming Pools Sports Complex, Poljud City Stadium, Croatian Hydrographic Institute, and Maritime Electronics Centre (Technical Study)
- Conceptual HVAC Design for the TDM Administrative Building (Technical Study)
- Conceptual Design Study of a Multi-Purpose Thermal Energy Plant for Air Conditioning and Recreational Ice Rink Operation (Technical Study)
- Conceptual Design Study of an Energy-Optimal HVAC System for the Poljud Swimming Pools Sports Complex (Technical Study)

5. COLLABORATION OPPORTUNITIES

The research group specializes in the development, analysis, numerical modelling, and experimental investigation of individual technologies and integrated systems in the field of mechanical engineering energy systems, with a particular emphasis on renewable energy sources. The group possesses expertise in the development of advanced materials, particularly phase change composites, as well as in the implementation of smart building technologies aimed at improving thermal comfort and enhancing energy efficiency. The group also has extensive experience in preparing technical studies, feasibility analyses, and expert reports for industrial partners and the energy sector.

6. CONTACT

Head of Research Group: sandro.nizetic@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR DIAGNOSTICS AND OPTIMISATION OF HYBRID ENERGY SYSTEMS (OPTIHYB)

Head of the Group:

Prof. Gojmir Radica, PhD

<https://www.croris.hr/osobe/profil/2759?lang=en>

Scientific Field:

Engineering Sciences / Mechanical Engineering

Brief Description of the Research Group:

The research group focuses on the development and optimisation of hybrid energy systems for mobile, stationary, and marine applications. Its activities encompass the modelling, monitoring, diagnostics, and optimisation of systems integrating internal combustion engines, batteries, fuel cells, renewable energy sources, and alternative fuels. Particular emphasis is placed on developing advanced technologies for system monitoring, emissions reduction, and energy efficiency improvement, as well as on the development of digital twins and innovative energy supply concepts. Through experimental and computational research, the group contributes to the transition towards sustainable, low-emission, and highly efficient energy systems.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Prof. Gojmir Radica, PhD
- Assist. Prof. Željko Penga, PhD

Other faculty researchers:

- Bruno Ševo, MSc in Mechanical Engineering
- Zoran Drašković, MSc in Mechanical Engineering

2. EXPERTISE AND KNOW-HOW

- Monitoring, diagnostics, and optimisation of hybrid energy systems
- Modelling of hybrid energy systems:
- Mobile systems: internal combustion engines, batteries, fuel cells
- Stationary systems: internal combustion engines, wind energy, solar energy, batteries, fuel cells
- Marine systems: internal combustion engines, fuel cells, batteries, alternative fuels, and renewable energy sources
- Advanced technologies for monitoring, optimisation, and emissions reduction in stationary and mobile hybrid energy systems
- Innovative concepts for energy supply based on hybrid energy systems
- Analysis of complex energy systems
- Development of digital twins for energy systems

3. RESEARCH INFRASTRUCTURE

Laboratories

- Thermal Machinery Laboratory

Equipment

- CFD computing server, 3D printer, CNC milling machine, and laser cutter for rapid prototyping and development of hybrid-system components, including fuel cell components
- Hybrid powertrain test bench with internal combustion engine
- Emissions analyser
- In-cylinder pressure measurement and combustion analysis systems
- Fluid flow measurement equipment
- Temperature sensing and monitoring systems
- Remote monitoring systems for energy-system operational parameters (Patent no.:D20250110A)
- Fuel cell test station
- Ten engineering workstations equipped with AVL software licences (BOOST, CRUISE M, and FIRE CFD) for modelling, simulation, and virtual testing of complex energy systems

4. KEY PROJECTS AND REFERENCES

- Development of a Water Curtain System for Preventing Seawater Intrusion, Strategic Partnerships for Innovation in Industrial Transition Programme (IP.1.1.03.0113), Principal Investigator at FESB: G. Radica (2024–2027)
- Micro Fuel Cells as an Alternative Power Source for Mobile Devices (MFC2GO), EU Recovery and Resilience Facility (NPOO), Project No. C3.2.R3-I1.01.0232, Principal Investigator: Ž. Penga (2024–2025)
- Advanced Technologies for Autonomous Systems (ATASYS), University of Split Institutional Research Project (IP-UNIST-06), funded through the National Recovery and Resilience Plan 2021–2026, Principal Investigator: Ž. Penga
- HRZZ IP-2025-02-1981 – HyRefuelStat, Research Team Member: G. Radica (2025–2028)
- HRZZ IP-2024-05-6299 – Coordinated Hydrogen and Electricity Systems and Markets, Research Team Member: Ž. Penga (2024–2027)

5. COLLABORATION OPPORTUNITIES

The research group welcomes collaboration with industry, public-sector organisations, and academic partners in the development and deployment of advanced hybrid energy systems for mobile, stationary, and marine applications. Collaboration opportunities include joint research and development projects, industrial testing and technology validation, feasibility studies, and optimisation of existing systems aimed at improving energy efficiency and reducing emissions. Particular interest is devoted to the integration of internal combustion engines, battery systems, fuel cells, renewable energy sources, and alternative fuels. The group offers expertise in modelling, monitoring, diagnostics, and optimisation of complex energy systems, as well as in the development of digital twins for predictive control and operational optimisation. Potential forms of cooperation include joint R&D and innovation projects, technology transfer and

commercialisation, development of innovative energy supply concepts, participation in national and European funding programmes, professional training and capacity building, technical consultancy and support for implementing advanced energy solutions. Special emphasis is placed on solutions aligned with regulatory requirements, sustainability objectives, and decarbonisation strategies.

6. KONTAKT

Head of Research Group: gojmir.radica@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR DYNAMICS AND VIBRATIONS (KDV)

Head of the Group:

Prof. Damir Sedlar, PhD

<https://www.croris.hr/osobe/profil/2357?lang=en>

Scientific Field:

Engineering Sciences / Mechanical Engineering, Fundamental Engineering Sciences

Brief Description of the Research Group:

The Dynamics and Vibrations Research Group focuses on the study of dynamic behaviour in engineering systems through a combination of experimental and numerical approaches. Its expertise includes experimental and numerical modal analysis, dynamic system identification, and the investigation of nonlinear dynamic phenomena. Research activities encompass vibration analysis using high-speed camera recordings, fatigue assessment, and the development of methods for structural damage detection and lifetime prediction. The group also develops and applies advanced numerical techniques, including meshless methods and multiphase fluid modelling, with the aim of improving the reliability, safety, and performance of engineering systems and structures.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Assoc. Professor Ivan Tomac, PhD (<https://www.croris.hr/osobe/profil/27590>)
- Prof. Emeritus Željko Lozina (<https://www.croris.hr/osobe/profil/17223>)

2. EXPERTISE AND KNOW-HOW

Experimental Dynamics and Measurements

- Experimental and Operational Modal Analysis (EMA / OMA)
- Non-contact vibration measurements using Laser Doppler Vibrometer (LDV scanning)
- Vibration and deformation analysis from high-speed camera recordings
- Noise measurement and analysis, including vibroacoustic diagnostics
- Experimental excitation of structures (modal shakers and impact hammer testing)

Numerical Modelling and System Identification

- Dynamic system identification (linear and nonlinear systems)
- Dynamic analysis of nonlinear systems
- Finite element methods, Meshless numerical methods and multiphase fluid modelling
- Correlation and updating of numerical models based on experimental data
- Numerical shape synthesis and geometry optimisation through advanced parameterisation techniques

Structural Reliability and Integrity

- Fatigue analysis and service-life prediction
- Structural health monitoring and damage assessment
- Vibroacoustic optimisation of engineering structures (e.g. ship structures)

3. RESEARCH INFRASTRUCTURE

Laboratories

- Vibrations and Noise Laboratory
- Machine Dynamics Laboratory

Equipment

- Advanced measurement and data acquisition systems, including: Polytec PSV-500 Scanning Laser Doppler Vibrometer (LDV)
- Laser Doppler Vibrometer Polytec OFV-1102 with OFV-200 controller
- Experimental modal analysis software packages (MEScope and ModalVIEW)
- Vibration excitation systems (TIRA shakers and Dongling ES-1-15 shaker)

4. KEY PROJECTS AND REFERENCES

- Numerical Synthesis of 3D Shapes with Advanced Geometry Parameterisation, Experimental Validation, and Feedback-Based Numerical Model Updating (HRZZ IP-2022-10-8856)
- Development of Innovative Composite Structures for Sound Insulation (CEKOM – IRI 1)
- Development of an Advanced Integrated Numerical Procedure for Optimising Ship Vibroacoustic Performance in Early Design Stages (CEKOM – IRI 2)
- Evolutionary Shape Synthesis with Integral and Partitioned 3D Phenotypes, Dynamic Parameterisation, and Meshless Modelling (HRZZ IP-2018-01-6774)

5. COLLABORATION OPPORTUNITIES

The group welcomes collaboration in the fields of dynamics, vibrations, noise control, and optimisation of structures and mechanical systems. Cooperation can be established through research and innovation projects, contract research, technical consultancy, expert assessments, and student and doctoral research projects.

Services and Collaboration Activities:

- Experimental modal and operational analysis of structures and machinery
- Laboratory and field measurements of vibrations and noise
- Identification of excessive vibration sources and development of corrective measures
- Numerical analyses (FEM), model validation, and model updating based on measurement data
- Assessment of fatigue, structural integrity, and remaining useful life
- Vibroacoustic optimisation of products and structures during early design stages

Academic Mobility and International Cooperation: The group actively supports international collaboration through the Erasmus+ programme, including: Student, doctoral researcher, and staff exchanges, Joint supervision of theses and dissertations, Guest lectures and research visits, Collaborative research initiatives

Target Sectors: Shipbuilding and marine engineering, mechanical and process industries, transportation systems, energy sector, civil and structural engineering

Deliverables: measurement and diagnostic reports, validated numerical models, engineering recommendations for vibration and noise reduction, reliability improvement strategies for engineering systems and structures

6. CONTACT

Head of Research Group: Damir.Sedlar@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR APPLIED THERMODYNAMICS AND ENERGY CONVERSION ENGINEERING

Head of the Group:

Assoc. Prof. Ivan Tolj, PhD

<https://www.croris.hr/osobe/profil/27591?lang=en>

Scientific Field:

Engineering Sciences / Mechanical Engineering

Brief Description of the Research Group:

The research group focuses on the development and application of hydrogen technologies for sustainable energy systems. Its research activities cover hydrogen production, storage, compression, and utilisation, with particular emphasis on electrolyzers, fuel cells, and metal hydride storage systems. The group conducts research on diagnostics and degradation analysis of electrochemical components, develops advanced control algorithms for hydrogen systems, and optimises their efficiency, reliability, and lifetime. Additional research areas include the integration of fuel cells into mobile and industrial applications, as well as the development of innovative solutions for incorporating hydrogen technologies into renewable energy systems and supporting the energy transition.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Prof. Emeritus Dr. Frano Barbir
- Assist. Prof. Ivan Pivac, PhD

Other faculty researchers:

- Jakov Šimunović, PhD, Research Assistant

2. EXPERTISE AND KNOW-HOW

- Hydrogen integration in renewable energy systems
- Integration of fuel cells into industrial vehicles (forklifts)
- Diagnostics and degradation analysis of electrochemical hydrogen compressors
- Hydrogen production by water electrolysis, including the impact of operating conditions on electrolyser performance and durability
- Design and optimisation of metal hydride hydrogen storage systems with enhanced heat transfer management
- Characterisation of metal hydride storage systems during hydrogen absorption and desorption processes
- Fuel cell design, operation, and applications
- Development of control algorithms for fuel cell and electrolyser systems
- Experimental testing and characterisation of electrochemical compressors

3. RESEARCH INFRASTRUCTURE

Laboratories

- Laboratory for Advanced Thermal Energy Technologies (C516)

Equipment

- Fuel cell test station for single-cell testing across various cell sizes (Teledyne Medusa), equipped with integrated Frequency Response Analysis (FRA) electronics
- Fuel cell test station for single cells and small fuel-cell stacks of various sizes (Scribner Associates)
- PEM electrolyser test station for single-cell testing (Sustainable Innovations Test Station for PEM Electrolyzers)
- Potentiostat/Galvanostat (BioLogic SP-150) with external current booster up to 10 A for advanced electrochemical testing, Base unit: ± 10 V, ± 400 mA, Current booster: ± 10 V, ± 10 A
- S++ Current and Temperature Scanner featuring: Local current measurements at 121 measurement points, temperature measurements at 49 measurement points, measurement ranges: 0–2 V and 0–100 °C, fuel cell active area: 50 cm²
- Stand-alone hydrogen energy system consisting of: Solar photovoltaic array (1.6 kW), Wind turbine (1.4 kW), PEM electrolyser (2.8 kW, maximum pressure 30 bar), Hydrogen storage system (600 L volume, 1.5 kg H₂ capacity), Fuel cell system (1.2 kW electrical output), Battery storage (24 V, 1000 Ah), DC/AC inverter (3.5 kW), Programmable electrical load (up to 1.5 kW)

4. KEY PROJECTS AND REFERENCES

- **HyRefuelStat – Development of a High-Efficiency Metal Hydride Compressor with Integrated Thermal Energy Storage for Advanced Hydrogen Refuelling Stations**
Croatian Science Foundation (HRZZ), Principal Investigator: Associate Professor Ivan Tolj, 2025–2028
- **HYTECH – Advanced Diagnostics and Prognostics for Efficient Green Hydrogen Production and Utilisation**
Croatian Science Foundation (HRZZ), Principal Investigator: Assistant Professor Ivan Pivac, 2026–2031
- **LUMINI2 – Laboratory Model and Prototype Control and Monitoring System for Renewable-Energy Microgrids with Hydrogen Technologies**
Targeted Scientific Research Programme, NPOO.C3.2.R3-I1.04
- **International Engineering Competence Centres for Sustainable Mobility Development in Albania and Montenegro**
Erasmus+ Capacity Building Project (ERASMUS-LS), 2023–2026
- **Increasing Efficiency, Reducing Harmful Emissions and Hybridisation of Marine Energy Systems**, Croatian Science Foundation (HRZZ), 2021–2025

5. COLLABORATION OPPORTUNITIES

The research group welcomes collaboration with universities, research institutes, industry partners, and public-sector organisations in the field of hydrogen technologies and sustainable energy systems. Particular interest lies in the joint development and deployment of technologies for hydrogen production, storage, compression, and utilisation, including electrolyzers, fuel cells, and metal hydride systems. Potential forms of collaboration include joint national and international research projects, the development of innovative products and prototypes, industrial testing and validation, technology transfer, as well as technical studies and expert analyses. The group has access to state-of-the-art research infrastructure for the experimental testing of fuel cells, electrolyzers, electrochemical compressors, and hydrogen storage systems, enabling advanced research and the validation of novel technologies and solutions. The group is especially interested in collaborations focused on integrating hydrogen technologies into transportation, industry, microgrids, and renewable energy systems, as well as projects supporting the energy transition and decarbonisation. In addition, the group offers opportunities for joint supervision of undergraduate, graduate, and doctoral students, organisation of workshops and professional training programmes, and the exchange of researchers, expertise, and knowledge.

6. CONTACT

Head of Research Group: Ivan.Tolj@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR MECHANICAL STRUCTURAL INTEGRITY AND THE DEVELOPMENT OF INDEPENDENTLY CONTROLLED GEAR TRANSMISSIONS

Head of the Group:

Assist. Prof. Vjekoslav Tvrđić, PhD

<https://www.croris.hr/osobe/profil/32612?lang=en>

Scientific Field:

Engineering Sciences / Mechanical Engineering

Brief Description of the Research Group:

The research group focuses on the reliability, durability, and structural integrity of mechanical systems, with particular emphasis on fatigue, fracture mechanics, and mechanical power and motion transmission systems. Its research activities include the assessment of damage initiation and propagation, service-life prediction of structural and machine components, and failure analysis under dynamic loading conditions.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Assist. Prof. Milan Perkušić, PhD

Other faculty researchers:

- Stipe Pleština, MSc in Mechanical Engineering

2. EXPERTISE AND KNOW-HOW

- Fatigue analysis
- Fracture mechanics
- Mechanical power and motion transmission systems
- Energy harvesting systems (energy harvesters and energy scavengers)

3. RESEARCH INFRASTRUCTURE

Laboratories

- Machine Elements Laboratory (C809), equipped with educational and research models of machine elements

Equipment

- Custom-designed test rig and prototype regenerative hydraulic device for harvesting vibration energy from mechanical systems

4. KEY PROJECTS AND REFERENCES

- Strength and Durability of Machine Elements **(2000–2002)**
- Fatigue Crack Initiation in Machine and Structural Components **(2003–2005)**
- Dynamic Strength of Thermally Cut Structural Components (2008–2010)

5. COLLABORATION OPPORTUNITIES

- Fracture Mechanics – application of fracture mechanics principles and methodologies to assess the service life, damage evolution, and structural integrity of machine components and load-bearing structures.
- Mechanical Power and Motion Transmission Systems, as well as General Machine Elements – engineering analysis, design calculations, technical consultancy, and scientific research related to individual machine components and complete mechanical assemblies.
- Energy Harvesting Technologies – numerical and experimental research on systems that capture and convert ambient energy into usable power, including vibration-based and other energy harvesting solutions.
- Polymer Gears – experimental investigation of the performance, durability, wear behaviour, and application potential of polymer-based gear systems.

6. CONTACT

Head of Research Group: Vjekoslav.TvrDIC@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR LINEAR AND NONLINEAR ANALYSIS OF THIN-WALLED STRUCTURES (LINATK)

Head of the Group:
prof. Frane Vlak, PhD

<https://www.croris.hr/osobe/profil/4121?lang=en>

Scientific Fields:

Engineering Sciences – Fundamental Engineering Sciences

Engineering Sciences – Mechanical Engineering

Engineering Sciences – Naval Architecture and Marine Engineering

Brief Description of the Research Group:

The research group specializes in elasticity theory, thin-walled members and structural systems analysis, ship structures, wind turbine structures, composite and orthotropic materials including materials produced using additive manufacturing technologies. Research activities focus on the structural analysis of thin-walled structures, the development of elasto-plastic constitutive models, structural reliability and uncertainty assessment, as well as parameter identification and model selection using Bayesian methods. The comprehensive goal is to enhance the reliability, safety, and efficiency of engineering structures through the implementation of advanced numerical and probabilistic approaches.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Radoslav Pavazza, PhD, Professor Emeritus
- Prof. Jani Barle, PhD
- Prof. Vedrana Cvitanić, PhD
- Assoc. Prof. Marko Vukasović, PhD
- Assist. Prof. Branka Bužančić Primorac, PhD
- Assist. Prof. Stipe Perišić, PhD

Other faculty researchers:

- Maja Džoja, PhD

2. EXPERTISE AND KNOW-HOW

- Elasticity theory
- Thin-walled beam theory
- Thin-walled beam structures
- Ship structures
- Wind turbine support structures
- Composite materials

- Plasticity theory
- Elasto-plastic constitutive modelling of orthotropic materials (sheet metals and additively manufactured metal components)
- Bayesian parameter estimation for constitutive and mathematical models
- Structural integrity and strength assessment
- Model uncertainty quantification
- Reliability model selection and assessment

3. RESEARCH INFRASTRUCTURE

Laboratories

- Mechanics Laboratory (setting up)
- Hydraulic and Pneumatic Systems Laboratory

4. KEY PROJECTS AND REFERENCES

Selected Projects

- IRI S3 – Development of Lightweight Polymeric Vehicle Body Components for Improved Energy Efficiency
- Deplanation and Distortion of Thin-Walled Cross-Sections
- Structural Strength Verification of the KPS-450-3-200 Traffic Sign Cantilever Structure

Selected Publications

- Andrade, D., Cvitanić, V., da Silva, L.S., & Rodrigues, D. (2025). Stress and strain anisotropy of CMT-WAAM 316LSi stainless steel: Characterisation and modelling. *Construction and Building Materials*, 493, 143274.
- Perišić, S., Barle, J., Tomac, I., & Đukić, P. (2024). Automatic damping estimation via bootstrap technique and Bayesian analysis for mechanical system condition monitoring. *Mechanical Systems and Signal Processing*.
- Vukasović, M., & Pavazza, R. (2021). Flexural analysis of thin-walled laminated composite beams with arbitrary open sections and shear influence. *Mechanics of Advanced Materials and Structures*, 29, 5041–5058.
- Grubišić, V.V., Barle, J., Vlak, F., & Ban, D. (2020). Fractures on a drillship derrick: Evaluation and improvement. *Engineering Failure Analysis*, 118, 104792.
- Barle, J., Grubišić, V.D., & Vlak, F. (2011). Failure analysis of a highway sign structure and design improvement. *Engineering Failure Analysis*, 18, 1076–1084.

Awards

- Marko Vukasović – University of Split Award for Science (2018), awarded in the category of early-career researchers, research assistants, and postdoctoral researchers.

5. COLLABORATION OPPORTUNITIES

The Linear and Nonlinear Analysis of Thin-Walled Structures research group develops analytical, numerical, and experimental methods for investigating the mechanical behaviour of structures and materials. Its research activities span several interconnected areas.

The first research area focuses on the analysis of thin-walled beams and structures, including their applications in shipbuilding and energy systems. The second area is dedicated to composite materials, covering their modelling and analysis at both the micro- and macro-scale. The third research area addresses the plasticity of orthotropic materials, with particular emphasis on the characterization and constitutive modelling of the anisotropic elasto-plastic behaviour of sheet metals and metal components produced using additive manufacturing technologies. The research activities are extended to the development of advanced methods for parameter estimation in mathematical and constitutive models, model uncertainty quantification, and Bayesian model selection. The group welcomes collaboration with academic institutions, research centres, and industrial partners in areas including analytical and numerical modelling of thin-walled and composite structures, the development and numerical implementation of elasto-plastic constitutive models for orthotropic materials, and the development and application of methods for structural reliability and condition assessment, as well as parameter estimation and uncertainty quantification. The group is open to joint research projects, researcher mobility and exchange programmes, and the transfer of scientific knowledge into industrial practice.

6. CONTACT

Head of Research Group: Frane.Vlak@fesb.hr

General Contact: projekti@fesb.hr

GROUP FOR ADAPTIVE PARAMETERIZATION FOR OPTIMIZATION AND ENGINEERING NUMERICAL METHODS

Head of the Group:

Prof. Damir Vučina, PhD

<https://www.croris.hr/osobe/profil/14719?lang=en>

Scientific Field:

Engineering Sciences / Fundamental Engineering Sciences

Brief Description of the Research Group:

The group's main research areas include numerical optimization methods, geometric modeling, evolutionary algorithms, and computational fluid dynamics (CFD). Special emphasis is placed on the application and development of artificial intelligence models for data analysis, system behavior prediction, and support of the engineering design process. By integrating computational mechanics, optimization techniques, and artificial intelligence, the group develops innovative solutions to improve the efficiency, performance, and sustainability of engineering processes and products.

1. RESEARCH TEAM

Faculty members in teaching and research positions:

- Assoc. Prof. Igor Pehnec, PhD
- Assoc. Prof. Milan Ćurković, PhD
- Assoc. Prof. Ivo Marinić-Kragić, PhD

Other faculty researchers:

- Luka Nikolić, MEng

2. EXPERTISE AND KNOW-HOW

- Numerical optimization methods
- Geometric modeling
- Evolutionary algorithms
- Computational fluid dynamics (CFD)
- Application of existing and development of novel artificial intelligence models

3. RESEARCH INFRASTRUCTURE

Laboratories

- Laboratory for Optimization and Design
- Rapid Prototyping Laboratory
- Ad hoc Wind Tunnel for VAWT Analysis
- CFD Analysis Laboratory

- Laboratory for Numerical Modeling and Optimization
- Laboratory for Fluid Mechanics and Hydraulic Systems
- Computational Fluid Dynamics Laboratory

Equipment

- High-accuracy and high-precision 3D scanners (GOM ATOS I and GOM ATOS COMPACT 8), Prusa and Modix 120X 3D printers, Proxxon FF 500 CNC Micro Mill, High-performance workstations and graphics stations
- Hydraulic machinery system (circulation pumps, fans, filters, etc.), Various measuring instruments (pressure measurement, velocity measurement, hot-wire anemometry, etc.)

Advanced Computing Resources

- Intel Xeon server (2 × 14 cores, 256 GB RAM)
- Intel Xeon server (2 × 16 cores, 260 GB RAM) equipped with an NVIDIA A100 GPU
- Numerical optimization computing cluster with approximately 20 computers (Intel i7, 8 cores, 32 GB RAM each)

4. KEY PROJECTS AND REFERENCES

- HRZZ 2013: Adaptive Parameterization of Variable 3D Geometries for Shape Optimization and Meshless Numerical Modeling
- HRZZ 2018: Evolutionary Shape Synthesis with Integral and Partitioned Phenotypes, Dynamic Parameterization, and Meshless Modeling
- HRZZ 2022: Numerical Synthesis of 3D Shapes Using Advanced Geometry Parameterization, Experimental Validation, and Feedback Adaptation of Numerical Models
- HRZZ 2025: Estimation of Blood Glucose Levels in Individuals with Type 1 Diabetes from Facial Photographs and 3D Facial Scans Using Machine Learning

5. COLLABORATION OPPORTUNITIES

Damir Vučina: Head of the Research Group.

Milan Ćurković: Collaboration opportunities include geometric modeling, shape optimization, 2D and 3D data processing, computer vision, and machine learning. Particular emphasis is placed on developing methods for 3D reconstruction, geometric analysis, and system condition assessment based on image and geometric data, with applications in medicine, industry, and cultural heritage.

Ivo Marinić-Kragić: Research interests include numerical analysis and engineering optimization in computational fluid dynamics (CFD), structural static and dynamic analysis, thermal analysis, energy management in microgrid systems (photovoltaic, battery, and hybrid systems), and engineering applications of machine learning.

6. CONTACT

Head of Research Group: Damir.Vucina@fesb.hr

General Contact: projekti@fesb.hr