



POLISH NATIONAL AGENCY
FOR ACADEMIC EXCHANGE



STER
PROGRAMME

<p>name of the unit:</p> <p style="text-align: center;">INSTITUTE OF MECHATRONICS AND INFORMATION SYSTEMS Lodz University of Technology</p>		<p>symbol:</p> <p style="text-align: center;">I-25 http://www.imsi.p.lodz.pl</p>
<p>head of the unit:</p> <p style="text-align: center;">Prof. Sławomir Wiak, PhD, DSc, multi dr h.c.</p>	<p>potential promoters:</p> <p style="text-align: center;">Prof. Sławomir Wiak, PhD, DSc, multi dr h.c.</p>	<p>contact person:</p> <p style="text-align: center;">Dorota Kamińska, PhD phone: 48-42-631-25-71 dorota.kaminska@p.lodz.pl</p>
<p>scope of activities:</p> <ul style="list-style-type: none"> • implementation of discrete models into optimal design of intelligent microsystems (MEMS/NEMS) and multi-physics analysis of MEMS/NEMS • automated optimal design solved by means of optimization algorithms • non-linear multiphysics analysis and multi-objective optimization of MEMS/ NEMS • numerical methods for MEMS/NEMS design: inverse problems • implementation expert systems into global design of intelligent microsystems (MEMS/NEMS) • research on affective computing, emotion, and stress recognition based on biological signal analysis within the national (Miniatura NCN) and international VRXanny (Erasmus+) projects. • reserch on stress reduction using Virtual Reality within the national (Miniatura NCN) and international VRXanny (Erasmus+) projects • research on Extended Reality solution application in education (many international Erasmus+ projects, eg. ViMeLa, Atomic, VRAna) • research on usability/accessibility testing using subjective (questionnaires) and objective (biomedical signals) data within the national (Lodz University of technology available, NCBiR) and international Mr. UD (Erasmus+) projects. 		<p>graphic material</p>   
<p>present activities:</p> <ul style="list-style-type: none"> • We implement advanced numerical methods for MEMS/NEMS design: automated optimization • We apply inverse problems by means of numerical optimization: single-objective formulation and we apply multi-objective formulation by means of Pareto optimality • We apply modern technology in the form of Extended Reality (EX) into education, followed by research on its effectiveness and usability. Recently, we have used EX as a tool for stress reduction and mental health boosters. • In affective computing, we analyse different signals such as speech, gestures, mimic and physiological ones to determine the emotional state, especially during usability testing and monitor mental health 		
<p>Future activities:</p> <ul style="list-style-type: none"> • Implementation of gradient-free and gradient-based methods for intelligent microsystem design © Multi Objective and Pareto-like evolution strategy (MOESTRA and P-EStra) • Nature-inspired computing: wind-driven optimization and Biogeography-based optimization 		



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Publications/patents, awards, projects:

- Di Barba Paolo, Slawomir Wiak: MEMS: Field Models and Optimal Design, Springer 2020, ISBN 978-3-030-21495-1, pp. 1-190
- Paolo Di Barba and Slawomir Wiak – Optimal Design and 3D printing and Metamaterials, IET (The Institution of Engineering and Technology), 2022, monograph
- Paolo Di Barba, Teodor Gotszalk, Wojciech Majstrzyk, Maria Evelina Mognaschi, Karolina Orłowska, Slawomir Wiak, and Andrzej Sierakowski: Optimal Design of Electromagnetically Actuated MEMS Cantilevers, *Sensors* 2018,18(8), 2533; monograph, pp 2-14
- Dorota Kamińska, Slawomir Wiak, Lidija Petkovska, Goga Cvetkovski, Paolo Di Barba, Maria Evelina Mognaschi, Rain Eric Haamer, Gholamreza Anbarjafari Virtual Reality-Based Training: Case Study in Mechatronics. *Technology, Knowledge and Learning* <https://doi.org/10.1007/s10758-020-09469-z>, 2020.
- D. Kamińska, K. Smółka, G. Zwoliński, S. Wiak, D. Merez-Kot and G. Anbarjafari, "Stress Reduction Using Bilateral Stimulation in Virtual Reality," in *IEEE Access*, vol. 8, pp. 200351-200366, 2020, doi: 10.1109/ACCESS.2020.3035540.
- Dorota Kamińska, Tomasz Sapinski, Slawomir Wiak, Toomas Tikk, Rain Eric Haamer, Egils Avots, Ahmed Helmi, Cagri Ozcinar and Gholamreza Anbarjafari: Virtual Reality and Its Applications in Education - Survey, *Information* 2019, 10(10), 318; doi:10.3390/info10100318, MDPI, pp. 2-20, (This article belongs to the Section Information and Communications Technology)
- PAT_WLA. PL, nr 229224 (2018-01-17). Electric wheelchair with variable base). Autorzy/Authors: Slawomir Wiak, Pyć Tomasz, Timofeev Vladimir, Popsui Sergei, Kapralov Guennady.

We conduct the following research projects:

- MDB-MEDICAL DATA BANK-Virtual platform for medical data and modern diagnostics. Operational Program Digital Poland, Priority Axis II, Action 2.3 - Digital accessibility and usefulness of public sector information.

ASM SMART DATA SYSTEM (ASM SDS) - Research on a data collection, processing and distribution system using machine learning algorithms for the modernization of implementation and management processes and the implementation of new and substantially improved research products and services (Number of contract RPLD.01.02.02-10-0022/18)

Keywords:

CAD, optimal design, intelligent microsystems (NEMS/MEMS), data base and expert systems, Artificial Intelligence (AI), Virtual Reality (VR), extended reality, affective computing, stress reduction, emotion recognition

List of internship proposal in this research team:

Extender reality researcher, Affective computing researcher, Postdoctoral fellowships and fellowships for PhD students to be engaged in advanced computer modelling of intelligent microsystems

List of attachments: