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Editors

Advances in Digital Health and Medical Bioengineering II

**Volume 2 - Health Technology Assessment,
Biomedical Signal Processing, Medicine and
Informatics**

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ISSN 1680-0737
ISBN 978-3-032-24044-6
Number of Pages
VIII, 249

E-ISSN 1433-9277 (electronic)
ISBN 978-3-032-24045-3 (eBook)

Part of the book series: IFMBE Proceedings (IFMBE, volume 143)
<https://link.springer.com/book/9783032240446>

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This Springer imprint is published by the registered company Springer
Nature Switzerland AG The registered company address is: Gewerbestrasse
11, 6330 Cham, Switzerland.

PREFACE

The three volumes of *Advances in Digital Health and Medical Bioengineering*, part II, gathers all accepted and presented papers at the 13th International Conference on E-Health and Bioengineering, EHB-2025, November 13–14, 2025, Iași, Romania (www.ehbconference.ro).

This hybrid conference was organized by the Grigore T. Popa University of Medicine and Pharmacy of Iași / Faculty of Medical Bioengineering, International Society for Digital Health and Education, and co-organized by the Institute of Computer Science of Romanian Academy - Iasi Branch. The conference was mainly dedicated to the e-health systems, medical bioengineering and biomedical engineering, but also addresses related fields. Its specific aim and objectives are to promote concepts and advanced hardware and software technologies in the emerging domains of e-health, medical devices and instrumentation, biosignal and image processing, medical informatics, artificial intelligence in healthcare, biomechatronics, biomaterials, biotechnologies, medical physics, healthcare management, teaching and (e)learning, rehabilitative and assistive technologies, environmental protection, food technologies, as well as in some younger disciplines such as bioinformatics, and systems biology. Thus, EHB 2025 was an international forum for fundamental and applied research and applications in bioengineering and biomedical engineering. EHB 2025 brought together researchers from academic and research institutions, leading industrial companies, and government laboratories worldwide to promote and popularize the scientific fundamentals and applications of digital health and bioengineering.

The conference motto was *Innovation for a better healthcare*, and we have to stress that the ultimate goal of medical systems, we mean a better quality of life, from medical and social points of view, cannot be achieved without an efficient use of information and management systems and of biomedical technology.

The EHB Conference is the largest medical bioengineering conference in Romania and Eastern Europe. This year it received 478 submissions from 51 countries across six continents. Following a rigorous double-blind, two-round peer-review process, authors revised their papers based on reviewers' feedback, resulting in an acceptance rate of about 61%. We sincerely thank the authors, conference committee members, session chairs, and especially the reviewers—without their dedication, this conference and book would not be possible. Extended versions of selected best papers will be published in *Advances in Electrical and Computer Engineering*, *Revue Roumaine des Sciences Techniques, Série Électrotechnique et Énergétique*, and special issues of *Sensors and Applied Sciences (MDPI)*. Special thanks are also due to our honorary chair, Prof. Constantinos Pattichis (University of Cyprus), and to all committee members and external reviewers for their expertise and support.

Also, thank you very much to the plenary speakers: Prof. Radu-Emil Precup (Politehnica University of Timișoara, Romania), Omneya Attallah (Arab Academy for Science, Technology, and Maritime Transport, Alexandria, Egypt), Martin Rožánek (Czech Technical University in Prague, Czech Republic), and Carlo Ricciardi (University of Naples Federico II, Italy) for sharing their knowledge, expertise and experience. We appreciate very much the implication of the young researchers as authors, and the partnership with IFMBE, Springer Nature, EasyChair, iThenticate plagiarism verification, and with our sponsor (Applied Sciences journal, MDPI) for their essential support during the preparation of EHB 2025 and this book.

BOOK OVERVIEW

The book **Advances in Digital Health and Medical Bioengineering II**, published by Springer Nature, is structured in three volumes that cover the major scientific disciplines in digital health and medical bioengineering.

- **Volume 1: Medical Devices, Measurements, and Artificial Intelligence Applications** presents state-of-the-art research on medical devices and measurement technologies, together with advanced artificial intelligence methods for healthcare research and practice.
- **Volume 2: Health Technology Assessment, Biomedical Signal Processing, Medicine and Informatics** brings together contributions focused on the evaluation and optimization of health technologies, advanced biomedical signal processing methods, and modern medical informatics solutions.
- **Volume 3: Telemedicine, Biomaterials, Environmental Protection, Medical Imaging, and Biomechanics** presents interdisciplinary research spanning remote and technology-assisted healthcare, biomaterials and biotechnologies for medical applications.

This volume, *Health Technology Assessment, Biomedical Signal Processing, Medicine and Informatics*, comprises **60 chapters, organized into seven thematic sections**. The first section focuses on *Technical and Economic Aspects of Healthcare* and includes 8 chapters, largely contributed by experienced Czech specialists. The chapters address both evaluation frameworks and applied health technologies, ranging from health technology assessment solutions such as indoor localization systems for asset management in medical facilities, to cost evaluation studies (for example, cost-of-illness analysis in diabetic retinopathy). The section is further enriched by applied biomedical and digital-health topics including estimating driver alcohol concentration from physiological data, 3D-printed patient-specific immobilization devices for radiotherapy, automated titration protocols delivered through a web application for chronic heart failure, clinical perspectives on vitamin D deficiency and relapse risk in multiple sclerosis, as well as practical monitoring solutions for ventilation parameters in premature newborns and heart rate variability measurement using modern ECG monitoring systems.

The second section gathers 18 chapters dedicated to *Biomedical Signal Processing*, highlighting advanced biosignal analysis for diagnosis and treatment. Several contributions address clinically relevant recognition and classification problems, including speech emotion recognition, ECG-based arrhythmia classification using machine learning, and diagnostic approaches using phonocardiogram analysis with neural networks, as well as studies investigating acoustic signatures of COVID-19 in speech, cough, and breathing. Other chapters introduce new analytical tools and methodologies, such as smart eyewear for enhanced head-ballistocardiogram detection, recurrence quantification analysis for Parkinson's disease, optimized single-lead ECG classification for wearable devices with reduced computational complexity, and EEG motor imagery approaches for brain-computer interfaces. The section also explores biomarkers and signal quality assessment, including early screening indicators for diabetic peripheral neuropathy and multiple approaches to photoplethysmography signal quality evaluation, alongside broader methodological advances such as cardiovascular indices estimation from combined ECG and ballistocardiogram, feature selection strategies

within Bayesian optimization, and multimodal models for pain level prediction from autonomic signals. The section is complemented by unconventional but insightful perspectives, including EEG hyperscanning during live dance performance and investigations into the physiological effects of Tibetan singing bowl vibrations on cardiac electro-mechanical function.

The third section, *Medicine and Informatics*, contains 10 chapters spanning a wide range of clinical and non-clinical disciplines. Several contributions focus on computational modeling and simulation of anatomical or physiological systems, including myocardial metabolism in health and heart failure, mandible morphometry, and a biomarker-oriented model exploring hydrogen sulfide in the microbiota–brain axis in Alzheimer’s disease. Alongside modeling, the section introduces diverse analytical methods and experimental approaches such as heart rate variability assessment as a potential marker for locomotor function in older adults, genomic analysis using entropy-based correlation measures, innovative microbial inactivation strategies using pulsed UVC-IR radiation, and quantitative pharmaceutical analysis through visible spectrophotometric methods. Additional chapters contribute mechanistic insights relevant to cytology and cancer cell lines, advances in nanotechnology such as engineered exosomes for early biomarker detection and therapy in Alzheimer’s disease, and structural investigations of DNA–protein complex flexibility associated with genetic variants relevant to type 2 diabetes.

The fourth section is dedicated to *3D Printing and Medical Engineering for Inclusion and Quality of Life* and comprises 7 chapters covering assistive technologies, rehabilitation, and equitable healthcare solutions. Applications include personalization of visual assistive devices for low vision using 3D printing, multiple perspectives on gait analysis and automated gait scoring using video-based methods, and integrated biomechanical and optical modeling of eye movements for personalized health applications. The section also includes a rehabilitation-focused contribution proposing a new design for an active elbow orthosis for children, as well as studies addressing additive manufacturing solutions suitable for critical medical environments and the development of assistive technologies such as spine orthoses.

The fifth section, *AI-Driven Smart Health Ecosystems for Ageing and Neurocognitive Care*, includes 8 chapters and showcases practical applications of AI in monitoring, care, and rehabilitation. The chapters explore approaches for tracking Parkinson’s disease progression using deep learning methods, analyzing speech-related markers in Parkinson’s disease, and applying machine learning to emotion recognition and neurocognitive care. Several contributions address Alzheimer’s disease detection using explainable machine learning, and propose applied solutions such as a portable, gamified platform for stroke rehabilitation. The section also includes algorithmic work relevant to prosthetic simulation, the use of virtual reality to support nursing education through visualization of pharmacological effects, and conversational systems such as a chatbot designed for pediatric cardiovascular disease management.

The sixth section gathers 8 chapters under *Biomedical Engineering in Aerospace and Defense Systems*, illustrating both aerospace navigation and defense-related human–system interaction. Aerospace-focused contributions include modeling and evaluation of human–system interaction and gyroscopic stability in navigation contexts. Defense-oriented studies examine the biomechanical and operational implications of small arms use, including analyses of body motion during handgun firing and broader interaction dynamics between

small arms and human operators. The section further extends into specialized biomedical monitoring topics, addressing electrodermal activity as a predictor of emergence time in general anesthesia, and EEG-based mapping of signal dynamics and emotional states aimed at developing emotion-aware biomedical systems.

The seventh section, *Marine Bioengineering and Ethics*, is represented by three chapters that connect engineering, well-being, and societal perspectives in maritime contexts. The contributions address a monitoring system for the mental well-being of seafarers, explore the concept of a human digital twin for seafarers through a business-model lens, and examine themes related to ethics and gendering in shipping, offering a concluding perspective that complements the volume's strong technological focus with essential human-centered considerations.

January 2026

**Hariton-Nicolae Costin
Ratko Magjarević
Gabriela- Gladiola Petroiu**

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