

Celebrating 60th Anniversary of TBME

THE IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING (TBME) is celebrating 60 years of publishing biomedical engineering advances. TBME was one of the first journals devoted to biomedical engineering. Thanks to IEEE, all of the TBME papers since January 1964 have been archived and are available to the public. In this special issue, celebrating TBME's 60th anniversary, we have invited 20 leading groups in biomedical engineering research to contribute review articles. Each article reviews state of the art and trends in an area of biomedical engineering research in which the authors have made important original contributions. Due to limited space, it is not our intention to cover all areas of biomedical engineering research in this special issue, but instead to provide coverage of major subfields within the discipline of biomedical engineering, including biomedical imaging, neuroengineering, cardiovascular engineering, cellular and tissue engineering, biomedical sensors and instrumentation, biomedical signal processing, medical robotics, bioinformatics, and computational biology. These review articles are witness to the development of the field of biomedical engineering, and also reflect the role that TBME has played in advancing the field of biomedical engineering over the past 60 years.

In the area of biomedical imaging and image analysis, Ugurbil reviews the development of ultra-high-field MRI with a focus on instrumentation and techniques, which has become a rapidly developing field in MRI research. Wang and colleagues review the emerging field of small-animal whole-body photoacoustic tomography and highlight studies conducted in the past decade. Woo and colleagues review the development of magnetic resonance electrical impedance tomography and discuss its features for imaging bioimpedance. In the area of image analysis, Viergever and colleagues present an overview of methods for the analysis of breast cancer histopathology images.

With respect to neuroengineering, Weiland and Humayun review the development of a retinal prosthesis and assert that significant vision restoration will require both better technology and an improved understanding of the interaction between electrical stimulation and the retina. Yuan and He review the current state and future prospects of sensorimotor rhythm-based brain-computer interfaces and their clinical applications. Gao and colleagues review the current state and future challenges of visual and auditory evoked potential based brain-computer interface systems. White and colleagues provide an overview of neurophysiology measurement techniques—specifically voltage-clamp methods and dynamic-clamp methods.

In the area of cardiovascular engineering, Henriquez reviews the development of cardiac electrophysiological modeling and the challenges facing the field as models move toward the clinic. Efimov and colleagues provide a historic overview of the development of cardiac defibrillators, which have been one of the most successful medical devices in biomedical engineering.

Concerning cellular and tissue engineering, Bellamkonda and colleagues explore the utility of hydrogels as carriers for stem cell delivery and their potential to overcome some of the current limitations in stem cell therapy. Niklason and colleagues review challenges and strategies to regenerate functional lung tissue for whole lung tissue engineering. Xu and colleagues review recent advances in thermal ablation techniques and the role of thermally induced immune responses.

On the topic of biomedical sensors and instrumentation, Lee and colleagues review integrated molecular diagnostic systems, which hold the potential to overcome a number of problems in the field of medical diagnostics today. Cauwenberghs and colleagues present an overview of the fundamentals and state of the art in noninvasive physiological monitoring instrumentation with a focus on electrode and optrode interfaces to the body, and micropower integrated circuit design for unobtrusive wearable applications. Zhang, Yang, and their colleagues review wearable technologies, which are essential to the realization of pervasive health information acquisition.

With respect to biomedical signal processing, Babadi and Brown provide an overview of the nonparametric spectral estimation theory and the multitaper spectral estimation techniques, with applications for EEG analyses of anesthesia and sleep.

Concerning surgical robotics, Yang and colleagues review significant achievements in the field and identify the current trends and future research directions of the field in order to make surgical robots safer, smaller, and smarter.

In the area of computational biology and bioinformatics, Cobelli and colleagues provide a historical overview of the development of multiscale models, models to measure, models to simulate, and models to control the glucose system, with an eye to the future. Cerutti and colleagues discuss how a functional genomics and systems biology perspective, fostered by the combination of biotechnologies and bioinformatics, may transform the concepts of diagnosis and, consequently, of treatment, toward the fulfillment of patient-specific medicine.

These comprehensive and timely reviews reflect the breadth and depth of biomedical engineering and its impact to engineering, biology, medicine, and the larger society. These reviews aim to serve the readers in gaining insights and an understanding of particular areas in biomedical engineering. Many articles also share perspectives from the authors on future trends in the field. While the intention of this special issue was not to cover all research programs in biomedical engineering, these 20 articles represent a collection of state-of-the-art reviews that highlight exciting and significant research in the field of biomedical engineering and will serve TBME readers and the biomedical engineering community in years to come.

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