

# Special Issue on Real-Time Diagnosis Algorithms in Biomedical Applications and Decision Support Tools

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## 1. Introduction

The use of automatic support tools in daily clinical practice is increasing continuously. From family doctors to surgeons, specialists are using a wide range of devices and software, increasing the level of accuracy in their diagnoses. Deep learning algorithms and data analysis in general are providing new possibilities for doctors. Many doctors now use user-friendly tools and devices in their daily practice which contain an impressive level of research underneath. The algorithms and data processing required are hidden to doctors in order to allow them to concentrate on their main task: taking care of patients. Still, continuous research must be conducted in order to improve these algorithms.

Each of the ten papers published in this Special Issue is proof of such advances and continuously evolving developments. Different proposals from various fields show how new data analysis techniques can improve the daily tasks of doctors. This is especially important when those algorithms are included as part of the devices that doctors use, making it possible to provide doctors with important information to validate their diagnostics. In this sense, these algorithms must be not only be accurate, but they must also be able to be executed in real-time. That was one of the main goals of this special issue.

As a second main goal, decision support tools are an issue when dealing with the analysis of massive amounts of data from patients. These tools will help to provide relevant information to doctors, showing trends and variations in the information.

In both cases, research in this area is essential in order to provide the best care to patients.

## 2. Real-Time Diagnosis Algorithms in Biomedical Applications

Five papers in this Special Issue mainly dealt with real-time issues:

- “Ventricular Fibrillation and Tachycardia Detection Using Features Derived from Topological Data Analysis [1]” by Azeddine Mjahad, Jose V. Frances-Villora, Manuel Bataller-Mompean, and Alfredo Rosado-Muñoz was published in July 2022 and dealt with the detection of an important cardiac pathology which can cause death if not adequately reverted in time.
- “Low-Cost, Compact, and Rapid Bio-Impedance Spectrometer with Real-Time Bode and Nyquist Plots” [2] by Didik R. Santoso, Bella Pitaloka, Chomsin S. Widodo, and Unggul P. Juswono, published in January 2020, presented a bio-impedance spectrometer with many possibilities for daily use by specialists, in addition to being accurate and compact.
- “Real-Time Localization of Epileptogenic Foci EEG Signals: An FPGA-Based Implementation” [3] by Jose V. Frances-Villora, Manuel Bataller-Mompean, Azeddine Mjahad, Alfredo Rosado-Muñoz, Antonio Gutierrez Martin, Vicent Teruel-Marti, Vicente Villanueva, Kevin G. Hampel, and Juan F. Guerrero-Martinez was published in 2020 and covered interesting research on epilepsy and proposed a method able to detect epileptic episodes in a short time, allowing the reversion of episodes as soon as possible.



**Citation:** Rosado-Muñoz, A.

Special Issue on Real-Time Diagnosis Algorithms in Biomedical Applications and Decision Support Tools. *Appl. Sci.* **2023**, *13*, 13308. <https://doi.org/10.3390/app132413308>

Received: 21 November 2023

Revised: 11 December 2023

Accepted: 14 December 2023

Published: 16 December 2023



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- “Optimization of Physical Activity Recognition for Real-Time Wearable Systems: Effect of Window Length, Sampling Frequency and Number of Features” [4] by Ardo Allik, Kristjan Pilt, Deniss Karai, Ivo Fridolin, Mairo Leier and Gert Jervan, published in November 2019, provided important insight into wearable devices, commonly used nowadays.
- “A Prototype of a Portable Gas Analyzer for Exhaled Acetone Detection” [5] by Jakub Sorocki and Artur Rydosz in June 2019 described the use of a gas analyzer to detect exhaled acetone. Acetone is an important compound related to some diseases. This proposal showed an interesting approach to using the device and measurement method.

### 3. Decision Support Tools in Biomedical Applications

The other five papers were more related to decision support tools:

- “A Machine-Learning Model Based on Morphogeometric Parameters for RETICS Disease Classification and GUI Development” [6] by José M. Bolarín, F. Cavas, J.S. Velázquez, and J.L. Alió, published in March 2020, described a graphical user interface helping specialists to detect RETICS disease, assisted by artificial intelligence.
- “Wavelia Breast Imaging: The Optical Breast Contour Detection Subsystem” [7] by Julio Daniel Gil Cano, Angie Fasoula, Luc Duchesne, and Jean-Gael Bernard was published in February 2020 and described a tool to help specialists in analyzing breast images to detect anomalies and better establish a relationship between disease and deformities.
- “Analogy Study of Center-Of-Pressure and Acceleration Measurement for Evaluating Human Body Balance via Segmentalized Principal Component Analysis” [8] by Tian-Yau Wu and Ching-Ting Liou, published in November 2019, conducted an interesting analysis of human body balance by means of several data analysis tools, showing the results as an important parameter to evaluate certain human movement parameters in patients.
- “Dynamic Handwriting Analysis for Neurodegenerative Disease Assessment: A Literary Review” [9] by Gennaro Vessio, published in November 2019, proposed an approach on detecting neurodegenerative processes by means of the analysis of handwriting. These tests are very important to the specialist in order to achieve early detection.
- “Automatic Detection of a Standard Line for Brain Magnetic Resonance Imaging Using Deep Learning” [10] by Hiroyuki Sugimori and Masashi Kawakami appeared in September 2019 and showed how to develop and estimate accurate parameters from brain magnetic resonance as important markers for the specialist.

### 4. Conclusions

The goals of the Special Issue were fulfilled by the inclusion of research works related to relevant research topics in biomedical engineering, such as improvement in health care, therapy, and diagnosis. All of the contributions to this issue have a high social impact which, in turn, is what science and research is made for: improving human lives.

**Acknowledgments:** I want to express my gratitude to the authors for their careful research work and openness to suggestions, the reviewers for the detailed comments and constructive suggestions, the editors and proofreading team for the careful design and high quality of the published papers, both in the content of the research and the print quality.

**Conflicts of Interest:** The author declares no conflict of interest.

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