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From the Guest Editors

Biomedical Signals Databases

Biological systems are the most sophisticated and complex systems we deal with. Analyzing these systems is usually a difficult task, not only due to the complexity, but also due to severe constraints imposed on the analysis. Most often the analysis is performed *in vivo*, which means that the specific system under test cannot be isolated from other interfering systems. Very often the inputs and/or outputs of the system are inaccessible, and invasive measurements are undesirable.

The main tool used for the analysis of these systems is *biomedical signal processing*. Sophisticated signal processing algorithms are required in order to directly and indirectly study the performance of the biological (physiological) system under the severe measurement constraints. We need such algorithms to be incorporated, for example, in monitoring, screening, and diagnostic equipment.

The database is a basic and required infrastructure for signal processing algorithm development. Databases are required for the design, evaluation, and objective comparison of algorithms. A good database must be rich enough to provide sufficient samples of the variety of types of signals (for example, pathologies) and population it represents. The acquisition conditions (sampling rate, signal to noise, etc.) must be carefully specified. The database, at least in part, must be annotated, so that the user will have a “Gold Standard” when testing his algorithm. The specification, acquisition, processing, documentation, maintenance, and assimilation of databases is an important task that requires a lot of knowledge, effort, and cooperation.

A very important issue is that of standardization. Industry as well as the medical and research communities very often need to objectively evaluate and compare algorithms and diagnostic and monitoring instruments. The availability of standard database will allow the objective evaluation and comparison of performance. Unfortunately, we do not yet have such

standards. Closest to the ranking as a standard databases are those in the field of cardiology: the MIT-BIH arrhythmia database (<http://ecg.mit.edu/>), which has been available since 1980 and has been used in more than 500 sites around the world for purposes varying from basic research on cardiac dynamics to the evaluation of arrhythmia detectors; the AHA (American Heart Association) Database for Evaluation of Ventricular Arrhythmia Detectors completed in 1985; and European ST-T database providing a collection of ECG recordings that exhibit annotated transient ST and T-wave changes. In other areas there are several databases and in some there are no available databases at all; however, these have not reached a standard position as yet.

A similar, but much more advanced, situation exists in speech research. There are some national (LDC) and international (ELRA) organizations that have taken upon themselves the task of specifying, maintaining, and assimilating speech databases. Recent efforts funded mainly by the European Community are geared toward the establishment of well-specified biomedical signal databases. The results of some of these efforts are discussed in this special issue.

The articles in this special issue on biomedical signal databases were selected to familiarize the reader with the main general problems of databases: specifications, acquisition, annotation, standardization, maintenance, and assimilation. The special issue also deals with the description of the most important specific physiological and biological databases.

The articles are organized in three topics:

- *Acquisition, processing and maintenance of databases:* The general problems of acquisition, annotation, and standardization of databases are discussed. The authors are experts drawing from the experience of the SIESTA, IMPROVE, and IBIS databases.

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- *Clinical and physiological databases:* Clinical and physiological biomedical signal databases are of extreme importance in healthcare delivery systems. Several specific databases are described.
- *Biological signals databases:* Biological signals databases are much less known than their clinical and physiological counterparts. Biological signals databases are, however, important for biological, conservational and environmental research. Two types of databases were chosen as example of the specific problems encounter in biological signals databases.

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magazine, who has made this special issue possible.

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