Editorial

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Biographical notes: Azzam F.G. Taktak is a Consultant Clinical Scientist at the Royal Liverpool University Hospital and an Honorary Professor at the University of Liverpool. He is a Chartered Engineer, Chartered Scientist, Vice President of Engineering at the Institute of Physics and Engineering in Medicine (IPEM) and a Fellow of the Institute. His main research interests are mathematical and statistical modelling and the use of artificial intelligence and machine learning in medicine. To date, he has published more than 75 peer-reviewed articles and edited two books; one on outcome prediction in cancer and the other on clinical engineering in healthcare.

The human body is a very complex system which generates a huge amount of data. Informed clinical decisions require extracting and amalgamating information from a variety of sources including patient demographics, clinical examination data, imaging data, laboratory results, etc. Analysing vast quantities of data allows us to understand how the human body functions and responds to external events. The field of signal processing plays an important role in the extraction of relevant information and separating real data from noise. At a later stage, signal and information processing techniques are also applied in the interpretation of the results to aid clinical decision making.

In biomedical engineering, some applications rely very heavily on signal processing techniques to achieve reliable results. Such techniques form a major part of the system design and much effort is spent to ensure outputs meet the specifications. Krusienski et al. (2011) reviewed key questions that researchers try to address in the information-rich area of brain-computer interface (BCI) using signal processing techniques. Sparacino et al. (2010) highlighted a number of signal and information processing issues in the development of smart glucose monitors. These issues span a number of stages from extracting relevant information, reducing noise, interpretation of the results and finally providing early warning system alerts.

In this special issue, a number of real-life applications are presented where signal and information processing are applied in medicine. Lai and Garibaldi present clustering analysis using semi-supervised techniques to classify breast cancer data. With such techniques, choosing an appropriate number of clusters is often subjective and requires prior knowledge by the user. Chambers et al. describe a framework to achieve stability in the identification of the correct number of clusters. Matam et al. describe processing of time series signals to try and forecast potential life threatening events in paediatric intensive care monitoring.

In more recent years, signal processing techniques have found a niche in analysing data at the cellular and molecular level. Data from such paradigms are often sparse and have high dimensionality. Romano et al. describe the application of a normalisation technique and principal component analysis in the response of cell metabolism and/or structure to outside agents in one study, and to understand the process of cell toxicity due to amyloid fibrils in another. Kalantzaki et al. generate biological networks from sparse temporal data to capture genetic interactions using kernel density estimation non-parametric methods.

References

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