Research on algorithms and models for pHealth applications: opportunities and challenges

J. Henriques[1], P. Carvalho[1], R. Paiva[1], C. Teixeira[1], M. G. Ruano[1], T. Rocha[1], S. Paredes[1], A. Bianchi[2], R. Barbieri[2], V. Salcedo[3], A. Romero[3]

[1]Centro de Informática e Sistemas da Universidade de Coimbra, Portugal
[2]Dep. of Electronics, Information and Bioengineering, Politecnico di Milano, Italy
[3]UPV-SABIEN Universitat Politècnica de València, Spain

The employment of information and communication technologies together with personal health solutions (pHealth) are a valuable concept, enabling the management of the disease by the patient himself, contributing towards the reduction of healthcare costs while improving the health quality. Among others, these solutions make possible the remote monitoring using non-intrusive sensors, to seamless access multiple sources of data, including physiological signals, providing professionals with a global and reliable view of the patient's status. While these new advances have created new opportunities, at the same time new challenges have been introduced. Of particular importance are appropriate data analysis algorithms and tools, which are decisive to complement telemonitoring technologies. In effect, these are fundamental in order to fully accomplish the real potential of the collected data and, therefore, to generate meaningful information from it. Data analysis methods, including machine learning and data mining techniques, as well as algorithms and models for physiological signal modelling and processing, are examples of such useful tools.

One of the main objectives of Project LINK, an EU-H2020 funded project, is to deepen the cooperation between three institutions in the area of intelligent processing applied to the management of cardiovascular diseases in pHealth context. One of the main activities is to identify new research opportunities, by promoting the integration and exploiting synergies among the different research groups of the consortium, supporting the research activities to be pursued along the duration of the project as well as working towards sustainability beyond LINK. These research questions will result from the intersection of the inputs provided by Innovation and research forum and clinical partners, key competences inside the consortium and shared research interests. An initial analysis, conducted inside the consortium, enabled to identify some of these challenges and opportunities, namely:

Robust measurements: A possible direction is to exploit the multiple sensors currently employed, possibly redundant. In particular sensor fusion techniques considering the dependences and correlations between the biosignals, to derive more robust measurements can be explored. This is particularly important in home-monitoring environments, where data mining techniques could certainly increase the reliability of the wearable acquisitions.

Fusion of information: Another promising direction of research is the development of data mining fusion strategies, able to combine heterogeneous sources of information, namely in the assessment of patient's clinical condition. Of particular importance are multi-parametric and multi-scale methodologies capable of combining historic data, such as demographics, biomarkers and clinical exams with the dynamic data collected during long periods of telemonitoring. This will markedly contribute to stratification and personalization aspects.

Knowledge discovery: An additional major challenge is the development of techniques able to analyse the data produced by such systems, and to provide clear and useful information for patients and professionals. The generation of knowledge from data will provide more confidence and control in managing their problems. The research on integrative approaches, capable of in incorporating evidence based knowledge (understandable by medical experts) into the data mining process can positively contribute to this aim.