Ecole Doctorale STIC

Sciences & Technologies de l'Information et de la Communication

ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2017

Axe Sophi@Stic :	BioSanté|
Titre du sujet :	Tensor representation of cardiac signals for atrial fibrillation analysis
Mention de thèse :	ATSI
HDR Directeur de thèse inscrit à l'ED STIC :	Vicente Zarzoso

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Description du sujet :

BACKGROUND:
Atrial fibrillation (AF) is the most common sustained arrhythmia encountered in clinical practice, especially affecting the elderly and held responsible of up to 25% of strokes. With the ageing of the Western population, this arrhythmia is becoming a major public health concern, representing one third of hospitalizations due to cardiac related disturbances. AF is indeed "the last great frontier of cardiac electrophysiology" as it continues to puzzle cardiologists. Physiological signal and data processing arises as a key tool to improve the understanding and management of this challenging cardiac condition.

The noninvasive analysis of AF can be carried out by processing cardiac signals recorded by electrodes located on the patient's skin, giving rise to the surface electrocardiogram (ECG), a

well-known clinical tool in cardiology. The ECG data can be arranged in the form of two-dimensional matrix structures, with rows and columns typically representing the spatial and temporal dimensions. Such matrices are then factorized into underlying source signal contributions using suitable matrix decomposition techniques such as principal component analysis, independent component analysis and their variants. This matrix decomposition approach has proven useful for a variety of purposes including artifact cancellation, AF complexity assessment and therapy outcome prediction. However, the number of signal components that can be estimated and analyzed in this way is limited by the matrix rank, which can never exceed the matrix lowest dimension. In addition, the constraints implicitly imposed to ensure unique matrix decompositions may lack physiological grounds, thus hampering result interpretation.

GOALS:
The present project aims to take a step forward in this multidimensional approach to cardiac signal analysis by considering data structures with more than two dimensions, known as multi-way arrays or tensors. As compared to matrix techniques, tensor decompositions present some remarkable features such as essential uniqueness with minimal or no constraints, and rank possibly exceeding the tensor dimensions. This thesis will explore the application of tensor techniques to cardiac signal processing by looking in particular for the optimal arrangement of ECG data in tensor form, according to appropriate models to be determined, in order to yield significant physiological and clinical information for AF analysis. The interesting properties of tensor decompositions and their success in other biomedical applications envisage promising prospects for this investigation, whose successful completion could represent a significant advance in the noninvasive characterization and patient-tailored management of this challenging cardiac condition.

URL : http://www.i3s.unice.fr/~zarzoso/2017_phdthesis_proposal.html

English version:

Please see “Description du sujet” above.

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