24 OCT

16h30 à 19h30
Campus Saint-Germain-des-Prés, U. Paris Cité

THÈSES ET HDR

Antoine MAZARGUIL : soutenance de thèse

Direction : Nicolas Vayatis, Pierre-Paul Vidal
Soutenance : le 24/10/2022 en Salle des thèses
Titre : Graph signal processing : locality, uncertainty principles and applications to neurophysiological movement data

AJOUTER AU CALENDRIER

Titre

Graph signal processing : locality, uncertainty principles and applications to neurophysiological movement data

Résumé

Graph Signal Processing (GSP) is a mathematical approach that allows the analysis and manipulation of multivariate signals with coherence, when information about the underlying structure is available. This notion of structure is carried by a mathematical object called a graph, and aims at representing as well as possible the object on which these signals evolve, thus allowing not to treat the signal dimensions independently. This field of research allows, among other things, to generalize the notion of frequency used in the temporal framework to more complex spaces such as a network of sensors. This thesis studies the applicability of GSP to physiological signals from upper limb movement. Several tasks are addressed in the manuscript.

In the first part, the problem of partially missing and noisy signals is introduced. A new interpolation and denoising algorithm is proposed, based on a notion of locality in the organization of the sensors. The model used is based on the hypothesis that two nodes of the network are close within the graph if they have relevant information about each other. The quality of the approach is illustrated on a large panel of applications and compared to other interpolation methods. Theoretical results are also presented.

In a second step, a new principle of uncertainty on graphs is presented as well as its implications in the fields of anomaly detection and signal interpolation. A review of the literature on graph uncertainty principles is performed, allowing us to identify the contributions of the new theorem. This principle is applied to motion data in order to detect registration anomalies. Under certain assumptions about the studied signals, the proof of the exact identification of the faulty sensors is brought.

In a third step, the work focuses on the learning of graph dictionaries that best model the motion data. A new type of atom is proposed based on the notion of locality on a graph, and an algorithm to search for a decomposition of a signal into local and low frequency components is presented. Theoretical results are established, and the algorithms are illustrated on real data."

Direction

Nicolas Vayatis, Pierre-Paul Vidal

Co-encadrement : Laurent Oudre