Max Langer (TIMC, Grenoble University)
Title : Phase retrieval in X-ray phase contrast imaging using deep learning
Abstract : X-ray in-line phase contrast imaging is a highly sensitive imaging technique relying on the coherence of the beam to achieve contrast through interference. The development of high-flux X-ray sources has considerably advanced phase contrast imaging, pushing the attainable resolution below 40 nm in 3D and finding applications in a variety of fields. While phase-contrast imaging relies on the phase shift of the beam induced by the sample, only the intensity of the beam can be measured. Thus, the phase information is lost and must be estimated from one or several intensity images through a process called phase retrieval. Here, we consider relatively short propagation distances. Phase retrieval in this context is a nonlinear ill-posed inverse problem. Various methods have been proposed to retrieve the phase, either by linearizing the problem to obtain an analytical solution or by iterative algorithms. Recently, deep-learning techniques have yielded advances in several image processing task, specifically in inverse problems and image reconstruction. In this talk, I present our developments of deep learning-based approaches for the phase retrieval problem in in-line phase contrast, where we aim to overcome the limitations of classical approaches, such as restrictive assumptions on the forward model, the choice regularization and a priori knowledge, and the computation time.

Thomas Oberlin (ISAE-SUPAERO, Toulouse)
Title : Learning divergences with unfolding: the case of phase retrieval in audio
Abstract : Many optimization problems in signal or image processing require the choice of a or divergence which can have a significant impact on the performances. In this talk, I will show how we can learn such a divergence in a supervised setting by means of unfolded neural networks and specific activation functions called adaptive piecewise linear units (APC). I will take the example of phase retrieval from the spectrogram when solved with the ADMM splitting algorithm.

Juan Miramont (CRIStAL, Centrale-Lille)
Title : Improving methods based on spectrogram zeros using unsupervised classification
Abstract : Recently, the spectrogram zeros have drawn attention from the time-frequency (TF) analysis community. Since they are intimately related to the energy distribution given by the spectrogram of a signal, some recently proposed approaches use the location of these points to obtain an estimation of the signal support in the TF plane. Moreover, exciting connections with other areas of research, like the study of determinantal point-processes or stochastic geometry, laid the mathematical groundwork of this different paradigm. From a more practical perspective, however, the approaches based on spectrogram zeros might face some limitations. For instance, the presence of strong interference between signal components can reduce their effectiveness. We will discuss how classifying the spectrogram zeros using an unsupervised approach can help to circumvent this difficulty. We will then explore what lessons we can learn from this problem in order to further develop these methods in the future.

Sylvain Meignen (LJK, Grenoble)
Title : Detecting and Localizing Interference in the TF plane
Abstract : In this presentation, we will define a new ridge detector that enables to localize strong interference in multicomponent signals in the time-frequency (TF) plane. Each mode of a multicomponent signal can usually be associated with a ridge in the TF plane, but this is no longer the case when strong interferences occur in the signal. The new ridge detector we propose is thus designed to determine when such situations happen in the TF plane. We show that this knowledge helps to determine an appropriate window length in the definition of the spectrogram, as well as the nature of the strong interference detected. An application of the proposed approach to voice signals will also be given.