INVERSE PROBLEMS IN SIGNAL PROCESSING. NEW RESULTS FROM THE NUMERICAL ANALYSIS

A. Cicone
DISIM, Università degli Studi dell'Aquila
via Vetoio n.1, 67100 L'Aquila, Italy
antonio.cicone@univaq.it

In many applied fields of research, like Geophysics, Medicine, Engineering, and Finance, to name a few, a classical problem is the identification of hidden quasi-periodicities and frequency patterns, and their extraction from a given signal, like, for instance, chirps.

Standard methods based on Fourier and Wavelet Transform, historically used in Signal Processing, proved to be limited when nonlinear and non-stationary phenomena are present. For this reason in the last two decades, several new nonlinear methods have been developed by many research groups around the world, and they have been used extensively in many applications.

In this talk, we will briefly review the Hilbert-Huang Transform (a.k.a. Empirical Mode Decomposition method) and discuss its known limitations. Then, we will introduce the Fast Iterative Filtering technique [2] and its generalizations to handle multidimensional, multivariate, or highly non-stationary signals, as well as the newly developed time-frequency representation called IMFogram [1]. We will discuss the theoretical and numerical properties of these methods and show their applications to real-life data. We will conclude the talk by reviewing the main open problems in this research field.

References

[1] P. Barbe, A. Cicone, W. S. Li, H. Zhou. Time-frequency representation of nonstationary signals: the IMFogram. Pure and Applied Functional Analysis, Volume 7, Number 1, 27-39, 2022.

[2] A. Cicone, H. Zhou. Numerical Analysis for Iterative Filtering with New Efficient Implementations Based on FFT. Numerische Mathematik, 147 (1), pages 1-28, 2021