

Signal processing of spherical data. How manifold topology interacts with data analysis techniques

Monday, 26 January 2026 15:00 (30 minutes)

In signal processing, the time-frequency analysis of nonlinear and non-stationary processes, as well as the determination of the unknown number of active sub-signals in a blind-source composite signal, are generally challenging inverse problem tasks. If we consider data sampled on a sphere, things get even more complicated. This is the reason why just a few techniques have been developed so far to study this kind of data. However, many real-life data are of this nature, like in Geophysics and Physics.

The idea is to extend the Iterative Filtering (IF) algorithm to work on the sphere. IF is a non-stationary signal decomposition method proposed a decade ago [Lin et al. 2009] to address the problem of extracting time-varying oscillatory components from a non-stationary multicomponent signal. This method proved to be really valuable in many applications, see [Barbarino&Cicone 2022] and references therein, and it was accelerated in what is known as Fast Iterative Filtering (FIF) [Cicone&Zhou 2021] by leveraging the Toeplitz matrix theory. In this talk, we introduce the generalization of IF to handle spherical data and show how we can address the question about its convergence [Barbarino et al 2024]. We conclude with some examples of application to geophysical data.

L. Lin, Y. Wang, and H. Zhou. Iterative filtering as an alternative algorithm for empirical mode decomposition. *Adv. in Adap. Data An.*, 2009, 1.04, 543-560.

G. Barbarino, A. Cicone. Conjectures on spectral properties of ALIF algorithm. *Linear Algebra and its Applications*, Volume 647, Pages 127-152, 2022.

A. Cicone, H. Zhou. Numerical Analysis for Iterative Filtering with New Efficient Implementations Based on FFT. *Num. Math.*, 2021, 147 (1), 1–28.

G. Barbarino, R. Cavassi, A. Cicone. Extension and convergence analysis of Iterative Filtering to spherical data. *Linear Algebra and its Applications*, 2024.

Primary author: CAVASSI, Roberto (University of L'Aquila)

Co-authors: TIMKO, Edward J.; BARBARINO, Giovanni; ZHOU, Haomin; LI, Wing S.

Presenter: CAVASSI, Roberto (University of L'Aquila)

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