Compressed Sensing and the new radio observatories (LOFAR/NenuFAR/SKA) as new tools to discover and study transients in radio

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Abstract

The next generation of giant and sensitive radio telescopes such as LOFAR and SKA, give access to a high-time resolution and high sensitivity window over a wide frequency spectrum. It can be exploited to study " slow " (> 1s) and " fast " (< 1s) transients from 10 MHz up to _˜10 GHz. In the case of XRB, it enables the close and distant mapping of the compact jet (at high frequencies) and relativistic ejections during the intermediary states (at low frequencies). However, such instruments impose tremendous data rate and instrumental effects to account for before studying the transient unambiguously.
We developed at AIM/CEA a new method based on sparse representations in the "compressed sensing" framework, to reconstruct image cubes with temporal dependence from interferometric data. Where classical methods assumes constant sources during an observation, we provide a robust spatial deconvolution and temporal reconstruction of the transient time profile with better detection level than frame-to-frame detection. This new method could enable, in the scope of LOFAR and SKA, the potential detection of transients in real-time as well as in archive data. In a second part, we will present the NenuFAR instrument which is the deployed extension of the french LOFAR station. This instrument was designed (among its various scientific projects) as a transient observatory (" pulsar detection machine ") and might enable the observation of FRBs and Rotating Radio Transients (RRAT) at low frequencies (< 100 MHz), complementary to other high frequency radio observatories.

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