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WAVELETS TAILORED TO FUNCTIONAL IMAGING : APPLICATIONS TO FMRI AND DYNAMIC PET

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Traditional wavelets have a number of vanishing moments that corresponds to their equivalent order of the derivation. They offer good energy compaction for piecewise smooth signals, but are less appropriate for more complex signals such as those originating in functional imaging ; e.g., the hemodynamic response after brain activation in functional magnetic resonance imaging (fMRI) and time activity curves (TACs) in positron emission tomography (PET). The framework of exponential-spline wavelets [1] allows us to design new wavelet bases that act like a given differential operator ; i.e., they can be tuned to the characteristics of a system and yield a sparse representation of some corresponding class of signals.
We show two examples. For fMRI, the wavelets are tuned according to the hemodynamic response of the system. The combination with a ℓ_1-regularization constraint reveals brain activation patterns without the knowledge of a stimulation paradigm [2]. For dynamic PET, the wavelets are tailored to the compartmental description of the dynamics of the tracer distribution. The ℓ_1-regularization constraint can then be incorporated in the tomographic reconstruction process [3].

References

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