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Sparse Multiresolution Analysis of Potential Field Data

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We propose a novel algorithm for the approximation and inversion of gravitational data. The method is based on an orthogonal matching pursuit such that it iteratively chooses trial functions out of a large redundant set of functions to best match the signal. Therefore, as an advantage to former methods, the method is able to combine arbitrary spherical basis functions. In particular, we use spherical harmonics to represent global trends as well as several localized trial functions, such as the Abel-Poisson scaling function and wavelets with different scales, to reconstruct more detailed structures of the signal. Within the process, the solution is stabilized with a particularly chosen penalty term. The outcome is a sparse approximation of the unknown field which is locally adapted to the detail structure of the signal as well as to the data density. Moreover, we obtain a multiresolution analysis of the signal such that we are able to look at the solution at different scales. Numerical experiments are presented.