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Sparse Approximation for Gravitational Field Modelling and Inversion

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We present a novel algorithm which is able to interpolate/approximate as well as invert large and/or heterogeneous data sets of the gravitational potential. This is achieved by combining global trial functions (such as spherical harmonics) with different kinds of localized trial functions (such as splines or wavelets) into a toolbox. The novel method, which is called the Regularized Functional Matching Pursuit (RFMP), iteratively chooses those trial functions from the toolbox which yield the best possible reduction of the data misfit. The obtained solution turns out to be locally adapted to the detail structure of the solution. For example, in case of South America, the algorithm first primarily covers the global trend with harmonics and then adds hat-like spline basis functions to locally correct remaining approximation errors, where the latter is primarily done near the Andes, where the signal has the most complicated structure. To achieve this, the algorithm does not need any a-priori information about the solution. Due to this locally varying accumulation of hat functions the solution is sparse in comparison to other approaches which require a uniform grid of hats. Moreover, a recent enhancement of the RFMP further reduces the number of iteration steps essentially.
Numerical examples for gravitational field approximations and inversions are demonstrated.