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Automatic Construction of a Sparse Best Basis for Potential Approximation and Inversion

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Numerous basis systems are nowadays available to represent geophysically relevant functions such as potential fields or results of data inversions. Each of the systems has its intrinsic advantages and disadvantages. Whereas classical methods such as expansions in spherical harmonics have their justifications, novel techniques such as wavelets, splines, Slepian functions, and mascons yield additional features which are tailored to improve the solution of particular problems. In practice, the choice of one of these tools is often not straightforward. For this reason, a novel algorithm called the Regularized Functional Matching Pursuit allows the use of a redundant system of trial functions where several basis systems can be combined into a so-called dictionary. The algorithm iteratively chooses a basis system out of the dictionary to build an approximation of the investigated function. Numerical experiments with EGM2008 and GRACE data show that a combination of global basis functions and different kinds of localized basis functions is selected by the algorithm. As a result, large amounts of data can be processed, where a relatively low number of trial functions suffices to achieve a low approximation error.