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Iterative Sparse Approximation of the Gravitational Potential

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In recent applications in the approximation of gravitational potential fields, several new challenges arise. We are concerned with a huge quantity of data (e.g. in case of the Earth) or strongly irregularly distributed data points (e.g. in case of the Juno mission to Jupiter), where both of these problems bring the established approximation methods to their limits.
Our novel method, which is a matching pursuit, however, iteratively chooses a best basis out of a large redundant family of trial functions to reconstruct the signal. It is independent of the data points which makes it possible to take into account a much higher amount of data and, furthermore, handle irregularly distributed data, since the algorithm is able to combine arbitrary spherical basis functions, i.e. global as well as local trial functions. This additionaly results in a solution, which is sparse in the sense that it features more basis functions where the signal has a higher local detail density. Summarizing, we get a method which reconstructs large quantities of data with a preferably low number of basis functions, combining global as well as several localizing functions to a sparse basis and a solution which is locally adapted to the data density and also to the detail density of the signal.