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Efficient computation of linear equation systems to analyse irregular gravity observations

Ch. Gruber
Astronomical Institute, Ondrejov (gruber@asu.cas.cz)

The parameter estimation of global gravity field models by the inversion of linear equation systems is beside the required memory allocation a highly demanding computational task. The most time consuming operation is the integration of the required base functions. As an example, roughly 1/2 L**4 dot products over the data length (e.g. millions of observations) are required to integrate a certain observation type, where L is the maximum model resolution, e.g. L=250. The workload has therefore been split in a first step to the sole integration of the spectral basis of the model functions and in a second step their expansion into contributions of a specific observation type to the linear model. If different gravity observations are then acquired at the same measurement locations, e.g. tensor components of the gravity gradients, no additional computational effort concerning their integration is needed. Moreover, since the product-sums of trigonometric functions are surjective a strong reduction in overall computations can be achieved. In this paper the conceptual approach is discussed and a rigorous numerical evaluation for the GOCE gravity gradient experiment has been computed.