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Covariance modeling in geodetic applications of collocation

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Collocation method is widely applied in geodesy for estimating/interpolating gravity related functionals. The crucial problem of this approach is the correct modeling of the empirical covariance functions of the observations. Different methods for getting reliable covariance models have been proposed in the past by many authors. However, there are still problems in fitting the empirical values, particularly when different functionals of T are used and combined. Through suitable linear combinations of positive degree variances a model function that properly fits the empirical values can be obtained. This kind of condition is commonly handled by solver algorithms in linear programming problems. In this work the problem of modeling covariance functions has been dealt with an innovative method based on the simplex algorithm. This requires the definition of an objective function to be minimized (or maximized) where the unknown variables or their linear combinations are subject to some constraints. The non-standard use of the simplex method consists in defining constraints on model covariance function in order to obtain the best fit on the corresponding empirical values. Further constraints are applied so to have coherence with model degree variances to prevent possible solutions with no physical meaning. The fitting procedure is iterative and, in each iteration, constraints are strengthened until the best possible fit between model and empirical functions is reached. The results obtained during the test phase of this new methodology show remarkable improvements with respect to the software packages available until now. Numerical tests are also presented to check for the impact that improved covariance modeling has on the collocation estimate.