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Gravity Field Parameter Estimation Using QR Factorization

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This study compares the accuracy of the estimated geopotential coefficients when QR factorization is used instead of the classical method applied at our institute, namely the generation of normal equations that are solved by means of Cholesky decomposition. The objective is to evaluate the gain in numerical precision, which is obtained at considerable extra cost in terms of computer resources. Therefore, a significant increase in precision must be realized in order to justify the additional cost.

Numerical simulations were done in order to examine the performance of both solution methods. Reference gravity gradients were simulated, using the EIGEN-GL04C gravity field model to degree and order 300, every 3 seconds along a near-circular, polar orbit at 250 km altitude. The simulation spanned a total of 20 days. A polar orbit was selected in this simulation in order to avoid the 'polar gap' problem, which causes inaccurate estimation of the low-order spherical harmonic coefficients. We have also applied the QR decomposition to simulated mission data, provided by ESA, the so-called Acceptance Review 3 data set. In this case, the gradients must be filtered due to their colored noise error spectrum.

The simulated gravity gradients were then processed with the GINS software package using either the usual normal equation computation or the QR approach for incremental linear least squares.

The accuracy assessment of the gravity field recovery consists in computing the median error degree-variance spectra, accumulated geoid errors, geoid errors due to in-

dividual coefficients, and geoid errors calculated on a global grid. The performance, in terms of memory usage, required disk space, and CPU time, of the QR versus the normal equation approach is also evaluated.