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The role of the attitude reconstitution in the framework of the GOCE gravity field processing

R. Pail (1), B. Metzler (1) and T. Preimesberger (2)

(1) Institute of Navigation and Satellite Geodesy, Graz University of Technology, Austria (pail@geomatics.tu-graz.ac.at / FAX: ++43 316 873 8888), (2) Space Research Institute, Austrian Academy of Sciences, Graz, Austria

The dedicated satellite gravity mission GOCE (Gravity field and steady-state Ocean Circulation Explorer), the first Earth Explorer Core Mission, in the context of ESA's Living Planet Programme, strives for a high-accuracy, high-resolution global model of the Earth's static gravity field. The mathematical model for its parameterization is based on a series expansion into spherical harmonics. The launch of the GOCE satellite is scheduled for August 2006. The goal is to resolve the model complete to degree and order 250, yielding approximately 63000 unknown spherical harmonic coefficients. GOCE is based on a sensor fusion concept: satellite-to-satellite tracking in the high-low mode (hl-SST) using GPS, and satellite gravity gradiometry (SGG). This data contains abundant information about the gravity field of the Earth, from very low (derived mostly from hl-SST) to high (derived mostly from SGG) frequencies.

The computation of a high-accuracy, high-resolution spherical harmonic model of the static Earth's gravity field from these complementary data sets is a demanding numerical and computational task, and therefore efficient solution strategies are required to solve the corresponding large normal equation systems. During the last decade, several approaches have been developed to solve this large system of equations. In Pail and Plank (2002, 2004), the rigorous solution of the large normal equation matrix by means of a parallel processing strategy implemented on a Beowulf cluster, the Distributed Non-approximative Adjustment (DNA) approach, was proposed, while in Pail et al. (2003) a fast, semianalytic implementation was presented. These two approaches will be realized by the Gravity Field Processing Facility Graz in the framework of the "GOCE High-Level Processing Facility" (HPF; Rummel et al. (2004)). The HPF is an assignment by the European Space Agency (ESA) for the installation of a de-

centralized operable software system for the scientific processing of GOCE Level 1b data into the gravity field model. This work is done by the European GOCE Gravity Consortium, a co-operation of 10 European research institutions.

The gravity gradients will be provided in the Gradiometer Reference Frame (GRF), which deviates from the actual flight direction (Local Orbit Reference Frame; LORF) by a few degrees. The attitude information of the GOCE satellite is reconstituted by a combination of the star tracker quaternions, providing mainly the absolute orientation and the very low-frequency components, and the twice-integrated angular accelerations deduced from the accelerometer readings of the gradiometer. Thus, the gradiometer is used as a gyroscope, whose observations are used to stabilize the attitude information.

The attitude reconstitution will not be perfect, but will be affected by several error sources. In many case studies the error budget of the GOCE gradiometer and its effect on the gravity field solution have been investigated. However, so far the error source of an inaccurate knowledge of the gradiometer orientation, and thus a potential misalignment of the SGG tensor, has not yet been adequately considered in studies on the performance of gravity field solution strategies.

In the present contribution, this aspect shall be investigated in detail on the basis of a parametric study. The effect of potential errors in the attitude reconstitution process are addressed, and their impact on the accuracy of the gravity field solution are investigated based on several numerical closed-loop simulations in a realistic GOCE mission environment. It turns out, that orientation errors have to be seriously considered, because they may represent a significant error component of the gravity field solution.

References:

Rummel R., Gruber T., Koop R. (2004): High Level Processing Facility for GOCE: Products and Processing Strategy. Proc. 2nd Internat. GOCE User Workshop, Frascati, March 2004.

Pail R., Lackner B., and Preimesberger T. (2003): Quick-Look Gravity Field Analysis (QL-GFA). DAPC Graz, Phase Ia, Final Report, WP Ia-4.1, 107 - 161, Graz.

Pail R., Plank G. (2002): Assessment of three numerical solution strategies for gravity field recovery from GOCE satellite gravity gradiometry implemented on a parallel platform. J. Geod., 76, 462 - 474.

Pail R., Plank G. (2004): GOCE Gravity Field Processing Strategy. Stud. Geophys. Geod., 48, 289-308.