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Surface topography estimated by inversion of satellite gravity gradiometry observations

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An integration of mass elements is presented for evaluating the six components of the 2-order gravity tensor (i.e. second derivatives of the Newtonian mass integral for the gravitational potential) created by an uneven sphere topography consisting of juxtaposed vertical prisms. The method is based on Legendre polynomial series with the originality of taking elastic compensation of the topography by the Earth's surface into account. The speed of computation of the polynomial series increases logically with the observing altitude from the source of anomaly. Such a forward modelling can be easily used for reduction of observed gravity gradient anomalies by the effects of any spherical interface of density. Moreover, an iterative least-square inversion of the observed gravity tensor values $\Gamma\alpha\beta$ is proposed to estimate a regional set of topographic heights. Several tests of recovery have been made by considering simulated gradiometry anomaly data, and for varying satellite altitudes and a priori levels of accuracy. In the case of GOCE-type gradiometry anomalies measured at an altitude of $\sim$300 km, the search converges down to a stable and smooth topography after 20-30 iterations while the final r.m.s. error is $\sim$100 m. The possibility of cumulating satellite information from different orbit geometries is also examined for improving the prediction.