On frequency response of Stokes and Hotine-Koch integral transforms in calculation of height anomaly in the local area by means of SRBF

Leyla Sugaipova and Yury Neyman
Moscow State University of Geodesy and Cartography, Higher Mathematics, Russian Federation (yuney@miigaik.ru)

The problem of determining the height anomaly in a local area of the radius $\psi_0$ using gravity disturbances and gravity anomalies is discussed. The influence of the far zone, as usually, is approximately taken into account using the global gravity field model and the truncation coefficients $Q_n(\psi_0)$ introduced by M.S. Molodensky [1]. The modification $Q_n^0(\psi_0)$ by O.M. Ostach [2] of these coefficients is described. They provide - in contrast to the original coefficients - the continuity of the used integral transform kernel $Ker^0(\psi)$ in the whole its definition domain. As a consequence, the modified coefficients decrease faster compared to the original ones with an increase of the degree $n$ (frequency). It reduces the error of the far zone influence. Coefficients are interpreted as Fourier coefficients of the outer part of the kernel when it is decomposed into the orthogonal system of nonnormalized Legendre polynomials. The relationship between $Q_n(\psi_0)$ and $Q_n^0(\psi_0)$ is indicated. In the frequency domain, the expression for the truncated kernel $\Delta Ker^0(\psi)$ of the integral transform used (Stokes or Hotine-Koch) differs from the corresponding full kernel by a multiplier, which is proposed to be called the frequency characteristic of the kernel truncation operator onto the inner zone of radius $\psi_0$.

In local modeling, when describing the details of the "useful signal", it is advisable to use approximation by means of spherical radial basis functions (SRBF) instead of traditional integration due to their good spatial localization [3, 4]. The procedure of constructing scaling functions and corresponding wavelets is briefly described. New scaling functions, based on the above-mentioned concept of frequency characteristic of the kernel truncation operator onto the inner zone of the radius $\psi_0$, are proposed. To prove the effectiveness of these scaling functions, numerical experiments were conducted. Both gravity anomalies $\Delta g$ and disturbances $\delta g$ were used as input data. The results of the calculations showed a high accuracy of recovering height anomalies from gravity anomalies. Besides, introduction of frequency characteristic of kernel truncation of corresponding integral transform onto the inner zone allows to cut off implicit influence of far zone. Known scaling functions that do not use this frequency characteristic lead, as experiments have shown, to biased results.

References: