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BEM for the nonlinear Molodensky problem

Ernst P. Stephan

Institute for Applied Mathematics, Leibniz University Hannover, Welfengarten 1, 30167 Hannover, Germany
(stephan@ifam.uni-hannover.de)

We investigate the mathematically justified numerical approximation of the nonlinear Molodensky problem, which reconstructs the surface of the earth from the gravitational potential and the gravity vector. The method, based on a smoothed Nash-Hörmander iteration, solves a sequence of exterior oblique Robin problems and uses a regularization based on a higher-order heat equation to overcome the loss of derivatives in the surface update. In particular, we obtain a quantitative a priori estimate for the error after k steps, justify the use of smoothing operators based on the heat equation and study the accurate evaluation of the Hessian of the gravitational potential on the surface, using a representation in terms of a hypersingular integral. A boundary element method is used to solve the exterior problem. Numerical results compare the error between the approximation and the exact solution in a model problem.