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Data filtering on the Earth's surface using linear and nonlinear diffusion equations

Róbert Čunderlík, Karol Mikula, and Martin Tunega

Dept. of Mathematics, Faculty of Civil Engineering, Slovak University of Technology, Bratislava, Slovakia
(cunderli@svf.stuba.sk, mikula@math.sk, martin.tunega@gmail.com)

The paper deals with data filtering on closed surfaces using linear and nonlinear diffusion equations. We define a surface finite-volume method (SFVM) to approximate numerically parabolic partial differential equations on closed surfaces, namely on the Earth's surface. The Earth is approximated by a polyhedral surface created by planar triangles and we construct a dual co-volume grid. On the co-volumes we define a weak formulation of the problem by applying Green's theorem to the Laplace-Beltrami operator. Then SFVM is applied to discretize the weak formulation, where we consider a piece-wise linear approximation of a solution in space and the backward in time discretization. Later on, we extend a linear diffusion on the surface to the regularized surface Perona-Malik model, which represents a nonlinear diffusion equation.
The proposed approach is suitable for filtering different types of satellite data that monitor behaviour of the Earth's surface, e.g. from satellite altimetry or remote sensing. In our numerical experiments we focus on reducing the stripping noise from the ITG-Grace03S satellite geopotential model due to the truncation error of spherical harmonics. We discuss advantages of the nonlinear diffusion that conserves main structures of the gravity field, while the stripping noise is effectively reduced.