Parallelized Bottom-Up Correction in Hierarchical Re-Distancing for Topography Simulation

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Topography simulation is typically implemented using the level-set method, which uses the level-set function $\phi(x, t)$ to represent the interface. The discretized level-set function should be a signed-distance function so that the computation of the gradient, needed for the advection, is numerically stable. The signed-distance property has to be restored after one (or more) advection step(s), because the level-set method does not impose this property. This restoring process is called re-distancing and the most established algorithm is the Fast Marching Method (FMM).
The necessity for higher spatial resolutions in Cartesian grids around critical geometrical features of the interface, such as narrow trenches and sharp corners, requires hierarchical meshes. Our recently developed FMM is applied in parallel to all meshes on each refinement level, from the coarsest to the finest level (to set the boundaries on the finer meshes). Among the challenges of this approach is the need to utilize the solution from the finer meshes to correct the solution on the coarser meshes.
We present a parallelized bottom-up correction step for hierarchical re-distancing using the FMM, which increases the accuracy of the discretized level-set function on the coarser meshes. The correction step processes the levels from the finest to the coarsest level (i.e., a bottom-up scheme). The coarser meshes are corrected by interpolation on grid points covered by finer meshes and a partial restart of the FMM for the other grid points, thus minimizing the computational effort.
The parallel re-distancing and correction step is implemented in C++ using OpenMP and evaluated for different geometries. The correction step gives a significant reduction in the error norm with an only small increase of the computational time by about 10
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InterCriteria Analysis of Data Obtained from University Students Practicing Sports Activities

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Physical activity among university students is essential for complementing sedentary behavior and for individuals' future mental and physical health. At the same time, intellectual qualities like operative, analytic, logical thinking, attention span, short-term