1063-68-283 **Joseph Teran*** (jteran@math.ucla.edu), UCLA/Walt Disney Animation. *A parallel multigrid Poisson solver for fluids simulation on large grids.*

We present a highly efficient numerical solver for the Poisson equation on irregular voxelized domains supporting an arbitrary mix of Neumann and Dirichlet boundary conditions. Our approach employs a multigrid cycle as a preconditioner for the conjugate gradient method, which enables the use of a lightweight, purely geometric multigrid scheme while drastically improving convergence and robustness on irregular domains. Our method is designed for parallel execution on shared-memory platforms and poses modest requirements in terms of bandwidth and memory footprint. Our solver will accommodate as many as 768X1152 voxels with a memory footprint less than 16GB, while a full smoke simulation at this resolution fits in 32GB of RAM. Our preconditioned conjugate gradient solver typically reduces the residual by one order of magnitude every 2 iterations, while each PCG iteration requires approximately 6.1 sec on a 16-core SMP at 768^3 resolution. We demonstrate the efficacy of our method on animations of smoke flow past solid objects and free surface water animations using Poisson pressure projection at unprecedented resolutions. (Received August 18, 2010)