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A PARALLEL LOG BARRIER-BASED MESH WARPING METHOD FOR DISTRIBUTED MEMORY MACHINES

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Parallel dynamic meshes are essential for computational simulations of large-scale scientific simulations involving motion. To address this need, we propose parallel LBWARP, a parallel log barrier-based mesh warping algorithm for distributed memory machines. Our algorithm is a general-purpose, geometric mesh warping algorithm that parallelizes the computationally intensive sequential LBWARP proposed by Shontz and Vavasis in [1]. It efficiently utilizes distributed memory machines and can be used to update very large meshes which are used to approximate the deforming geometric domains that occur in many computational simulations. By predetermining neighbor lists for each processor, communication among processors can be avoided during the most time consuming step of the algorithm, i.e., during the weight generation step. Furthermore, since the structure of the weight matrix is very sparse and is weakly diagonally dominant, we use a parallel modified LU factorization solver, which is fast and has low complexity, in order solve the linear system for new coordinates of the interior nodes of the warped meshes. Our numerical results demonstrate the efficiency and strong scalability of parallel LBWARP. We also demonstrate an advantage of parallel LBWARP in that it reuses the weight matrix when performing multiple deformations, which significantly reduces the overall time of the algorithm.

REFERENCES

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