Coupling Parallel Simulation and Parallel Visualization on PC Clusters

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Progresses in hardware and software technologies make possible the use of parallel platforms for image synthesis. New parallel programming environments help developpers in parallelizing efficiently their applications. In particular, complex physical simulation with massive data sets could be managed with reasonable response time. Moreover a parallel visualization improves significantly the reactivity of the application.

Our goal is to couple a parallel simulation code and a multi-display visualization and test it on a PC cluster. The simulation is parallelized with the parallel programming environment Athapascan [3, 2], and rendering computations are distributed by Net Juggler [1] on graphics nodes. Practically, we focus on physical simulation of deformable objects, and more precisely on clothes, that are discretized in a large number of interactive particules.

A cloth is modeled as a mesh of particles linked up by springs. This object is partitioned in elementary tasks [4]. At each time step, physical simulation consists of two steps of Newton's equation integration. The tasks are executed by the Athapascan environment and enable computation of the new position of the object. In this phase, the scheduler automatically manages data locality in order to minimize communication costs. Finally, a communication scheme has been implemented between the computation tasks and Net Juggler rendering tasks avoiding global synchronizations. It enables a good overlaping between computation and visualization tasks, and consequently optimizes the resource use.

Many experiments have been conducted with various numbers of particles, processors or graphics cards. Our implementation supports up to a million of particles (about $3s$ for one frame on two nodes). Visualization by Net Juggler on up to 3 graphics cards has been done without difficulty.

In this work, we combine synchronized parallel I/O for rendering and asynchronous parallel simulation code. We believe that, for such an environment, interactivity is reachable with more powerful computing clusters. Visualization scalability, by increasing the number of graphics cards, is possible with our software architecture but have not been already tested. From a scientific point of view, we have to go further into the analyzis of the interaction between the simulation flow and the visualization constraints. Moreover to control this flow, new methodologies have to be developed to tune many parameters.

References

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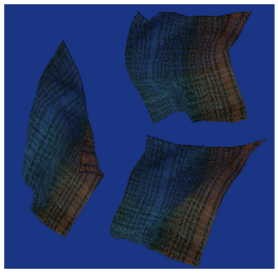

Fig.1: Pieces of cloth of 100 particles.

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