Numerical Simulations in the SILC Matrix Computation Framework

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This paper presents two practical ways of building numerical simulations in the SILC framework that provides easy access to various matrix computation libraries in an environment- and language-independent manner [1]. SILC is a client-server system in which user programs are clients of a SILC server. User programs for SILC first deposit input data (such as matrices and vectors) into a SILC server, and make requests for computation by means of textual mathematical expressions. These expressions are translated into calls for appropriate library functions and carried out on the server side. Then, the user programs retrieve the results of computation from the server. SILC's mathematical expressions constitute a uniform interface for libraries and underlying computing environments, allowing users to use alternative libraries and environments without modification to the user programs. With the aim of setting general guidelines for SILC users, we propose the following two modes for constructing numerical simulations in SILC:

Limited application mode. Rewrite the most time-consuming, computationally intensive part of existing user programs by means of the SILC framework. Those computations that are hard to realize in terms of matrix computations are implemented within the user programs by fetching data from the server and sending the results of computation back to the server. Therefore, this mode imposes some overheads due to the data communications between the user programs and the server. Also, the maximum amount of data may depend on the size of main memory in the user programs' environments. However, this mode is easier to apply than the other one.

Comprehensive application mode. Move all relevant data to the SILC server and realize the overall simulations using SILC's mathematical expressions. The user programs first deposit all data into the server. After that, the user programs issue a number of computation requests to control the simulations, while exchanging few data with the server in the middle of the simulations. In this mode, the maximum data size depends mainly on the server's memory capacity, so that a larger amount of data than the limited mode can be handled. However, the user programs may need to be rewritten from scratch, since they are not necessarily in the form that can be reimplemented with ease by means of SILC's mathematical expressions.

We selected two example applications of (1) cloth simulation based on the implicit Euler method and (2) a simulator of interactions between fluid, rigid and elastic bodies based on the Moving-Particle Semi-implicit (MPS) method. Experimental results will be presented in the talk.

Keywords : matrix computation libraries, simulation framework, mathematical expressions.

References

[1] T. Kajiyama *et al.*: SILC: A flexible and environment independent interface for matrix computation libraries, Proc. PPAM 2005, LNCS 3911, pp. 928–935, 2006.