One approach of new parallel architecture for real space descretization methods

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In this presentation, a parallel computer architecture for real space descretization method was proposed. In recent years, performance improvement rate of supercomputers is considerably becoming slower than before. The reasons why the improvement rate is becoming slower can be categorized;

1. Single processor speed up
2. Expansion of number of processors

Modern processing unit operates around 3 GHz and it is considered as the inherent bound comes from material. On the other hand, another limitation is based on complexity of network equipment. All recent supercomputers can be considered as distributed memory type architecture and such computer requires data communication with processors which are in one supercomputer. However, data communication is relatively slower operation than calculation. Additionally, hardware requirement increases as the square of the number of processors in most nervous case. Considering the fact that today's fastest computer has over 10,000 processors, everyone says that expand the number of processors is difficult with modern technology.

Generally speaking, solving linear equation is one of the most time consuming part of numerical simulation. Because most descretization method provides sparse matrix, a lot of researchers are developing a lot of sparse solvers. Computational time to solve required is depends on the structure of matrix, especially for parallel computer, since the amount of data communication is determined by matrix structure.

In line with such background, I examined the parallel performance of several parallel sparse linear solvers on existing supercomputers. And the fact was observed that parallel Jacobi method had the most favorable nature for parallel computing. Finally, I found out the favorable nature for parallel computing in Jacobi method, and new parallel computer architecture was proposed.