15th International Conference on Domain Decomposition Methods
July 21-25, 2003, Berlin, Germany

Optimised Data Structures for Efficient Large Scale Parallel Computations

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Abstract: Scientific computations strive to be efficient. Yet the standard definition of parallel efficiency does not take the performance of the scalar program into account. Fully efficient parallel programs combine high performance computations on the individual processing elements with high parallel efficiency. The optimised data structures presented in this talk are one step towards such efficient parallel programs.
Current computer architectures perform operations on regular data structures typically several times faster than operations on irregular or unstructured ones. This observation is driving the design of the *hierarchical hybrid grid framework*, which first generates and then exploits regular substructures on globally unstructured grids. The approach is based on the assumption that the problem geometry can be represented by a much coarser grid than the one needed for an accurate resolution of the solution. The necessary refinement is carried out in such a way as to generate regular subregions in the global grid. The data structures for storing unknowns and operators on the refined grid are designed to exploit the regularity of the subregions. Furthermore, by introducing ghost cells even in the sequential case they are well suited for parallel computations, as will be shown for overlapping Schwarz techniques.

Type of contribution: Talk
Location: Lecture Room, **Time:** Thursday, 24 July, 12:00

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