RONALD HAYNES, Memorial University of Newfoundland
A Parallel Space-Time Approach for the Numerical Solution of Partial Differential Equations

There is a continuing need to pursue the development, implementation and theoretical analysis of algorithms for the numerical solution of time dependent PDEs particularly suited to today's increasingly complex problems of interest. Moreover, there is an opportunity to study algorithms designed to take advantage of evolving computing hardware - available commodity clusters, hybrid CPU-GPU systems and even desktop machines with 4-24 cores. Such algorithms consist of three modules: (1) a procedure to step forward in time, (2) the computation of a new spatial mesh as required, and (3) the solution of the (physical) PDE on the newly constructed mesh. Moving mesh methods, developed over the last 30 years, have proven to be a robust and efficient choice to track solutions of PDEs which evolve over disparate space and time scales. Domain decomposition (DD) parallelizes a computation by partitioning the spatial domain into subdomains. The solution on each subdomain is computed by individual processors or cores. With appropriate conditions to transmit solution information between cores, the subdomain solutions can be rapidly combined to give a solution to the original problem. The application of DD methods for the physical PDE, step (3) above, is well established. Here we will consider the application of DD to the PDE based mesh generation problem used in the moving mesh method. And finally we present some recent work on the Revisionist Integral Deferred Correction approach which is a relatively easy way to add small scale parallelism (in time) to the solution of time dependent PDEs.