On the parallel implementation of numerical schemes for the hyperbolic Euler equations

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The modeling of fuids usually results in a number of partial diferential equations that relate the change of local properties (such as density, velocity, temperature,...) in time to the corresponding change in space. Among the equations used, the Euler equations (for inviscid fow) and the Navier-Stokes equations (for viscid fow) are probably the most prominent examples and are used in a variety of applications. Mathematically speaking, the proper discretization of conservation laws is of importance to obtain physically relevant results that can be used in applications ranging from the analysis of aircrafts to transport phenomena in the sun.

These problems are challenging from a numerical point of view, since care has to be taken to propagate shock waves without diminishing the performance of the scheme.

MPI is the classical approach for scientific computation on a parallel architecture. However, with respect to the ongoing developement of HPC systems, a reduction of the communication overhead is desirable. The Partitioned Global Address Space (PGAS) programming model is a more convenient way to write a parallel program and it offers the potential of reducing the communication overhead.