Mixed OpenMP/MPI approaches on Blue Gene for CDF Applications (EDF R&D and IBM Research collaboration)

Pascal Vezolle
IBM France

EDF and IBM are collaborating to improve significantly the scalability of some applications using IBM Blue Gene solution. EDF is the first French Electricity provider and the European leader. The application on the Blue Gene/P can use the familiar OpenMP or multi-threads programming to exploit the shared memory in a node, and an MPI interface between the nodes. We will present in this session the advantages and constraints of a mixed OpenMP/MPI approach. For a general finite volume CFD application, we will describe a new optimal mesh numbering allowing to introduce OpenMP directives while optimizing the cache effects without core loop modification. For billions of cells CFD simulations require tens of thousand processors. For such simulations it is compulsory to reduce the parallel challenges (domain decomposition of unstructured meshes, communication and computation load balancing, memory considerations, handling massive I/O associated) by introducing a new level of parallelism with a mixed OpenMP/MPI implementation.
We will conclude by presenting some scalability results for a distributed stochastic control algorithm (for Energy management problems) implemented with both MPI and multithreading mechanisms.