The Future of CFD and the CFD of the Future

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ABSTRACT:

CFD is undergoing a rapid evolution. The distinction between CFD and the so called Structural FE codes is disappearing. The solids and plastics are already being viewed as special subsets of fluids. In the next few years the distinction between the structural and fluid codes will all but disappear. The algorithmic advancements will have to include much stronger emphasis on rheology, fluid structure interaction and physics that includes the complete transformation from solids to fluids and the phases in-between.

A parallel evolution is occurring in the computer architecture. The codes of today, with a few exceptions, rely heavily on iterative matrix solvers. The algorithmic core of most of the CFD codes of today was developed when the paradigm was a single CPU with limited memory or a parallel system with multiple CPU's –at the most numbered in 100's - in a MIMD or SIMD architecture. Hence the methodology used is that adapted to such architectures. The current trends indicate that the architecture of the future will be multi-core CPU's or GPU's in a cloud or grid-computing architecture. The use of matrix solvers for such architecture will present bottlenecks associated with communication and management software. This will necessitate a new look at how to solve the governing equations and how to do so effectively in the paradigm of cloud computing.

A third evolution will occur in how to implement and view CFD as a design tool. Increasingly the emphasis will shift to embedded applications and CFD as a stand-alone tool will practically disappear. The embedded applications may merge with virtual reality tools or be included in intelligent AI type interfaces where the emphasis is on the design function of interest rather than on CFD. CFD will then be part of an interactive tool such as the one for x-ray tomography or the performance analysis of an aircraft engine. Further with increasing task specific embedded applications, the day is perhaps not far when specific ASIC chips may implement CFD for such applications.

In summary, CFD will surely become ubiquitous but so buried that most often it will not be obvious that the tool exists. Everyone knows there is an engine in a car yet hardly anyone cares to ask what that engine is.