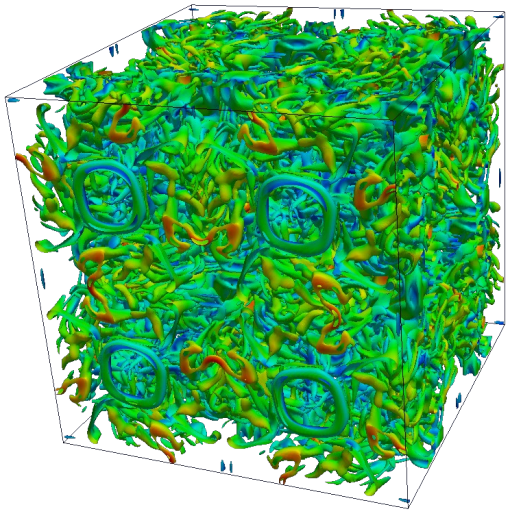
On high performance computational fluid dynamics

Implementing the link-wise artificial compressibility method on graphics processing units

Christian Obrecht, Associate Professor, INSA Lyon
Centre for Energy and Thermal Sciences of Lyon (CETHIL)

Tuesday 11 December 2018 at 3 PM
Sala Cafaro, Department of Energy, Politecnico di Torino



During the last decade, graphics processing units (GPUs) have shown to be very effective hardware platforms for general-purpose high-performance computing. Their area of use now include a considerable number of cardinal scientific computing applications such as molecular dynamics or computational fluid dynamics.

The link-wise artificial compressibility method (LW-ACM) is a recent implementation of the artificial compressibility method which can be expressed in both a finite-difference framework and a link-wise framework, the latter showing strong analogies with the lattice Boltzmann method (LBM). Similarly to the LBM, the LW-ACM proves to be well-suited to massively parallel computations on GPUs, with the additional benefit of a significantly reduced memory consumption and, consequently, improved performance.

This presentation will comprise three main parts. In the first one, we will introduce the hardware architecture of modern GPUs as well as present general programming principles and some current programming technologies, namely CUDA and OpenCL. The second part will focus on the LW-ACM and its implementation on GPUs. The third part will be devoted to some applications of the LW-ACM such as thermal flow simulation and phase change modelling.