High-Performance Computing and Big Data for direct numerical simulation of transitional and turbulent flows: challenges and perspectives

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Algorithmic Aspects of Domain Decomposition Methods

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Massively parallel simulations generate increasing volumes of large data, whose exploitation requires large storage resources, efficient network and increasingly large post-processing facilities. In the coming era of exascale computations, there is an emerging need for new data analysis and visualization strategies.

We will present here an original solution to address these questions for massively parallel direct numerical simulations of transitional and turbulent flows.

Domain decomposition methods are, alongside multigrid methods, one of the dominant paradigms in contemporary large-scale partial differential equation simulation.

In this talk, I will present a lightweight implementation (HPDDM, https://github.com/hpddm/hpddm) of theoretically and numerically scalable domain decomposition preconditioners in the context of overlapping and substructuring methods. A broad spectrum of applications will be covered, ranging from the scalar diffusion equation to Maxwell's equation, and including incompressible linear elasticity. Numerical results with hundreds of processes will be provided, clearly showing the effectiveness and the robustness of the proposed approaches.

HPDDM is currently interfaced with two finite element libraries, FreeFem++ (http://www.freefem.org/ff++/) and Feel++ (http://www.feelpp.org/), which allows for quick prototyping and throughout testing.

Tuesday, September 8th 9:30 AM (coffee offered, talks at 10 AM)
Maison de la Simulation, Digiteo building (565), room 34

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