

## HIGH-PERFORMANCE ISSUES FOR AERONAUTICS DESIGN

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HPC is the norm today for large-scale multidiscipline and multi-scale simulations and optimization. It spreads vigorously in many areas, ranging from biology and pharma to powerplant simulation and aircraft design. However, recent studies point out that current HPC applications hardly use 20 to 25% of the supercomputers peak performance. The current Top500 list shows also that the world most powerful computers reach several petaflops peak performance, e.g., 7 PetaFlops for the K computer and 2.5 PF for IBM BlueGene /Q.

The observed lack of efficiency exhibited by the existing HPC applications is therefore a challenge to both computer scientists and applications designers and users, including aircraft design bureaus.

The goal of this talk is to identify avenues for the most appropriate use of HPC power, to point out current issues and to suggest best practice recommendations.

A short state-of-the-art will first overview the current paradigms underpinning HPC, from both the hardware and system's perspectives. This includes multi and many core machines, memory hierarchies (HDD, SSD, DRAM), hybrid machines (CPU+GPU, FPGA), and parallel as well as distributed environments (clouds, grids, clusters, ...).

A second part will focus on application requirements for best HPC efficiency in the aeronautics sector, including flight dynamics simulation, design optimization, drag and noise reduction. It will focus on modeling, implementation, resource allocation, programming, algorithmic aspects (communication avoiding algorithms, parallel blocks, ...), hierarchical parallelization, parallelism extraction (loops, ...), locality characteristics, etc.

A last issue will focus on fault-tolerance, in order to cope with hardware and system failures at runtime for long-running simulation applications (days, weeks, ...). An overview of current techniques supporting fault-tolerance will provide insights on existing and upcoming issues and solutions (fault-tolerant MPI, Algorithm-Based Fault-Tolerance, aka ABFT, code and data duplication and migration, etc).

### REFERENCES

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