GAME-CHANGING COMPUTATIONAL ENGINEERING TECHNOLOGY

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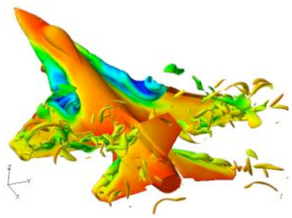

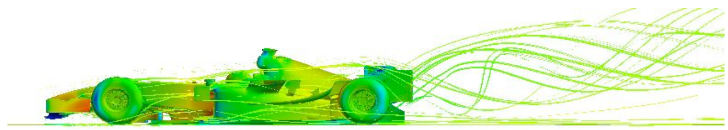

During the last two decades, giant strides have been achieved in many aspects of Computational Engineering. Higher-fidelity mathematical models, better approximation methods, and faster algorithms have been developed for many time-dependent applications. SIMD, SPMD, MIMD, coarse-grain, and fine-grain parallel processors have come and gone. Linux clusters are now ubiquitous, cores have replaced CEs, and GPUs have shattered computing speed barriers. Most importantly, the potential of high-fidelity physics-based simulations for providing deeper understanding of complex engineering systems and enhancing system performance has been recognized in almost every field of engineering. Yet, in many engineering applications, high-fidelity time-dependent numerical simulations are not performed as often as needed, or are more often performed in special circumstances than routinely. The reason is very simple: these simulations remain too computationally intensive for time-critical operations such as design, design optimization, and active control. Consequently, the impact of computational sciences on such operations has yet to materialize. Petascale or exascale computing alone is unlikely to make this happen. Achieving this objective demands instead a game-changing computational technology that bridges both ends of the computing spectrum. This talk will attempt to make the case for this pressing need and outline a candidate computational technology for filling it that is based on model reduction, machine learning concepts, trained data bases, and rigorous interpolation methods. It will also illustrate it with preliminary results obtained from its application to the support of the flutter flight testing of a fighter aircraft and the aerodynamic optimization of Formula 1 car.