Department of Aerospace Engineering Sciences

K. D. Wood Colloquium

Charbel Farhat

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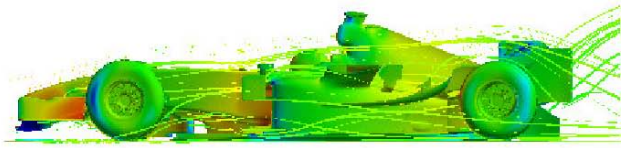

Because of the constant introduction of various rules limiting engine power, Formula 1 has become all about aerodynamics. While wind tunnels remain the most important aerodynamic design tool, Computational Fluid Dynamics (CFD) has emerged as a serious capability for gaining insight into the behavior of configurations that are impractical in a wind tunnel. It is now also accepted as a complementary design capability for minimum drag or maximum down-force. However, the flexibility of two key components, namely the front and rear wings, makes a Formula 1 car an aeroelastic system and not only an aerodynamic one. Unfortunately, Formula 1 wind tunnel models are usually too stiff to address this issue and CFD alone cannot predict the importance of aeroelastic effects on performance. This is unfortunate because in a race where 1/100th of a second can separate a winner from a loser, incorporating the aeroelastic effects — including the unsteady ones — in the design process can make all the difference. To this effect, this talk will describe an on-going research effort at Stanford University aimed at developing a near real-time fluid-structure computational technology based on CFD, structural dynamics, reduced-order modeling, Grassmann manifolds, differential geometry, and data bases. This technology will be illustrated with simulations performed for a real Formula 1 car and validated with wind-tunnel data.

Friday, January 25, 2008
12:00 p.m.
Bechtel Collaboratory, Discovery Learning Center

Refreshments will be served!

Biography

Charbel Farhat is Professor of Mechanical Engineering, Professor, by courtesy, of Aeronautics and Astronautics, Professor in the Institute for Computational and Mathematical Engineering, and Director of the Army High Performance Computing Research Center at Stanford University. He is the recipient of several prestigious awards including the Institute of Electrical and Electronics Engineers Computer Society's Gordon Bell Award, the International Association of Computational Mechanics' Computational Mechanics Award, the Department of Defense Modeling and Simulation Award, the US Association of Computational Mechanics Computational and Applied Sciences Award, the Institute of Electrical and Electronics Engineers Computer Society's Sidney Fernbach Award, the American Society of Mechanical Engineers Aerospace Structures and Materials' Best Paper Award, and the National Science Foundation's Presidential Young Investigator Award. Professor Farhat is Editor of the International Journal for Numerical Methods in Engineering. He also serves on the editorial board of eleven other international scientific journals, and on the technical assessment board of several national research councils and foundations. He is an elected Fellow of the American Society of Mechanical Engineers, the International Association of Computational Mechanics, the World Innovation Foundation, the US Association of Computational Mechanics, and the American Institute of Aeronautics and Astronautics.