STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

Wednesday, April 18, 2007
Carnegie Room 315, 2:30 pm
****** Note special time ******

Determining limits of machine performance through convex optimization techniques

Dr. Bram Demeulenaere
Mechanical Engineering Department, PMA Division
Katholieke Universiteit Leuven, Belgium

With only a bit of exaggeration it can be said that every engineering design boils down to solving an optimization problem. To conclude from this observation that numeric optimization provides a magical solution to all design problems would, however, be a gross oversimplification. One variant of a series of no-free-lunch theorems puts this as follows: “a general-purpose universal optimization strategy is theoretically impossible, and the only way one strategy can outperform another is if it is specialized to the specific problem under consideration".

No-free-lunch theorems justify the view that custom optimization routines should be developed for particular applications areas, thereby utilizing as much prior knowledge as possible. The presented research adheres to this philosophy by formulating design problems in the area of machine construction as convex programs. Convex programs constitute a specific class of nonlinear optimization problems for which every local optimum is also globally optimal. As a result, finding the global optimum of convex programs is relatively straightforward. The challenge, and art, in using convex optimization is rather in recognizing and formulating the problem. Once this formulation is done, solving the problem is (almost) technology.

This talk will give a brief introduction to convex optimization and illustrate its main concepts based on a simple motion trajectory design problem. After that, it will be shown how the performance limits of counterweight balancing of linkages are found by formulating counterweight design as a convex program.

Bram Demeulenaere is a postdoctoral researcher of the Research Foundation-Flanders (FWO-Vlaanderen). He is currently affiliated with the Mechanical Engineering Department of the Katholieke Universiteit Leuven (Belgium) and was a visiting scholar at the Electrical Engineering Department of the University of California, Los Angeles in 2004-2005 under the supervision of Prof. Lieven Vandenberghe. Dr. Demeulenaere received his Mechanical Engineering degree and Ph.D. degree from the Katholieke Universiteit Leuven in 1999 and 2004, respectively. Dynamic optimization of multibody systems constitutes his main research interest with applications in cam design, counterweight balancing of linkages, design of input torque balancing mechanisms, design of weaving machines, spline optimization and human body simulation.

For more information, please contact Prof. Frank Fisher at Frank.Fisher@stevens.edu or 201-216-8913