AEROSPACE & MECHANICAL ENGINEERING

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INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL

UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Michael G. Olsen**
Associate Professor of Mechanical Engineering
Iowa State University
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TOPIC: **LASER-BASED MEASUREMENTS OF TURBULENT MIXING IN MACROSCALE AND MICROSCALE CHEMICAL REACTORS**

DATE: Tuesday, January 25, 2011

TIME: 3:30 p.m.

PLACE: 138 DeBartolo Hall

ABSTRACT

Turbulent mixing is essential to the performance of not only traditional macroscale chemical reactors but also of recently developed microscale chemical reactors. Detailed measurements of the mixing processes in these reactors are therefore necessary for both understanding the complex flow phenomena present in these reactors and also for validating the accuracy of computational models used in chemical reactor design and optimization. In this seminar, experimental results are presented for a macroscale reactor and two microscale reactor designs, and these results are used to assess the accuracy of computational models. In the macroscale experiments, simultaneous particle image velocimetry (PIV) and planar laser-induced fluorescence (PLIF) measurements were performed in a confined rectangular liquid jet. The experimental data were analyzed to yield both pointwise and spatial turbulence statistics. Comparisons with large-eddy simulations of both velocity and concentration show excellent agreement between experiment and simulation. The experimental data were also used to assess the validity of conditional moment closure (CMC) and PDF models used in mixing simulations and to suggest a means for model improvement. In the microscale experiments, microscopic particle image velocimetry (microPIV) measurements were performed in two microscale chemical reactor designs, a confined impinging jets reactor (CIJR) and a multi-inlet vortex reactor (MIVR), both of which are used in the Flash Nanoprecipitation process for manufacturing functional nanoparticles. These measurements represent the first successful application of microPIV to microscale turbulent shear flow. Flow visualization experiments were also performed using both flashlamp digital photography and confocal microscopy. Comparisons of the experimental results to numerical simulations suggest that because these microscale reactors operate just beyond the transition to turbulence, simple Reynolds-averaged Navier-Stokes (RANS) based simulations are of limited usefulness and more computationally expensive techniques such as large-eddy simulation must be applied.

NOTE: *If you are interested in meeting individually with Prof. Olsen, please contact Evelyn at 631-5431*