SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: March 1, 2013

The School of Dynamic Systems, Mechanical Engineering Program, is pleased to offer the following research project for the summer of 2013. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and, if possible, develop a timetable for the twelve-week research period.

PROJECT TITLE: Fluid Flow in the Screen-Bounded Channel in a Fiber Separator

Dr. Urmila Ghia
Computational Fluid Dynamics Research Laboratory (CFDRL), Room 637 ERC
Mechanical Engineering, Room 683 Rhodes Hall
University of Cincinnati
Cincinnati OH 45221-0072
Tel: (513) 556-4612
Fax: (513) 556-3390
Email: urmila.ghia@uc.edu

The research in our laboratory (CFDRL: Computational Fluid Dynamics Research Laboratory) involves numerical simulation and computer visualization of fluid flows encountered in engineering/industrial environments. Applications have ranged from gas turbine engine flows, to biological flows (such as ventricular assist devices, and stenosed arteries), styrene transport in boat-manufacturing facilities, flows in hospital rooms, and more recently, length-segregated fiber separation.

WISE Research Project Abstract:

Significant exposure to fibers (e.g., asbestos fibers) increases the risk of lung cancer, mesothelioma and other pleural disorders in humans. Fiber length has been implicated as a determinant of fiber toxicity. Hence, samples of length-separated fibers are required for toxicological studies. The Bauer-McNett Fiber Classifier (BMC) is a device used for separating fibers according to their length. The BMC consists of four or five elliptical tanks arranged in a cascade. Each tank includes a narrow open channel formed by a metal plate known as the midfeather plate on one vertical side, and a screen on the other vertical side. The tank base forms the bed of the channel. The screen consists of small square openings/apertures through which the fluid escapes, and fibers longer than the opening size do not pass through, and are, thus, separated based on their length.

Bauer-McNett Fiber Classifier

For the WISE 2013 research project, the undergraduate student will use Computational Fluid Dynamics (CFD) to study the flow in the rectangular open channel formed by the midfeather plate and the screen of the Bauer McNett Classifier. The effect of the screen on the flow will be examined by replacing a segment of one of the vertical side walls of the open channel by a screen, comprised of a 3 x 3 array of square apertures.

The WISE student will determine the velocity distribution and the shear stress distribution in the flow field. The shear stress distribution helps in determining the fiber orientation, since it is known that the fibers align themselves along the direction of the shear stress. Knowledge of fiber orientation near the screen elements will help to evaluate the possibility of fibers longer than the screen aperture size of the given screen to not pass through the apertures. Therefore, the shear stress data will enable evaluation of the efficiency of the Bauer McNett Classifier as a length-based classifier. Additional elements of the actual classifier will be subsequently incorporated in the CFD model