

**DEPARTMENT OF MECHANICAL, INDUSTRIAL AND NUCLEAR
ENGINEERING
College of Engineering**

**SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN**

APPLICATION DEADLINE: MARCH 3, 2003

The Department of Mechanical, Industrial and Nuclear Engineering is pleased to offer the following research project(s) for the summer of 2003. Interested students are urged to contact the faculty member(s) directing the project(s) that most interest 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.

Integrated and Computerized Setup Planning and Fixture Design

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The objective of this project is to research and develop an integrated framework for automatic generation of setup plans and fixture designs, applied to a wide range of components (prismatic, rotational, as well as irregular) that require machining in lathes, 3-axis machines, and 5-axis machining centers using modular, standard, or dedicated fixtures. Setup planning and fixture design are two closely related tasks. While setup planning is constrained by fixtures to be applied, it also provides guidelines for fixture design. The cyclic interaction creates the “chicken or egg” dilemma, which is the main research barrier. This problem will be solved as follows. First, a graph representation is developed to capture the feature/tolerance relationship of a product model. Through the recognition of design datum frames, the graph is transformed to a datum-machining surface relationship graph (DMG). With considerations of production scheme (integrated, distributed, or combined operations), fixturing constraints, machine tool capability, and tolerance decomposition, DMG will be converted into a setup graph. Tolerance stack-up analysis and setup plan verification is then followed to provide information for fixture design.

If successful, this research will yield both basic and applied advances. As basic research, it will provide a generalized methodology to unify current research results in setup planning and fixture design to achieve smooth integration of computer-aided design (CAD) and computer-aided manufacturing (CAM). It will also shed light on mathematics based tolerance analysis. For practicing engineers, it will allow them to incorporate setup generation and fixture design capability into existing CAD/CAM software tools; thus, dramatically improve user productivity. The incorporation of the research results into course curriculum will broaden mechanical, industrial, and manufacturing engineering students’ knowledge spectrum; thus, better preparing them for the knowledge intensive and multi-disciplinary working environment in the 21st century.