# University of North Carolina at Charlotte


*The 5-axes machine tool provided by MTTRF represents a significant upgrade of the Siemens Large Manufacturing Solution Lab. The state-of-the art equipment will offer new options to several research groups of our department. Students will experience real-world manufacturing processes including hands-on experiments.*

## RESEARCH

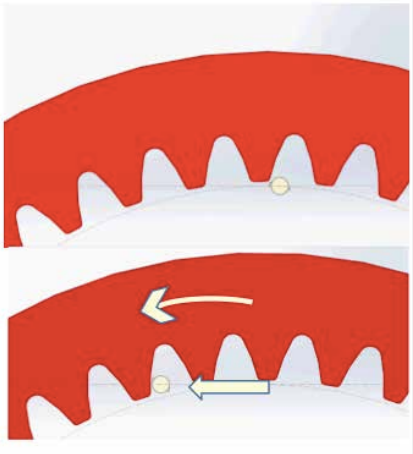
### Research on Large-Scale Manufacturing at Small and Medium Lot Sizes

The manufacturing of large products and components faces increasing challenges concerning both the efficiency (production costs and time) and the accuracy of produced parts. In certain industries, the individual components are continuously increasing in size and mass, while tolerances decrease in order to reduce assembly efforts and improve the overall energy efficiency. Simultaneously, the lot sizes have increased from small to medium batch numbers such that improvements by iterative manufacturing and inspection processes are no longer suitable.

The objective of the research is to enhance the accuracy as well as the efficiency of large-scale manufacturing processes with small to medium lot sizes by developing alternative manufacturing methods. The research will focus on two application areas: the production of internal gears by generation cutting processes and improved machining processes for the aerospace industry.

As for the machining of internal gears, a new cutting process called “Internal Indexing Generation Milling, IIGM” will be developed. The major challenge will be the investigation of machining and tool conditions and the correction of systematic error components to produce high-quality gears. This will also include the manufacturing of helical internal gears with various flank modifications.

**Internal Indexing Generation Milling (IIGM)**



As for aircrafts, the traditional paradigm of removing a substantial fraction of the material from a blank is not cost effective, namely because thin-walled parts are used increasingly for modern airplanes. Here, the major objective is to machine thin-walled components from thin-walled preforms considering both the tool dynamics and the workpiece dynamics. The latter is modelled by a novel flexure with adjustable flexibility.

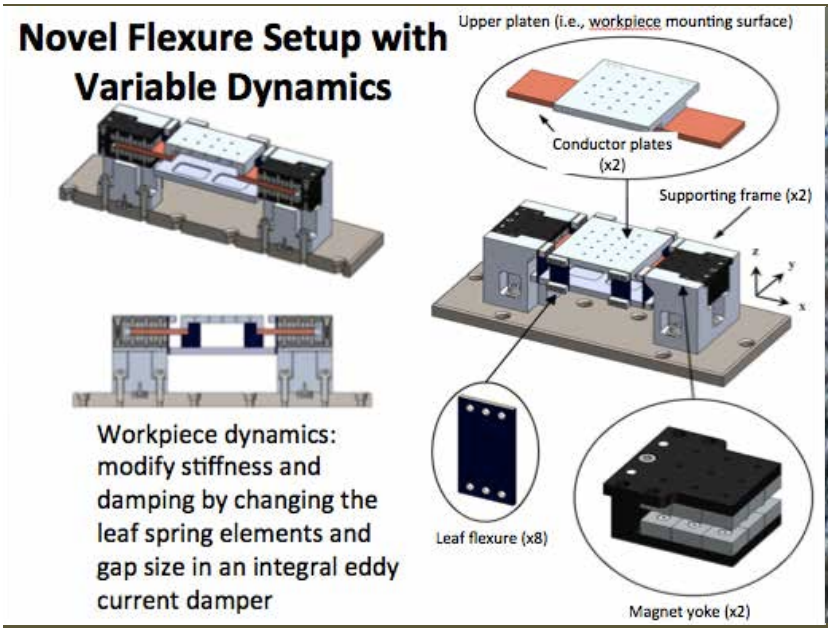
# EDUCATION

## Advanced Manufacturing Processes and Equipment
### (Graduate course)

This course is dedicated to physics-based analysis and simulation of manufacturing processes. The MTTRF equipment is integrated into the class though a series of homework assignments, in which students are required to develop simulations of various machining operations to predict forces, spindle torque, power, tool temperatures, etc. The MTTRF equipment is instrumented to enable measurements of these quantities and to compare the measured and predicted values. Students are introduced to programming and operation of the equipment under the supervision of experienced technicians and are then expected to design and carry out their own experiments to validate their simulations.

## Gear Manufacturing and Metrology
### (Graduate course)

This course is dedicated to the geometrical specification of involute gears as well as the broad spectrum of manufacturing and measuring methods. Students are introduced to simulation, programming and operation of the MTTRF equipment and a suitable CMM under supervision. The gear manufacturing process applies the indexing generation milling method (IGM), developed in a former project utilizing the MTTRF equipment.





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MTTRF Awardee since 2009