Northwestern University
Graduate Program in
Mechanical Engineering
Northwestern University

• Established 1851 for Northwest Territory (OH, IN, IL, MI, WI, MN)
• Location: Evanston and Chicago, IL
• Private university
• ~17,000 students (plus ~ 4,000 part-time)
  • ~ 8,000 undergraduate
  • ~ 7,900 graduate
Northwestern University

Eight departments:

- Biomedical Engineering
- Chemical & Biological Engineering
- Civil & Environmental Engineering
- Electrical Engineering & Computer Science
- Engineering Sciences & Applied Mathematics
- Industrial Engineering & Management Science
- Materials Science & Engineering
- Mechanical Engineering
ME Graduate Program Rankings

• #13, US News and World Report
• #5 in US, #6 in world based on Shanghai Rankings (impact of scholarly output)
• Top 5 in most recent National Research Council rankings
2010 NRC Rankings

Northwestern
Mechanical Engineering at NU

Research Thrust Areas for ME @ NU

- Design
- Biosystems & Health
- Nano/Micro-science
- Energy
- Multiscale Simulation

Core Groups

- Systems
- Manufacturing
- Mechanics

Northwestern
Research Topics

- human-robot systems
- human-centered design
- haptic displays
- bio-inspired sensing, actuation
- robot manipulation, automation
- prosthetics, rehabilitation
- complex networked systems
- system and device design
- multibody dynamic simulation and optimal control
- swarm robotics

Funding: NSF, NIH, industry

Commercialization: many licensed patents; spin-offs: MAKO Surgical (bought by Stryker), Cobotics (now part of StanleyWorks), HDT Robotics, Tanvas

Systems Research

- spatial/surface haptic interfaces
- bio-inspired sensing and actuation
- self-organization and swarm robotics
- human-robot systems: prosthetics, assist devices, rehabilitation

Northwestern
Manufacturing

Research Topics

- computer integrated processing
- **design** optimization
- machine tool control
- micro-, **nano**-manufacturing
- metamaterials, **nano**photonic
- tribology, interfacial mechanisms
- industrial systems optimization
- **energy** conscious manuf.
- life cycle assessment
- additive manufacturing

Funding: NSF, ONR, DOE, AFOSR, NRL, NIST, industry,
Commercialization: Over 25 patents; close relationships with many industries, eg, Ford, Boeing, Alcoa, GE, GM, IBM, Otis, Goodyear

Northwestern
Manufacturing Research

Incremental forming

Tooling inserts

Surface texturing

Virtual texturing

Woven fabric composites

Friction reduction

Design

Bio

Nano

Energy

Simulation

Northwestern
Mechanics - Solids

Research Topics
- **nanocomposites and nanomaterials**
- **biological** and bioinspired materials
- Nondestructive testing
- **multiscale** material analysis
- structural health management
- **computational** modeling
- **materials** design and characterization

Funding: NSF, ONR, DOE, AFOSR, NRL, ARO, industry

Commercialization: Over 25 patents; close relationships with many industries, eg, Ford, Boeing, GE, GM, Medtronic, Lockheed, Goodyear

Solid Mechanics Research

Nano- and bio-materials

Nanocomposites

Photonic crystal sensors

Self-assembled photovoltaics

Smart actuator materials

Northwestern
Mechanics - Fluids

Research Topics
- nano- and microfluidics
- biological system mechanics
- granular flows
- turbulence
- multiscale modeling
- fluids in energy
- computational modeling
- membranes and charged surfaces
- protein folding and self-assembly

Funding: NSF, NIH, DOE, NASA, DARPA, industry
Commercialization: Patents, relationship with many industries, eg, GE, Dow, international corporations
Leadership: American Physical Society, ASME Fluids Board, many major editorships
Fluid Mechanics Research

Thermo-fluid heat transfer probs.  Bio-inspired robotics and neuromechanics

lotus effect  protein folding

Proteins fold into complex structures. We want to know how they accomplish this feat of self assembly.

Northwestern
Mechanical Engineering at NU

Outstanding Central Facilities:

- Mechanical Engineering Machine Shop
- Rapid Prototyping Laboratory
- Mechatronics Laboratory
- NUANCE: NU Atomic and Nanoscale Characterization Experimental User Facility
- Mechanical Properties & Fatigue Facility
- Optical Microscopy and Metallography Facility
- Chemical Analysis Facilities
- Center for Nanofabrication and Molecular Self-Assembly
- Center for Nanoscale Materials (CNM) @ Argonne
- plus specialized equipment in research group labs…
Facilities

NUFAB

Rapid Prototyping Lab

Manufacturing Processes Laboratory

NUANCE

Quest HPC Center

Northwestern
Collaborations

http://collaboration.mccormick.northwestern.edu (active map of collaborations by year)
Key Institutes @ NU

The Garage
WHERE IDEAS GET BUILT

Segal Design Institute

NICO

NORTHWESTERN INITIATIVE FOR MANUFACTURING SCIENCE AND INNOVATION

Northwestern
INSTITUTE FOR SUSTAINABILITY AND ENERGY

NAISE
Northwestern University
Argonne National Laboratory
Institute of Science and Engineering

IBNAM
Institute for BioNanotechnology in Medicine

THE FARLEY CENTER FOR ENTREPRENEURSHIP AND INNOVATION
and many others...

INTERNATIONAL INSTITUTE FOR NANOTECHNOLOGY
Mechanical Engineering at NU

MS Programs:
• 12 units of courses/project
• One year program (can be 9 mo)
• 1-3 unit research project
• Thematic areas
  – Energy-Sustainability
  – Nano
  – Robotics
  – Simulation-driven Engineering (SdX)
  – Mini-MBA certificate
  – Design-your-own
• Opportunities for internship (industry, gov’t lab)

ME@NU provides an exciting, interdisciplinary and thriving environment for achieving excellence in research and education
MS Programs

Northwestern Engineering
MS Degree Programs in Mechanical Engineering

MS Degree Specializing in Nanotechnology

- Enhance your career with a Northwestern MS degree specializing in Nanotechnology.

- This program is for students finishing a BS in engineering or related field with a strong foundation in nano/microtechnologies.

- Students will gain expertise in areas such as nanomaterials, nanofabrication, and nanodevices.

- Prerequisites include fundamental courses in materials science and general chemistry.

- Core courses cover topics in nanomaterials, nanofabrication, and nanodevices.

- Electives allow students to specialize in areas such as nanoelectronics, nanosensors, and nanobiotechnology.

Northwestern Engineering
MS in Mechanical Engineering with Specialization in Energy/Sustainability

- Jump start your career with an MS degree at Northwestern, with an emphasis in sustainability. This program is for students finishing an ME degree, engineers, or science and engineering professionals.

- The program includes courses on energy systems, sustainable design, and environmental impacts.

- Students will learn about renewable energy technologies, energy efficiency, and sustainable materials.

- Research opportunities include projects on renewable energy conversion, sustainable building design, and environmental impact assessment.

Northwestern Engineering
MS Degree Programs in Mechanical Engineering

MS degree specializing in Robotics and Control

- This specialization is broadly related to robotics, and includes fundamental areas of autonomous control, planning, dynamics, and mechanical design and construction of novel robotic devices.

- The program includes courses on robotics fundamentals, control systems, and advanced robotics.

- Research opportunities include projects on robot locomotion, autonomous navigation, and haptic interfaces.

- Students will work on projects related to robotics, automation, and control systems.
Mechanical Engineering at NU

PhD Program:

- Student-advisor matching in the first year
- 15 courses post-BS degree
- No comprehensive exam with >3.5 GPA
- MS thesis with defense (optional en route to PhD)
- Candidacy exam: written thesis proposal and oral exam
- Opportunities for internship (industry, gov’t lab…)
- PhD degree in 5 years post-BS
  - Median number of years registered as a graduate student: 6.8 years for all engineering Ph.D’s across US

ME@NU provides an exciting, interdisciplinary and thriving environment for achieving excellence in research and education
ME Graduate Student Society (MEGSS)

http://www.mccormick.northwestern.edu/mechanical/graduate/megss.html

- Student voice in department
  - Representatives on faculty committees
- Social Events
  - Promotes meeting students outside lab/research area
  - Bi-monthly social
  - Semi-annual outings (concerts, new student welcome)
- Mentor Program
  - Pairs incoming students with current MEGSS members
  - Assist in quick acclimation to NU environment (housing, advisor selection, courses, Chicago / Evanston activities)
Responsible Research

- Federal Requirements
  - [http://www.citiprogram.org](http://www.citiprogram.org) - online
  - PhDs do ME 513 – spring quarter
- Research Ethics
  - Honesty
  - Referencing
  - Authorship
- Personal Ethics
  - Mentoring
  - Discrimination
  - Fairness

*Introduction to the Responsible Conduct of Research, NH Steneck*
Athletics Facilities

• Olympic pool
• Jogging track
• Weight rooms
• Tennis, racquetball, squash
• Basketball courts
• Cardiovascular equipment
• Private beach
• Membership free to students
Chicago ~ 10 Million people in Chicagoland

Navy Pier

Lake Front Trail ~ 18 miles

Architecture

Concerts, CSO, Ballet, Lyric Opera

Sports
Local Collaborations

Northwestern University

Shirley Ryan Ability Lab

Argonne National Lab
Department of Mechanical Engineering