CENTER FOR PRECISION METROLOGY

ATOMS TO AEROSPACE
EVALUATION TO ENGINEERING
SENSORS TO SYSTEMS
ORIGINATION TO OPTIMIZATION
PRINCIPLE TO PRACTICE
SCIENCE TO STANDARDIZATION
The Center for Precision Metrology is an interdisciplinary association of UNC Charlotte faculty and student researchers, allied with industrial partners in the research, development and integration of precision metrology as applied to manufacturing. Working with state-of-the-art dimensional tolerances on the order of 10 parts per million or better, precision metrology encompasses the methods of production and inspection in manufacturing, measurement algorithms and tolerance representation, and the integration of metrology into factory quality systems.

Through the William States Lee College of Engineering acting as the host college, the interdisciplinary nature of the Center blends the expertise of faculty and student researchers from a number of University of North Carolina at Charlotte academic colleges and related departments.

CENTER STATUS & INDUSTRIAL AFFILIATES

Beginning as an industry/university consortium in the early 1990’s and then supported from 1994-2005 as a National Science Foundation Industry/University Cooperative Research Center (NSF I/UCRC), the now ‘graduated’ Center for Precision Metrology is charged with breaking new ground in precision metrology through addressing real-world industrial concerns. Through the associated Affiliates Program, industry and Center researchers collaborate on projects that involve generic and specific manufacturing metrology problems. In support of the Center’s research efforts, affiliate members contribute funds and equipment that are directly applied to student projects and stipends. Additional specific research is funded through contracts with industrial partners to address proprietary application and development projects. Government funding sponsors fundamental and large-scale metrology projects.

TECHNICAL AREAS & FACULTY CONTACTS

- **Metrology Applications and Algorithms**
  Dr. Gert Goch
  Dr. Edward Morse
  Dr. Jay Raja
  Dr. Robert Wilhelm

- **Machine Performance Metrology and Modeling**
  Dr. Robert Hocken
  Dr. Robert Wilhelm
  Dr. John Ziegert

- **Nanoscale Science and Engineering Metrology**
  Dr. Robert Hocken
  Dr. Stuart Smith
  Dr. Quiming Wei
  Dr. Terry Xu

- **Manufacturing Process Modeling**
  Dr. Harish Cherukuri
  Dr. Russ Keanini
  Dr. Tony Schmitz
  Dr. Scott Smith

- **Machine Dynamics and High-Speed Machining**
  Dr. Matt Davies
  Dr. Tony Schmitz
  Dr. Scott Smith

- **Computer-Aided Tolerancing and Factory Control**
  Dr. Edward Morse
  Dr. Robert Wilhelm

- **Precision Optical-Electrical-Mechanical Systems**
  Dr. Faramarz Farahi
  Dr. Mike Fiddy
  Dr. Robert Hocken
  Dr. Kevin Lawton
  Dr. Steve Patterson
  Dr. Yasin Raja
  Dr. Stuart Smith

- **Precision Surfaces and Optical Metrology**
  Dr. Angela Davies
  Dr. Chris Evans
  Dr. Tsing-hua Her
  Dr. Brigid Mullany
STANDARDS

Faculty serve as members and experts on national and international standards committees including:
- ASME B46 classification and designation of surface qualities
- ASME B89 dimensional metrology
- ASME Y14 engineering drawing and related documentation practices
- ISO TC172 optics and photonics
- ISO TC213 geometric product specification
- Optics and electro-optics standards council

The William States Lee College of Engineering provides the majority of the near 30,000 square feet of research facilities, including 4,000 square feet of controlled environment for metrology and instrument development. Additional laboratories are designated for Computer Integrated Manufacturing, Machine Dynamics, Sensor Systems, Nanoscale Science and Engineering, Mechatronics, Instrumentation, Precision Surfaces and Large Scale Metrology. Technical staff includes Chief Engineer Jimmie Miller, Chief Metrologist Greg Caskey, and Electronics Technician John Brien.

PAST AND CURRENT PROJECTS

METROLOGY PRACTICES & ALGORITHMS
- 3D structure function of surfaces
- 3D tolerance control
- 5 axis coordinate measuring machine (CMM) uncertainty
- Adaptive sampling techniques
- Characterization of structured surfaces
- CMM contact scanning of edges and corners
- Combined moire-interference metrology
- Environmentally tolerant SWLI characterization
- Error budget software for machine tools
- Freeform metrology
- Laser tracker dynamic performance
- MicroCMM baseline metrology
- Non-axisymmetric artifacts
- Open metrology software
- Rough surface metrology
- Part manufacturing information
- Scanned profile uncertainties
- Spectral imaging metrology
- Tolerance specification consistency
- Vision CMM calibration techniques
- Wavelength shifting interferometry

MACHINE & INSTRUMENTATION DEVELOPMENT
- Compressed sampling microscope
- Computed tomography standards
- Dynamic range extension for optical imaging
- Fast tool servo for diamond turning non-axisymmetric components
- Giant magnetoresistive sensor design
- Grazing incidence metrology
- Instrumentation for crankshaft metrology
- MilliKelvin temperature control
- Nanoprint lithography positioning stage
- Nanometric dilatometer
- Nanoscale hardness instrumentation
- Speckle scales for two dimensions
- Sub-atomic measuring machine
- Vectored touch sensor
- Wavelength stabilization of laser diodes
- Wettability characterization
- Whitelight fiber optic interferometry probe
- X-ray microscope development

MANUFACTURING & MACHINING
- Ceramic machining
- Deformation machining
- Diamond films for manufacturing
- Error correction for freeform machining
- Machine tool geometric error correction
- Metals affordability initiative
- Molecular dynamics of machining
- Process damping in milling
- Subscale machining of large components
- Thermal modeling
- Tool tuning for machining centers
- Tool path modulation characterization
- Vibration assisted diamond turning
- Virtual manufacturing
CENTER RESOURCES INCLUDE THE FOLLOWING:

MANUFACTURING

- ABB IRB140 six axis robot
- AGIE 150 HSS+F wire EDM machine
- AGIE mondo sinking EDM
- Haas OM-2 mill with 30,000 rpm spindle
- Haas TM1 CNC mills
- Haas TL1 CNC lathe
- Makino A55 machining center
- Monarch VMC 45 machining center
- Moore Nanotech 350FG diamond turning machine (DTM)
- NGK 50,000 rpm spindle
- Okuma/GBI Cincinnati CVLC30 revolution lathe
- Precitech Nanoform 350 DTM
- QED Q22-XE Magneto-Rheological finishing (MRF) machine
- Strausbaugh 6DF lap

METROLOGY

- Agilent (Keysight), API, HP, optodyne laser metrology
- API Tracker 3, Faro Ion and Leica AT901 laser trackers
- API and Renishaw telescoping ballbars
- ASL, Hart Scientific, and Lion Precision temperature measurement systems
- Bruker Contour GT-X scanning white light interferometer
- Brown & Sharpe (Hexagon) Gage 2000 CMM (PCDMIS)
- Hart Scientific temperature calibration cells and baths
- Heidenhain KGM grid encoder
- Indigo micro-thermal measurement system
- Leitz PMM 654 CMM (Quindos)
- Leitz PMM-F CMM (Quindos)
- Lion Precision and API spindle analyzers and gages
- Mahr MFU7 form measuring machine
- Manufacturing Laboratories Inc. (MLI) MetalMax and Harmonizer
- Mitutoyo RA 1500 Roundtest roundness measuring instrument
- Nikon MM400 toolmakers microscope
- New River Kinematics Spatial Analyzer
- Somicronic Surfascan 3C
- Taylor-Hobson FormTalySurf and TalyStep profilometers
- Tropel CM 25 cylindrical interferometer
- Veeco Digital Instruments Dimension Metrology AFM
- Zeiss F25 micro CMM (Calypso)
- Zeiss Prismo 7 Navigator CMM (Calypso)
- Zygo NewView 5000 scanning white light interferometer
- Zygo Verfire AT phase-shifting interferometer

The CPM also has access to the cleanroom fabrication and materials analysis recourses of the Center for Optoelectronics and Optical Communications.