

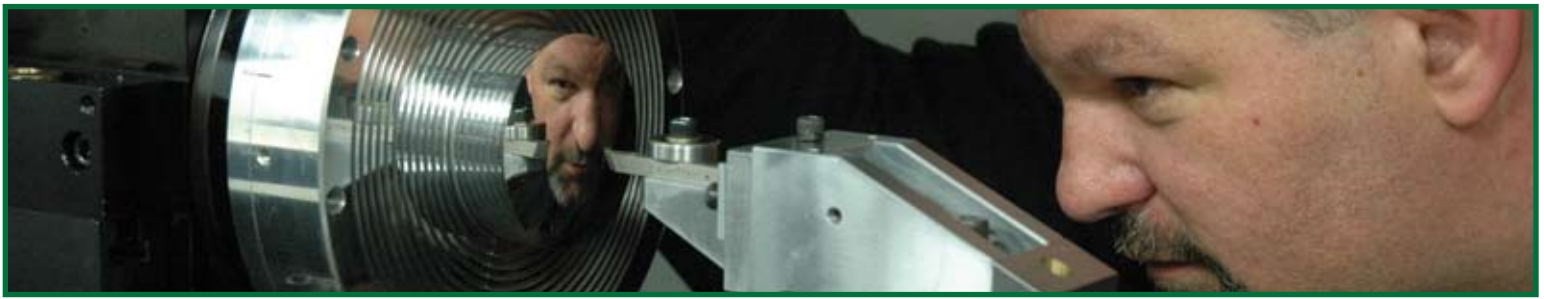
University of North Carolina at Charlotte
Center for Precision Metrology

*Atoms to Aerospace
Sensors to Systems
Science to Standardization
Principle to Practice
Origination to Optimization*



UNCC[®]CHARLOTTE

www.cpm.uncc.edu



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 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.

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 departments within the following colleges:

- **The William States Lee College of Engineering (sponsor college)**
- **College of Liberal Arts and Sciences**
- **College of Computing and Informatics**
- **Belk College of Business**

Center Status & Industrial Affiliates

Originally supported as a National Science Foundation Industry/University Cooperative Research Center (NSF I/UCRC), the Center for Precision Metrology is charged with breaking new ground in precision metrology through addressing real-world industrial concerns. Through the associated Affiliates Program, industrial 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 is solicited for sponsoring fundamental and large-scale metrology projects.

Additionally the Center is partnered with lead university UCLA as an NSF Nanoscale Science and Engineering Center for Scalable and Integrated Nanomanufacturing (SINAM) along with the University of California, Berkeley; Stanford University; University of California, San Diego; and HP labs.

Technical Areas & Faculty Contacts

Metrology Applications and Algorithms

Dr. Edward Morse, Mechanical Engineering
Dr. Jay Raja, Mechanical Engineering
Dr. Robert Wilhelm, Mechanical Engineering

Machine Performance Metrology and Modeling

Dr. Robert Hocken, Mechanical Engineering
Dr. Robert Wilhelm, Mechanical Engineering

Metrology Instrumentation for Nanoscale Science and Engineering

Dr. Robert Hocken, Mechanical Engineering
Dr. Patrick Moyer, Physics and Optical Sciences
Dr. Stuart Smith, Mechanical Engineering
Dr. Quiming Wei, Mechanical Engineering
Dr. Terry Xu, Mechanical Engineering

Manufacturing Process Modeling

Dr. Harish Cherukuri, Mechanical Engineering
Dr. Russ Keanini, Mechanical Engineering
Dr. Scott Smith, Mechanical Engineering

Machine Dynamics and High-Speed Machining

Dr. Matt Davies, Mechanical Engineering
Dr. Scott Smith, Mechanical Engineering

Computer-Aided Tolerancing and Factory Control

Dr. Edward Morse, Mechanical Engineering
Dr. Robert Wilhelm, Mechanical Engineering

Precision Optical-Electrical-Mechanical Systems

Dr. Jim Cuttino, Mechanical Engineering
Dr. Angela Davies, Physics and Optical Sciences
Dr. Famarz Farahi, Physics and Optical Sciences
Dr. Mike Fiddy, Physics and Optical Sciences
Dr. Robert Hocken, Mechanical Engineering
Dr. Kevin Lawton, Mechanical Engineering
Dr. Patrick Moyer, Physics and Optical Sciences
Dr. Steve Patterson, Mechanical Engineering
Dr. Yasin Raja, Physics and Optical Sciences
Dr. Stuart Smith, Mechanical Engineering

Precision Surfaces

Dr. Brigid Mullany, Mechanical Engineering

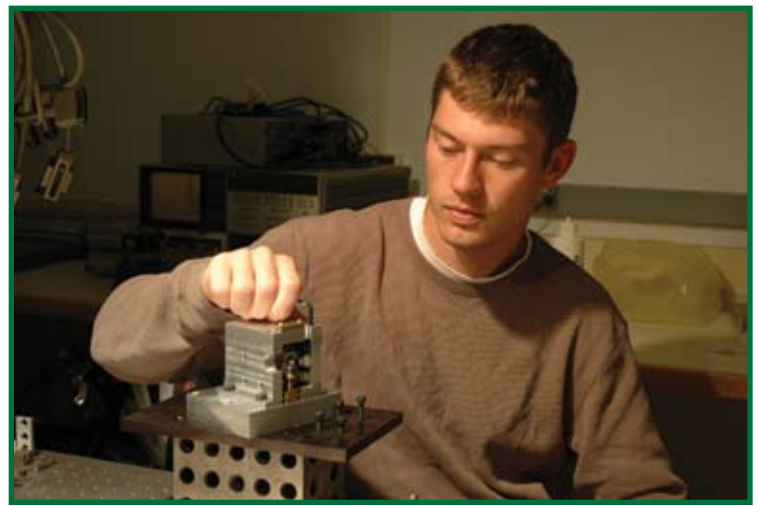
Past and Current Projects

Metrology Practices & Algorithms

- 3-D Tolerance Control
- 5 Axis CMM Uncertainty
- Adaptive Sampling Techniques
- Characterization of Structured Surfaces
- CMM Contact Scanning of Edges and Corners
- Internet-Based Metrology
- Kite Square
- Non-Axisymmetric Artifacts
- Open Metrology Software
- Post-Process Metrology Research
- Scanning CMM Capabilities and Calibration Techniques
- Tolerance Specification Consistency
- Vision CMM Calibration Techniques
- Wavelength Shifting Interferometry

Machine & Instrumentation Development

- Enabling Technology for Extreme UV Optics Measuring Machine
- Fast Tool Servo for Diamond Turning Non-Axisymmetric Components
- Giant Magnetoresistive Sensor Design
- Grazing Incidence Metrology
- High-Speed Optical Metrology
- Instrumentation for Crankshaft Metrology
- MilliKelvin Temperature Control
- Nanoimprint Lithography Positioning Stage
- Nanometric Cutting
- Nanometric Dilatometer
- Nanoscale Hardness Instrumentation
- Small Hole Profilometry
- Sub-Atomic Measuring Machine
- Vectored Touch Sensor
- Wavelength Stabilization of Laser Diodes
- Whitelight Fiber Optic Interferometry Probe



Manufacturing & Machining

- Ceramic Machining
- Deformation Machining
- Diamond Films for Manufacturing
- Fiducial Manufacturing Uncertainty Analysis
- High-Speed Machining
- Machine Tool Accuracy Initiative
- Machine Tool Geometric Error Correction
- Metals Affordability Initiative
- Molecular Dynamics of Machining
- Thermal Modeling
- Tool Tuning for Machining Centers
- Vibration Assisted Diamond Turning
- Virtual Manufacturing

Standards

Faculty serve as members and experts on national and international standards committees including:

- ASME B5 Machine Tools - Components, Elements, Performance and Equipment
- ASME B46 Classification and Designation of Surface Qualities
- ASME B89 Dimensional Metrology
- ASME Y14 Engineering Drawing and Related Documentation Practices
- ISO TC213 Geometric Product Specification



Facilities

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 Computer-Aided Design. Technical staff includes Chief Engineer Jimmie Miller, Chief Metrologist Greg Caskey, Electronics Technician John Brien, Master Machinist Roland Hege and CNC Machinist Brian Dutterer.



Center Contact Information

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UNC Charlotte is an equal-opportunity institution. One-thousand five-hundred copies of this brochure were printed at a cost of \$700.

Center laboratories contain the following equipment:

Computational

- ICAMP, Origin, ACIS and SILMA Software
- High-Performance Sun and Dell Workstations
- SGI Extreme Graphics, PCs, Network Servers

Manufacturing

- ABB IRB140 Six Axis Robot
- AGIE 150 HSS+F Wire Electrodischarge Machine (EDM)
- AGIE Mondo Sinking EDM
- BPM 3-D Modeler
- Cincinnati Maxim 500 Machining Center
- Haas TM1 CNC Mills
- Haas TL1 CNC Lathe
- Hardinge XCL CNC Lathe
- Makino A55 Machining Center
- Monarch VMC 45 Machining Center
- Moore 350 FG Nanotech DTM
- Precitech Nanoform 350 Diamond Turning Machine
- Strausbaugh 66DF Lap
- Tschudin, Mitsui Seiki Grinders

Metrology

- API and Renishaw Telescoping Ballbars
- ASL, Hart Scientific, Keithley Temperature Measurement Systems
- Brown & Sharpe XCEL 765 CMM
- Hart Scientific Temperature Calibration Cells and Baths
- Indigo Micro-Thermal Measurement System
- Leitz PMM 654 CMM
- Lion Precision Machine Tool Spindle Analyzer and Gages
- Mahr MFU7 Form Measuring Machine
- Mahr-Perthen Perthometer PRK Surface Profilometer
- Manufacturing Laboratories Inc. (MLI) MetalMax System and Harmonizer
- Mitutoyo RA 1500 Roundtest Roundness Measuring Instrument
- Renishaw, HP and Optodyne Laser Metrology Systems
- Somicronic Surfscan 3C
- Starrett CMM
- Taylor-Hobson FormTalySurf and TalyStep Profilometers
- Tropel CM 25 Cylindrical Interferometer
- Veeco Digital Instruments Dimension Metrology AFM
- Veeco Wyko RST Scanning White Light Interferometer
- View Engineering Voyager 12x12 Vision CMM
- Werth Inspector 250/400 Vision/Contact CMM
- Zygo Axiom Interferometer Specialized High Speed Metrology System
- Zygo Mark IV Flatness Interferometer
- Zygo Maxim 3-D Surface Interferometer
- Zygo NewView 5000 Scanning White Light Interferometer