Tdm-5 | Wednesday, February 26 | 8:00 AM - 5:00 PM | 1-Day (8 hours)

Course Description: Precision Metrology Using Coordinate Measuring Machines

Instructor: John Stoup, National Institute of Standards and Technology (NIST)

Course Description: This tutorial will introduce the attendees to NMI level CMM dimensional metrology. It will identify and describe the most important issues that affect CMM measurement results including laboratory environment, basic instrument design and error mapping, artifact fixturing and limitations, and proper probe mastering techniques. How we progress through task-specific measurement decisions and protocol designs will be reviewed, discussed, and analyzed using NIST client examples. We will discuss how to plan your CMM measurement efforts including probe choices, mounting and alignment concerns, data collection methods, and simple data analysis. We will discuss statistical process control and how to apply proper techniques to build confidence in the measurement results. The differences between long term reproducibility, short term reproducibility, and repeatability will be presented along with how each of them can be developed in real measurement situations to generate useful data for uncertainty estimates and to help identify the weakest links in your metrology lab and equipment. For complicated, flexible 3D instruments like CMM’s, knowing what is important, why it’s important, and when it’s important will help CMM operators of all skill levels become better metrologists and improve performance. We will study task specific uncertainty budgets, how to develop the error component estimates, and where the data comes from. Although these techniques are tuned for the NIST M48 CMM design, the general concepts and methods are universal to any CMM. It is important to note that this tutorial WILL NOT teach specific programming language or how to use CMM software due to the wide variety of OEM-specific systems available.

Learning Objectives:

1. Application of CMM - based dimensional metrology techniques.
2. Calculation of CMM - based uncertainty components.
3. Understanding artifact effects and how to resolve them.
4. Recognizing the differences between precision and accuracy limitations.

Instructor Biography: His career as a dimensional metrologist and engineer at NIST began in 1988 with gauge block mechanical comparisons, short gauge block interferometry, angle metrology, diameter and flatness interferometry, and complex form characterization. John continued his metrology experience in the areas of dimensional measurement systems, and uncertainty budget development for nearly every type of dimensional artifact including gauge blocks, diameter standards of all types, roundness and flatness, angle, CMM assessment gauges, and many others over the next 10 years of laboratory efforts.

For the last 20 years, John has been the primary metrologist for the state of the art NIST Moore M48 CMM’s. He has participated in over ten BIPM sponsored key international intercomparisons and has piloted both BIPM sponsored global key comparisons of diameter. He designed and built a unique laser micrometer for external diameter measurement with state of the art capability and has measured hundreds of different types of dimensional gauges including a recent collection of over 30 components for the new James Webb Space Telescope. Stoup is a NVLAP technical assessor and has performed international NVLAP assessments, including CMM measurement capability. He has performed internal quality assessments at NIST and peer technical assessments at other NMI’s.