Micro/Nano Seminar Series
Hosted by
Dr. Balaji Panchapakesan
Mechanical Engineering Dept.

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Three Dimensional Surface Profilometry Employing Standing Wave Probes For MEMS and Nanoscale Metrology

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Abstract: In general, measurement of microscale components continues to remain a challenging problem using current state of the art micro-tools. For example to measure small features such as holes, pins or channels; AFM, SPM, or SEM are frequently used. However, these tools are more applicable for surface finish measurement and lack the ability to make dimensional measurements on high aspect ratio features. On the other hand, conventional coordinate metrology devices are designed to only measure the form of parts and not surface finish. As a result, various new microscale probing systems have been developed over the past few years for the metrology industry. Nonetheless, challenging problems remain such as adhesion interaction between the probe tip and measured surface, inherent scaling issues and lack of ability to perform uninterrupted scanning. Additionally, none of these devices enable true 3D surface profiling which is the ability to simultaneously measure surface finish and form of the part. Applications in the optical and medical industries perform independent quality control using both surface finish and form techniques. Moreover, an instrument enabling both techniques would yield greater benefits in QC and automation lines.

This talk will present some of the recent efforts at InsituTec novel metrology instrument with the ability to measure both surface finish and form of microscale parts. In general, the measurement technique utilizes a novel microscale tactile sensor referred to as a standing wave probe. The probe is designed with a high aspect ratio (700:1), nominal diameter of 7 μm and precision force sensing less than 1 μN. The probe is retrofitted to a high speed nanopositioning system with multi-axis control. As a result of the probe's small contact radii and high bandwidth response, the instrument is able to scan along a surface of a microscale part and monitor both the form and surface finish. This novel measurement technique is referred to as three dimensional surface profiling. This presentation will address principle of operation and modeling using the standing wave probes. Additionally, experimental data of microscale parts will be discussing on 3D surface profiling.

Biosketch: Dr. Shane Woody co-founded InsituTec Inc. in 2001 while completing his MSc (2001) and PhD (2005) degrees in Mechanical Engineering at UNC Charlotte's Center for Precision Metrology. Dr. Woody has received numerous awards and grants such as being named one of Charlotte's top 40 young entrepreneurs in 2007, recipient of business development grant from North Carolina's ScienceBoard and Technology, and an NCIDEA grant. He is also the recipient of numerous innovation research grants such as Lemelson's Foundation's National Collegiate Inventors Award and NASA's prestigious graduate research award. Some of his research activities include mechatronics, high speed sensors and actuators, quantitative analysis of nonlinear dynamic systems, flexure designs and multi-coordinate gauge head design. Dr. Woody's research interests range from microsensing development to microscale pick and place to in-process instrumentation integration to gauge head design. These efforts have accumulated 2 Patents, and 8 Pending patents.