STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

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Carnegie Room 315, Time 1:30 pm

Enhancing the Sensitivity of MEMS/NEMS Sensors with Sophisticated Algorithms

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Over the past two decades, significant advances have been made in the sophistication and diversity of Micro and Nano Electro Mechanical Systems (MEMS/NEMS). MEMS/NEMS offer significant advantages in terms of ultra-low mass, size and power consumption coupled with the high-volume, mass-manufacturing capabilities established by the silicon integrated circuit industry. Thanks to these advances, advanced sensor networks composed of massively parallel arrangements of MEMS/NEMS devices can now be realized.

Unfortunately, there is a major problem with the above rosy scenario – namely, poor sensitivity or signal-to-noise ratio (SNR) for MEMS/NEMS devices. A primary reason for MEMS/NEMS devices not yet achieving juggernaut status within the sensor world is the fact that the SNR decreases significantly with size. One way to mitigate the effect of SNR reduction is to employ advanced signal processing techniques that match the hardware sophistication of MEMS/NEMS devices. This talk will describe such a novel counter-intuitive algorithmic approach toward improving sensor performance. Within this approach, named Active Signal Processing, instead of removing system noise by filtering processes (Passive Signal Processing), it is possible to improve SNR by injecting noise into the measurement. ViaLogy has pioneered the development and demonstration of Quantum Resonance Interferometry (QRI), a quantum stochastic resonance (QSR)-based technique for improving SNR. The core of QRI processing involves the QSR-based generation of a Quantum Expressor Function (QEF), which characterizes the system of interest by encoding within it the noise environment, minimum level of detection, and the precision of measurement. Using digital post-processing of sensor information, QRI can detect and quantify the presence of a signal by the destruction of the resonance condition responsible for generating the system QEF. An example of the application of QRI to improve the SNR for microfabricated DNA Microarrays will be described.

Dr. Thomas George is currently the Director of Product Development, at ViaLogy LLC, where he is responsible for developing new applications and hardware implementations for ViaLogy's patented signal processing algorithms for weak signal detection, as well as exploring opportunities for sensor fusion and IP-based sensor interoperability for advanced MEMS and NEMS devices. Prior to joining ViaLogy, Dr. George was the manager of the MEMS Technology Group at NASA/JPL. In this position, he created and managed a multi disciplinary group consisting of 22 researchers working on the development of diverse MEMS/NEMS technologies for NASA applications. The group pursued end-to-end development from concepts to implementation in space missions. R&D efforts were directed towards effectively exploiting new phenomena at micro- and nano-scales in order to create novel sensors and actuators. Dr. George has a PhD in Materials Science Engineering from UC Berkeley and has co-authored over 100 publications and 8 issued patents.

For more information, please contact Prof. Frank Fisher at Frank.Fisher@stevens.edu or 201-216-8913