

MEMS-Based Systems Solutions Emerge For Analytical Instruments

MEMS-based systems solutions (MBSS) integrate microelectromechanical-systems (MEMS) front ends including sensors, actuators, and/or structures with signal processing vis-à-vis ASIC, embedded software in the microprocessor-based ASIC, energy management/storage, and network connectivity. All of these components are interconnected and housed in a package.

The concept is based on systems engineering, co-design principles, and design for manufacturing and test. It is driven by the need to vertically integrate the recently commoditized MEMS front-end devices and to provide a total solution to the end user while simultaneously providing product differentiation and higher gross margins to the supplier. The promised concept of “thinking outside the chip” should create a “win-win” solution for MEMS-based system providers and users alike for a broad range of applications.

Analytical instruments offer a great opportunity for MEMS-based systems solutions. MEMS devices are ideal for handheld and portable/field-usable instruments since they are small and robust, requiring little power for a low cost while offering surprisingly high performance. These instruments are finding their way into a broad assortment of applications for solid, liquid, and gas analysis including environmental monitoring, process control quality assurance, homeland security, and defense.

Strategic Directions International (SDI) has estimated the total worldwide and analytical and life sciences market to be approximately \$35 billion in 2008 with a compounded annual growth rate of 5% to 6%. The majority of this market is for “benchtop” laboratory instruments with the portable and handheld market expecting to grow at double-digit rates over the next five years.

APPLICATION EXAMPLES

Thermo-Fisher Scientific has developed a unique near-infrared (NIR) optical spectrometer “engine” using Sandia National Laboratories’ MEMS SUMMiT process. The handheld microPhazir can measure liquids and solids and costs approximately \$17,000. Applications include hazardous materials analysis, asbestos analysis, counterfeit materials analysis, narcotics analysis, and process quality control.

Fraunhofer ENAS has developed two spectrometers, a MEMS MIR/NIR and a Fabry-Perot. The MIR/NIR, developed in conjunction with TQ Systems, is based on micro-mirror developments at the Center for Microtechnologies of the Chemnitz University of Technology. Key features include fast and efficient measurement, compact and portable design, shock resistance, and light weight. It can be used for different environmental monitoring gas and liquid measurements. The Fabry-Perot system was developed in conjunction with InfraTec GmbH monitors and analyzes liquids and gases. This novel filter is tunable on different wavelengths from 3 to 5 μm and is part of an infrared detector that analyzes gases and gas mixtures due to their absorption characteristics.

The University of Michigan Wireless Integrated Microsystems and Sensors (WIMSS) Center has for well over 10 years undertaken major research efforts on μGCs that integrate numerous other functions of an instrument into a total analytical instrument solution. Its approach is to meet the emerging needs of in-field measurements through the development of long-term, unattended operation in the field with

drastically reduced cost and power, using no consumables and running on energy scavenged from the environment through a wireless-based system.



WHAT'S NEXT?

MEMS by their inherent nature lend themselves favorably to these types of applications because of their robust nature, small size, low cost, and low power consumption. Much of the research that is being conducted at leading research institutes will result in many new products that will increase the quality of life of the world's population.

As these systems become more mature, their resulting reduced cost will enable adoption into mobile phones and other low-cost consumer applications, making them and their diagnostic data affordable and accessible to a large sector of our population, especially in under-developed nations—truly an exciting concept.

Want to know more? Roger Grace has organized and will present and chair the March 21-22, 2012 session “Smart Systems Integration in the USA: Technologies and Applications” at the Smart Systems Integration Conference 2012, March 20-22, in Zurich, Switzerland (www.mesago.de/en/ssi/home.htm). 

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