

Reinventing the Wheel



 **smalltimes**
BIG NEWS IN SMALL TECH.

Steve Crosby, publisher

**Geography of Auto Production –
Will Detroit Continue to be the Industry's Hub?**
Federal Reserve Bank of Chicago/Detroit Branch
November 3, 2003

Positioning for tomorrow

- Economic evolution
- Anticipate, create the future
- Build on regional strengths
- Go with synergies

Small Tech: Why Size Matters

- **Microsystems**
 - 1 millionth of a meter
 - Feature size and fabrication process similar to IC
 - Ink jet printer heads, auto sensors, airbag accelerometers
- **Nanotechnology**
 - 1 billionth of a meter
 - Feature size and fabrication process similar to nature
 - Sunscreen, catalysts, coatings
 - Future: Drugs, electronics, power

Small Tech synergies

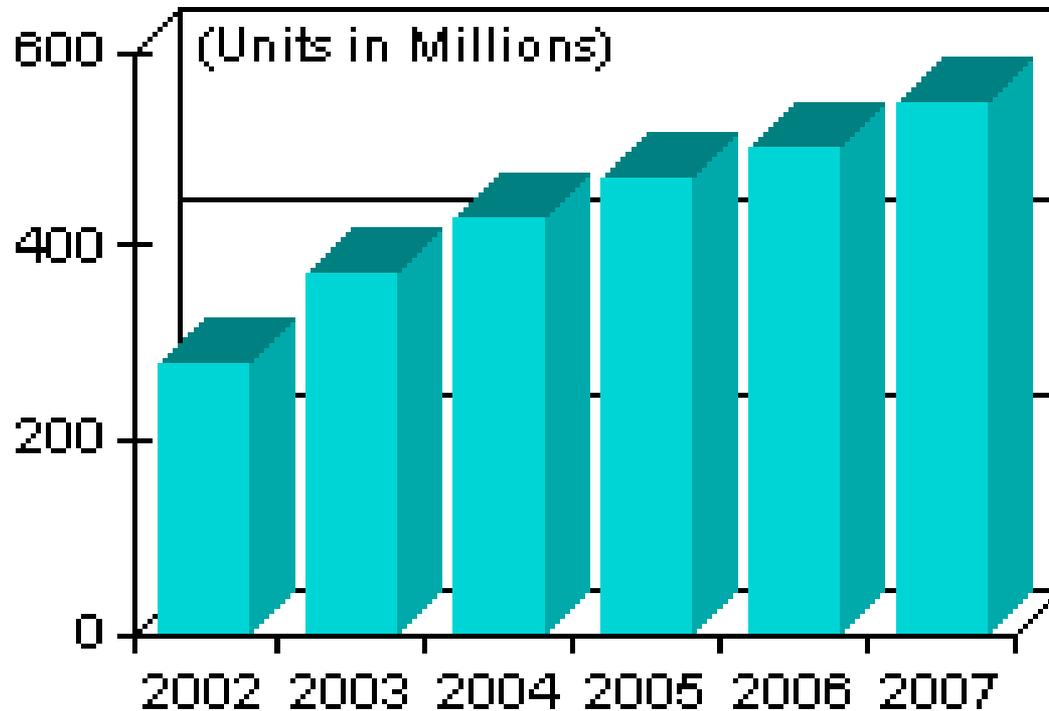
- **Life Sciences:** Next-generation drug delivery, prosthetics, new drugs
- **Energy:** Cleaner fuels today, fuel cells tomorrow
- **Homeland Defense:** Sensors for air, water, airport security

Small Tech is Here Today

- Nanomaterials (U.S.) \$200m in 2002, \$1b by 2007, \$4.5b by 2012*
- MEMS (U.S) \$3.9b in 2002, \$8.3b in 2007**
- 42 small tech companies in MI, most related to auto industry
- Auto industry is biggest user of MEMS

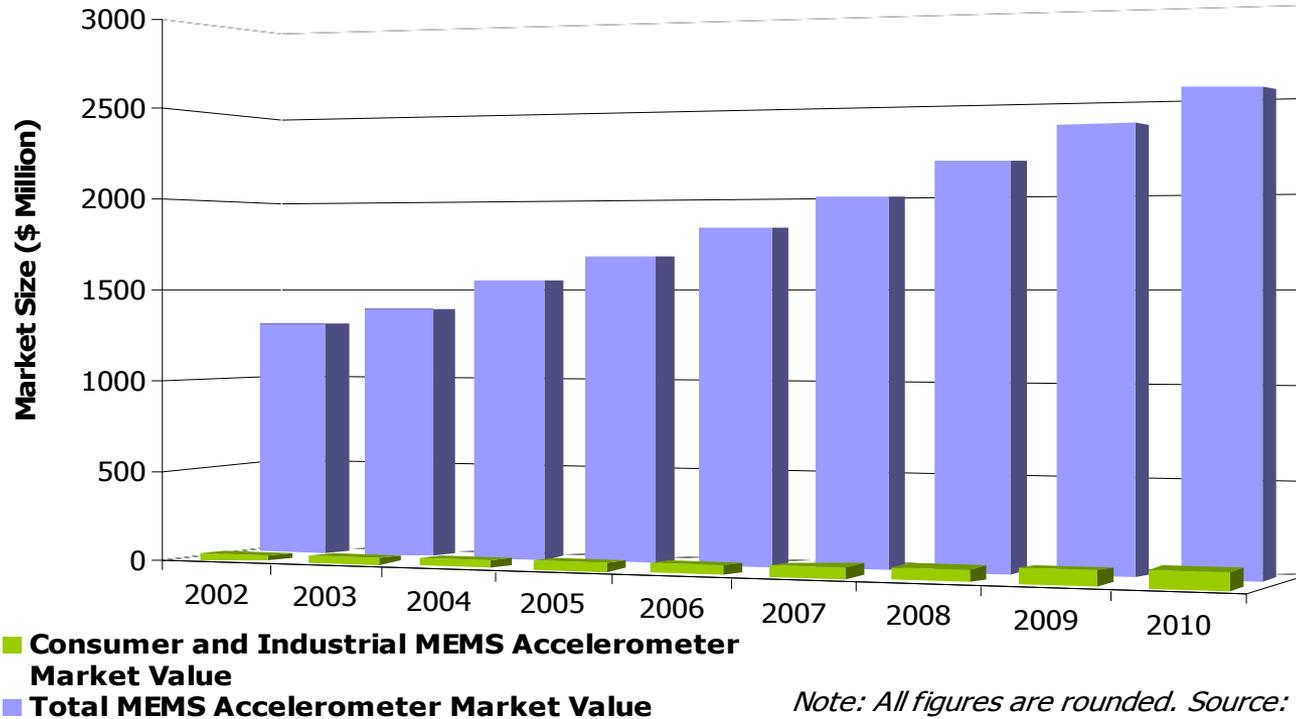
Sources: * The Freedonia Group **In-Stat/MDR

MEMS Unit Shipments in the Automotive Industry



Source: *In-Stat/MOR* 1/03

Total MEMS Accelerometer Market: Product Realisation Out of Total Market Potential (World), 2002-2010



Existing Auto Applications



After tire pressure, rollover sensing is next: A Volvo XC90 takes a tumble in a company crash test. The new SUV comes equipped with a roll stability control system that uses gyros to sense imminent rollover and, if necessary, activate stability and traction control systems. If a rollover does occur, the system pre-activates inflatable safety curtains and tightens up the seat belts.

Existing Auto Applications



The 2003 Mercedes-Benz S-Class sedan's PRE-SAFE system senses emergency braking or skidding to tighten seat belts before a crash. It also adjusts the front and rear seat positions when an accident threatens by, for example, moving reclined seats to a vertical position. In the event of an imminent rollover, the system closes the sunroof.

Existing Auto Applications



The 2003 Ford Taurus telematics and safety concept car uses sensors to determine the seating position of the driver and passengers before it activates the passive seat-belt restraint system in response to crash and pre-crash sensors.

What is it?

Small tech is at work just about everywhere in today's automobiles, from detecting rollovers to monitoring fuel pressure.

MEMS sensors are primarily used to monitor and control engines, along with performing other safety and chassis control duties. Hexacore materials reinforce panels and other body parts as well as a flexible buildup of static electricity in fuel lines.

Demand is growing fast for applications that monitor safety and control chassis. Strategy Analytics Inc., a technology research firm, predicts sales of automotive accelerometers will rise 23.6 percent (compared average annual growth rate) from 2006 to 2010 and unit demand will grow from 79 million to 202 million units.

Accelerometers are typically used to deploy air bags, detect rollovers and monitor tire pressure. But it's not enough for these systems to merely sense what's going on; they also need to relay that information. So, they're commonly combined with microprocessors and transmitters.

In fact, these microsystems are integrated into intelligent automotive systems that can respond to a variety of stimuli. For example, a dynamic chassis system simultaneously collects information about wheel speed, steering wheel position, engine torque, braking and overall vehicle movements to appropriately adjust the hardness of the car's shock absorbers.

Research by Intel from
Illustration by Ben Hovley

Automotive Applications

This integrated microsystem from Bosch, at right, recognizes when a vehicle is likely to roll over and sends information to the car's stability control system. It can also trigger seat-belt tighteners and deploy certain air bags, which roll down from the sides and protect occupants' heads.



Highly sensitive accelerometers like this one from Analog Devices, which can detect when a car is moved, are used in vehicle security systems.

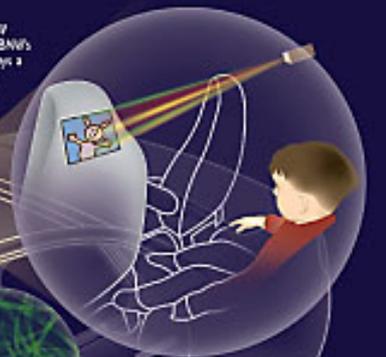
The microcontacted silicon resonated absolute pressure sensor (Bosch sensor pictured below) was the first automotive application to use small tech in the late 1970s. Nitrofilm pressure is used to calculate how much fuel to inject into the engine cylinders.



Delphi's oil condition sensor detects contamination, reaction temperature and determines oil level.



Small tech can also keep passengers entertained. Altronix and BMW have collaborated on a prototype rear-seat entertainment system for BMW's 7 Series sedan using Altronix's light scanning engine, which employs a MEMS mirror to create moving images. Altronix is using the same technology to develop unobtrusive dashboard displays that put information closer to the driver's field of vision.



Multiwall carbon nanotubes from Hovonan Catalysts International LLC have been used to reinforce side-impact error crumple and shell body panels and are also an additive in nylon fuel lines, fittings and fuel filter housings where they prevent static electricity buildup.

Accelerometers like this one from Sensonor are now the standard way in which automobile air bag systems detect a crash.

Sensonor's tire pressure sensor attaches to the valve stem and is mounted inside the tire. It communicates with an onboard computer using a sophisticated wireless network.

An active wheel speed sensor like this Delphi model is part of the vehicle's anti-lock braking system (ABS). It can be used to indirectly monitor tire pressure by detecting differences in the rotational speed of individual wheels.



Michigan's Strengths

- MEMS: U-M one of top two in U.S.; Wayne State has Delphi lab
- Nano: Cutting-edge research at U-M, MSU, CMU and others; Donald Tomalia is a world pioneer in dendrimers
- Strong tech transfer and VC investments



Recommendations

- Position Michigan to become world leader in small tech auto applications
- Industry and state support for university research, commercial startups
- Exploit synergies with life sciences, energy, homeland defense