What is Next for MEMS
Actually, it’s Actuators!

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Sensing and Actuating
Complementary Phenomena

Feel

See

Hear

Sense

Actuate

Move

Project

Make sound
Sensing and Actuating
MEMS act in both directions

Physical change

Sensors

Signal

MEMS

Micro-actuators

Motion

Environmental

Audio

Electro

Mechanical

Fluidic Micro-actuators

Piezo actuators

Micro Mirrors
MEMS Competitive Landscape
ST offering vs Competition

ST is the only company to offer the full range of Sensors & Micro-actuators
10 Years of MEMS Sensors and Actuators

ACCELEROMETER
GYROSCOPE
INERTIAL MODULE
PRESSURE SENSOR
MICROPHONES
UV SENSOR
HUMIDITY SENSOR

2000
2005
2008
2010
2012
2013
2014
2015

FLUIDIC MICRO-ACTUATORS
PIEZO ACTUATORS
MICRO MIRRORS

ST Innovations
A Complete Offering

Mobile & Consumer
- Leading supplier of MEMS for mobile and consumer applications

New markets
- Fitness & Wearable
- The Internet of Things

Automotive
- Addressing the market for assisted guidance, personal safety & comfort
Motion MEMS
Continued Innovation

>5 Billion motion MEMS shipped to date

Renewal of product portfolio/continuing to lead innovation

- Launched new industry leading 6-axis sensor
- 3rd generation Gyroscope for Optical Image Stabilization <5mm², thickness <0.75mm

"This is the first time that we see a true 6X sensor in an Apple product that doesn’t require an external accelerometer." Chipworks
Microphones

• More than 500 million MEMS microphones shipped
  Market share from <2% in 2012 to 10% in 2014
• Focus on High Performance Microphones
  • Always-on feature
  • Audio fidelity required by Social Media
• Proliferation of analog and digital microphones
designs across the customer base in mobile and PC
Environmental Sensors

Pressure

- More than 300 million Pressure sensors shipped
- Introduced world’s smallest pressure sensor in tiny package (2x2x0.76mm)
- Applications
  - Altimeter
  - Indoor navigation
  - Weather station

UV sensor

- Introduced and ramped the world’s first sensor to provide a direct digital output of the Ultraviolet Index (UVI)

Humidity & Temperature

- Combined temperature & humidity sensor in production
FingerTip™ Touch-screen Controller

- Strong growth with touchscreen controllers
- High-profile wins beating out competition in some of the most demanding smartphones
- Winning value proposition
  - Very good high-end analog performance
  - Very low power consumption
  - High flexibility of solution and fast time to market
- FingerTip technology well positioned to address wearable, security and active pen applications

First to deliver a touchscreen controller for a curved smartphone display
Product & Market Strategy

New products for traditional markets

New products for new markets

Traditional products for traditional markets

Traditional products in new markets for ST

New Markets
Micro-machined device able to move a tiny object, either liquid or solid, with relatively small force and along a small distance.

Convert an electric current into a mechanical output causing the displacement or rotation of a mechanical structure.

The MEMS actuators use different transduction schemes for their operation:
- Piezoelectric
- Electrostatic
- Thermal
- Electromagnetic
The mechanical structures of MEMS micro-actuators are built on the **same principles** and using the **same basis processes** as MEMS sensors.

MEMS sensors have **specialized analog** signal processing parts.

MEMS micro-actuators have **specialized analog** and **power management** parts (since higher voltages required for some applications).
What can we do with MEMS micro-actuators?

- **Piezo-Electric**
  - Camera autofocus
  - Inkjet print head

- **Electro-Static**
  - Micro-mirrors
  - Touchless UI
  - Ultra-mobile projection

- **Thermal**
  - Inkjet print head
  - Microfluidic MEMS

- **Electro-Magnetic**
  - Micro-mirrors
  - Touchless UI
  - Ultra-mobile projection
Micro-actuators using Piezo-electric

**Camera Auto-focus**

- **Lower power consumption** and **higher speed** versus Voice-Coil Motor (VCM) based solution
- Announced commercialization of Thin-film Piezo Partnership with **innovative lens maker PoLight** for autofocus actuator in smart phones

**Printing**

- **High-speed** inkjet print head for commercial and industrial applications
- Enables printing with **high-viscosity materials**
- **Adaptable** to different printing materials
Optical Micro-actuators for Projection

HUD
Drivers Information

Image Projection
Extending Mobile Displays

HMD
Wearable Devices
Micro-mirrors for Scanning

Intel RealSense™ Depth Camera

8 Products already on the market

(Some) Applications Examples

- 3D Scanning for 3D Printing
- Accurate Gesture Control for Immersive Gaming
- Face Recognition
- Object Avoidance in autonomous devices

JewelPUMP™ for Insulin

Nanopump developed by Debiotech with ST for diabetes management

Easy to use. Personalized

Source: www.jewelpump.com
So what will the next 10 years bring?
Thank you