

MEMS

Ultrasonic Sensors

Richard Przybyla, Hao-Yen Tang, Stefon Shelton[†],
Prof. David Horsley[†], and Prof. Bernhard Boser
University of California, Berkeley & [†]Davis

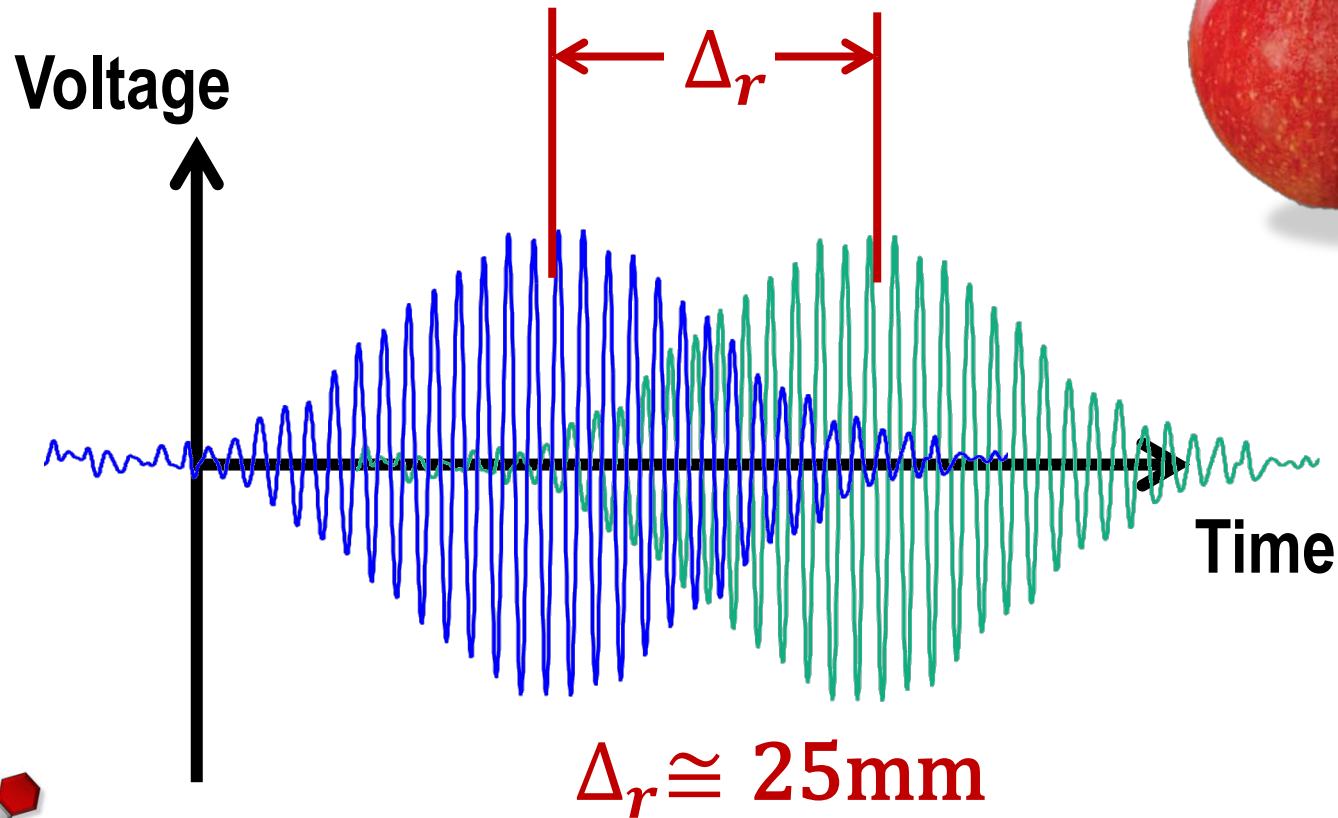
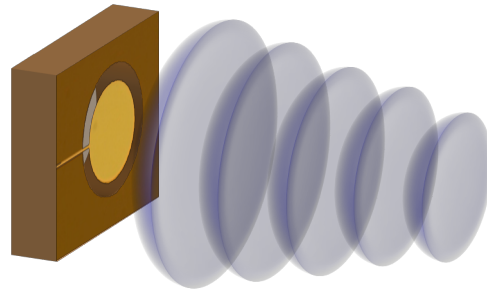




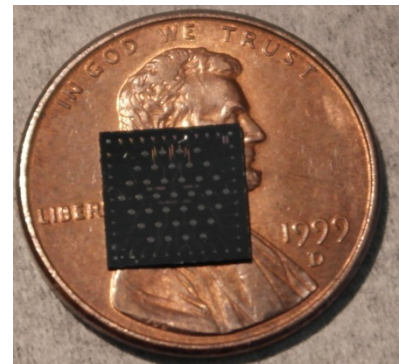
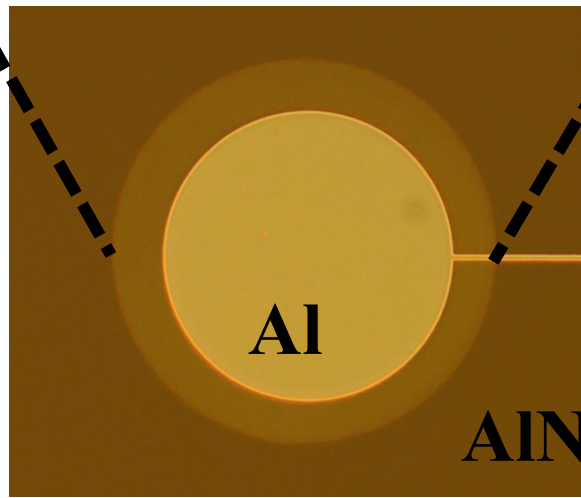
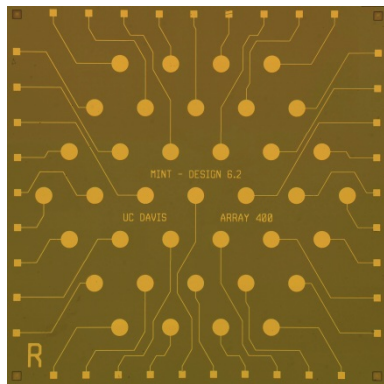
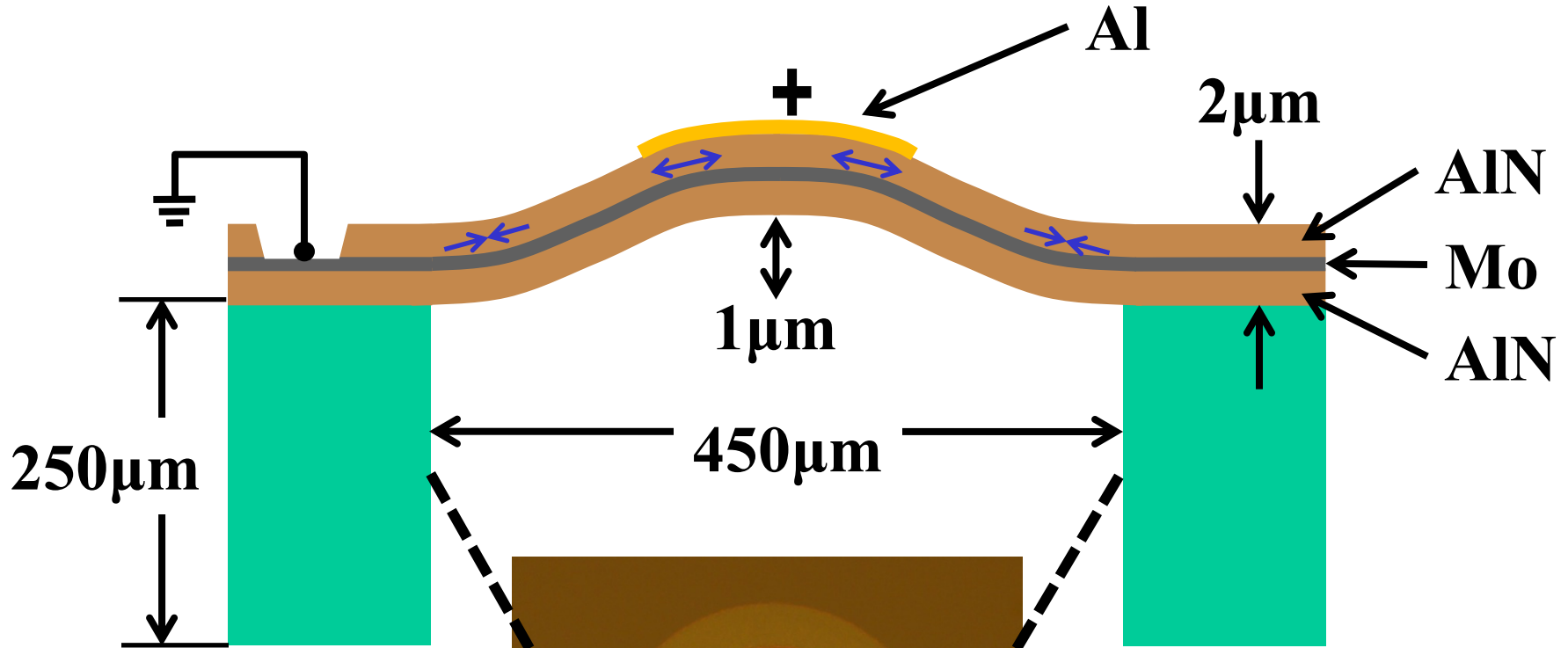
Uses ultrasound to navigate
Identifies insects from wing velocity
Targets mosquitoes from 80 cm away

[D.R. Griffin, J. Animal Behaviour, 1960]

Range Resolution

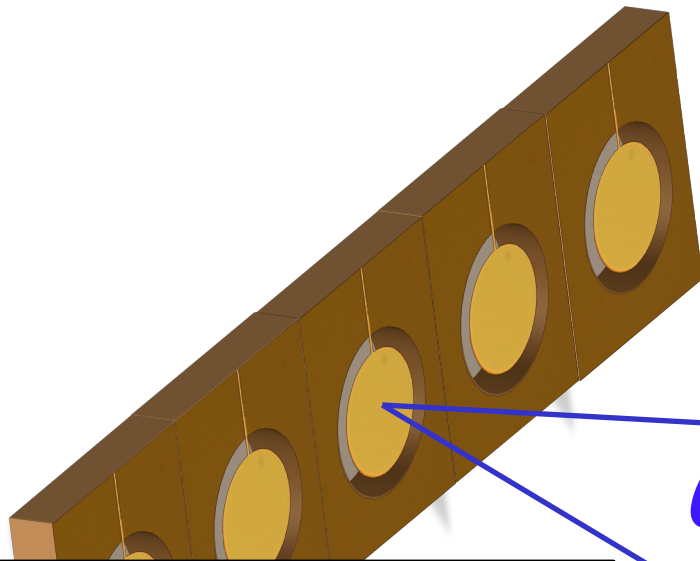


AlN pMUT Operation

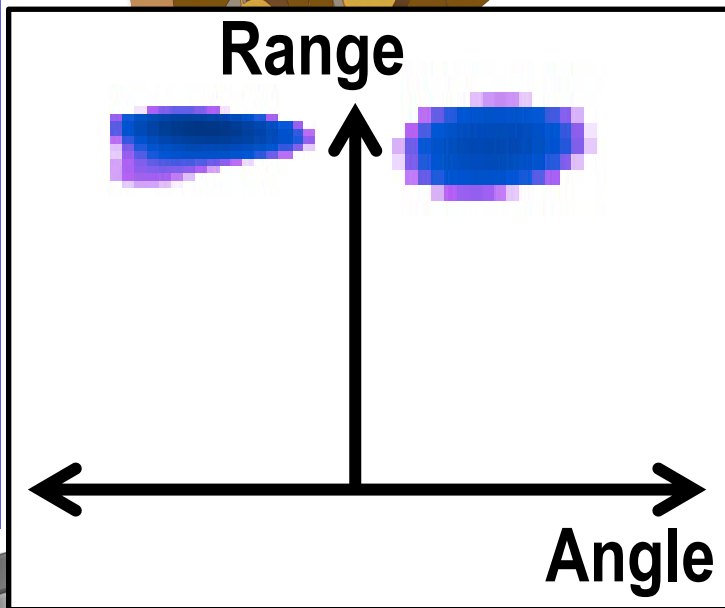
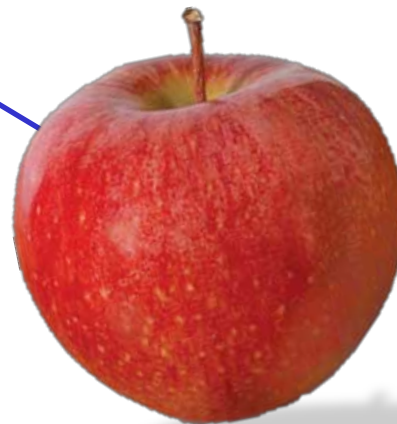
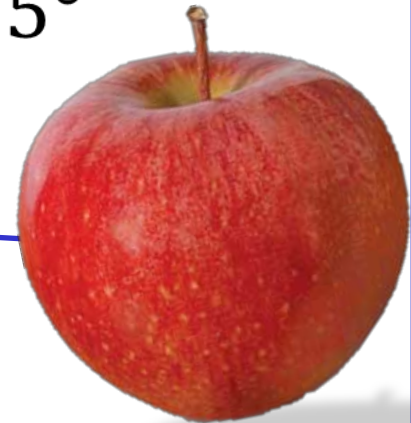


Angle Measurement

$$\theta_b \cong \frac{2.78\lambda}{N\pi d}$$
$$\cong \frac{51^\circ}{A} \cong 15^\circ$$



θ



Medical Ultrasonography

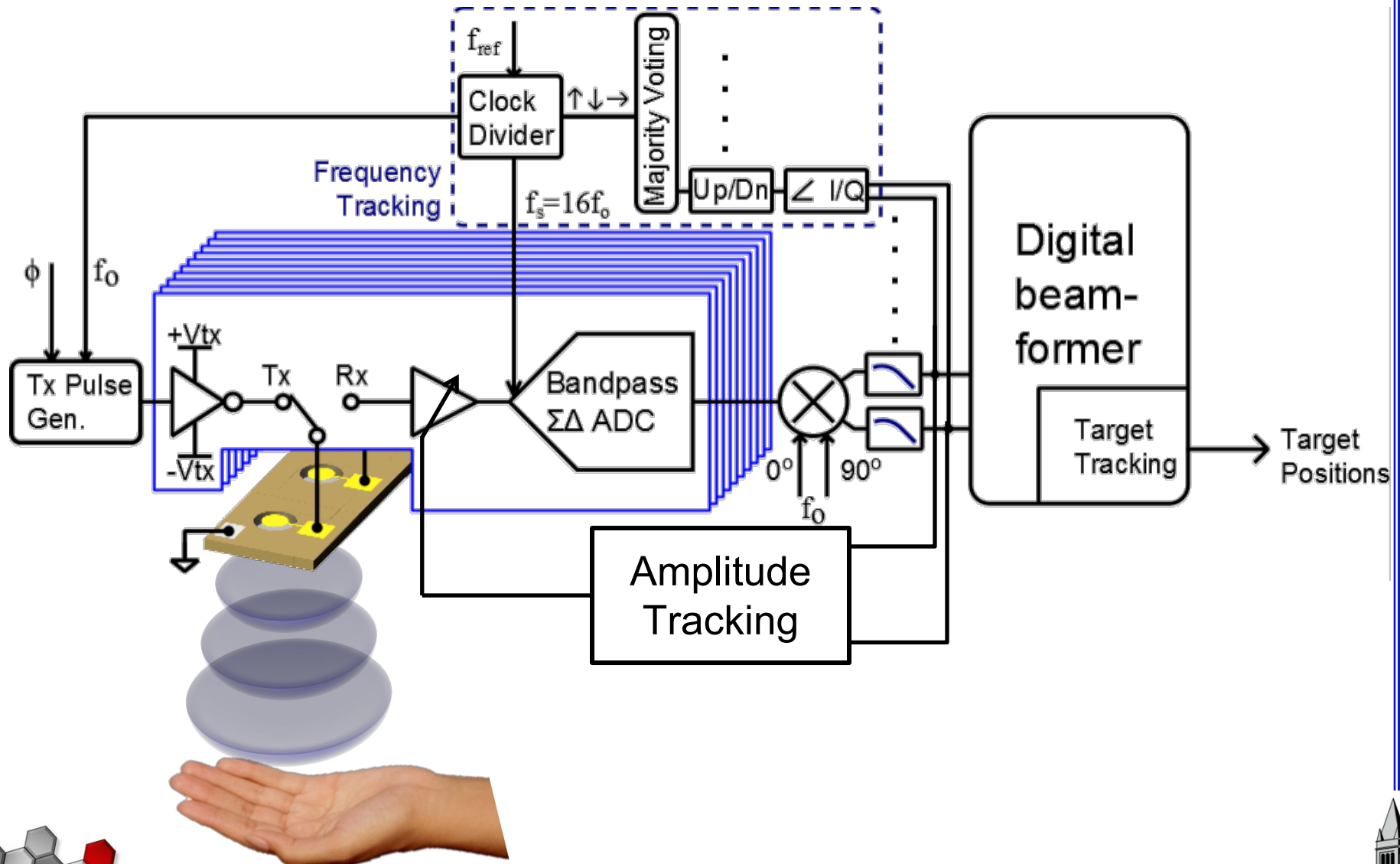


~5cm \cong 160 λ

Good resolution
possible because of
large transducer

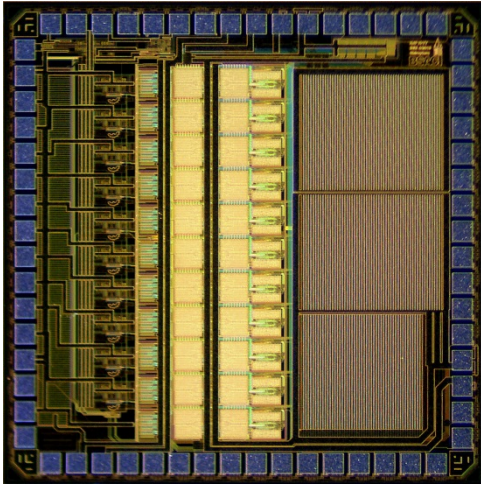


Custom Readout ASIC



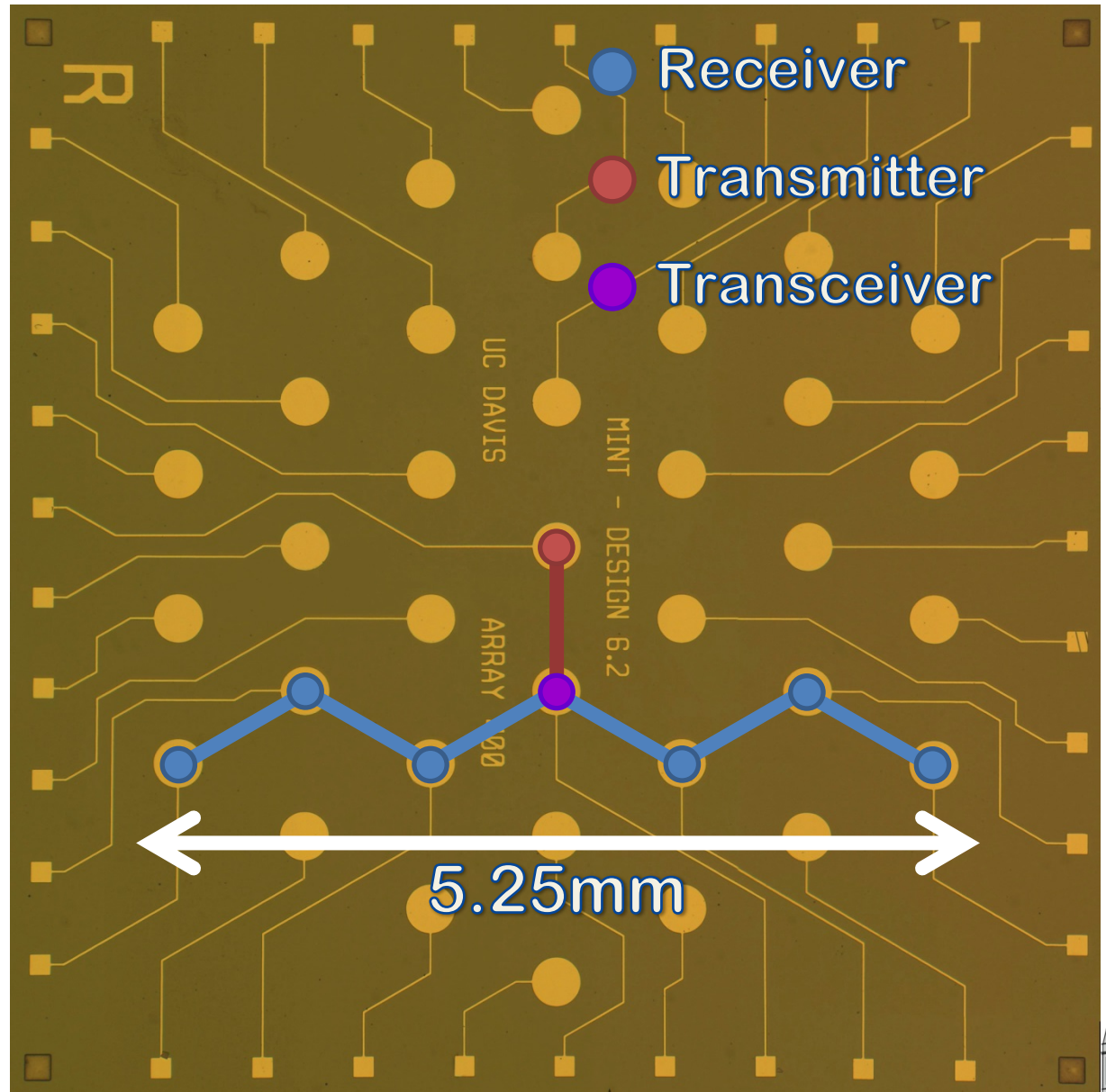
MEMS ultrasound chip

CMOS ASIC

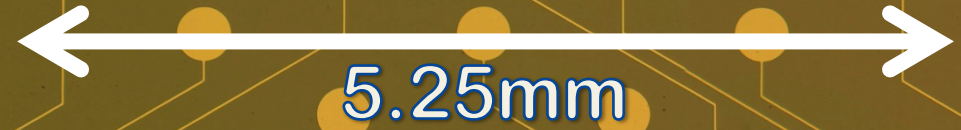


2.5mm

2mm x 1mm
active area



- Receiver
- Transmitter
- Transceiver



5.25mm

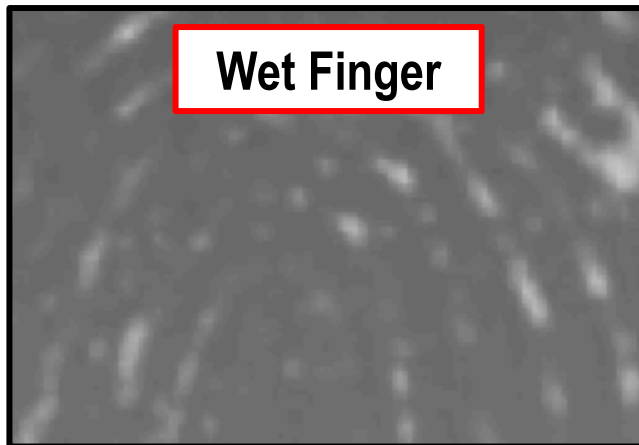
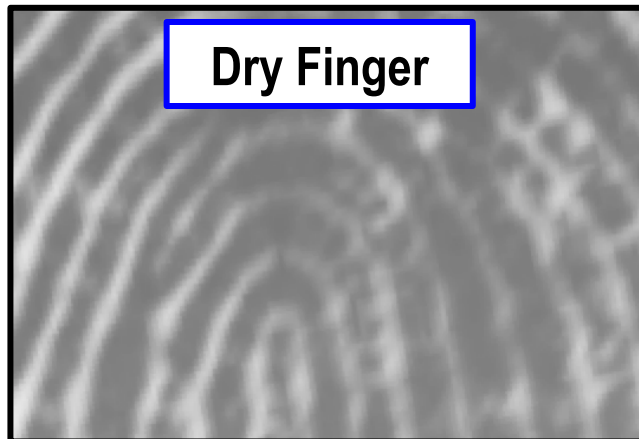


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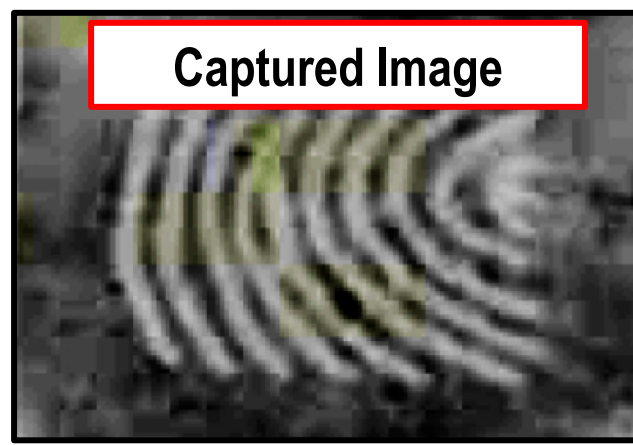


Capacitive Fingerprint Sensor

Humidity



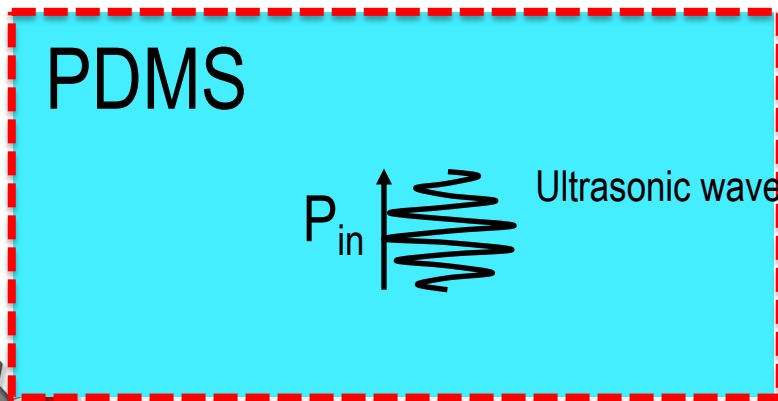
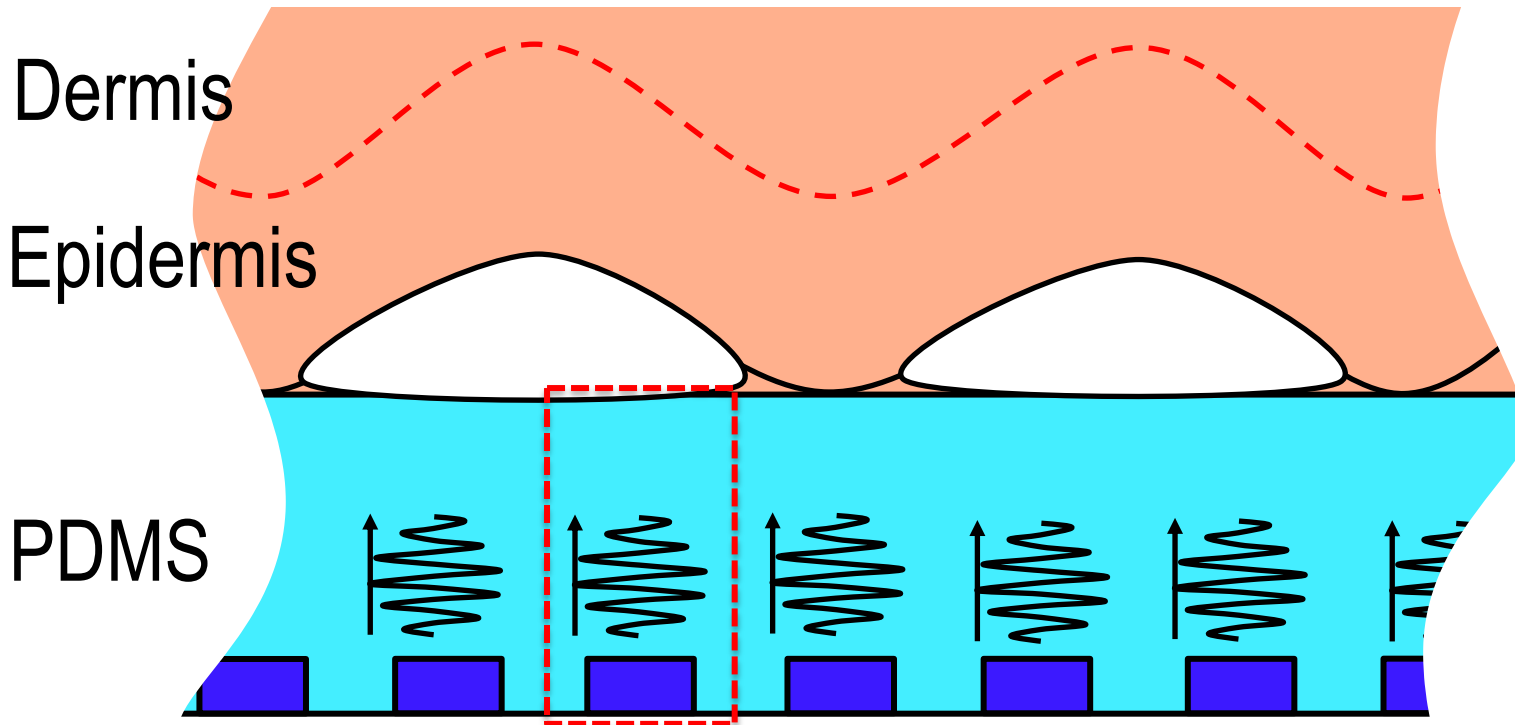
Spoofing



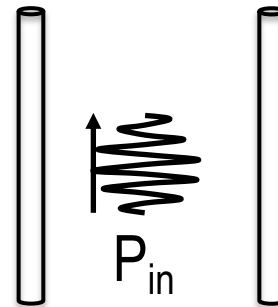
Ref: FPC1011F3 Area Fingerprint Sensor, http://www.fingerprints.com/wp-content/uploads/2014/01/FPC1011F3_product-sheet_.pdf

http://www.fingerprints.com/wp-content/uploads/2014/01/FPC1011F3_product-sheet_.pdf

Operating Principle



Transmission line



Characteristic Impedance
→ Acoustic Impedance
 $Z = \rho v$
(Density \times Speed of Sound)

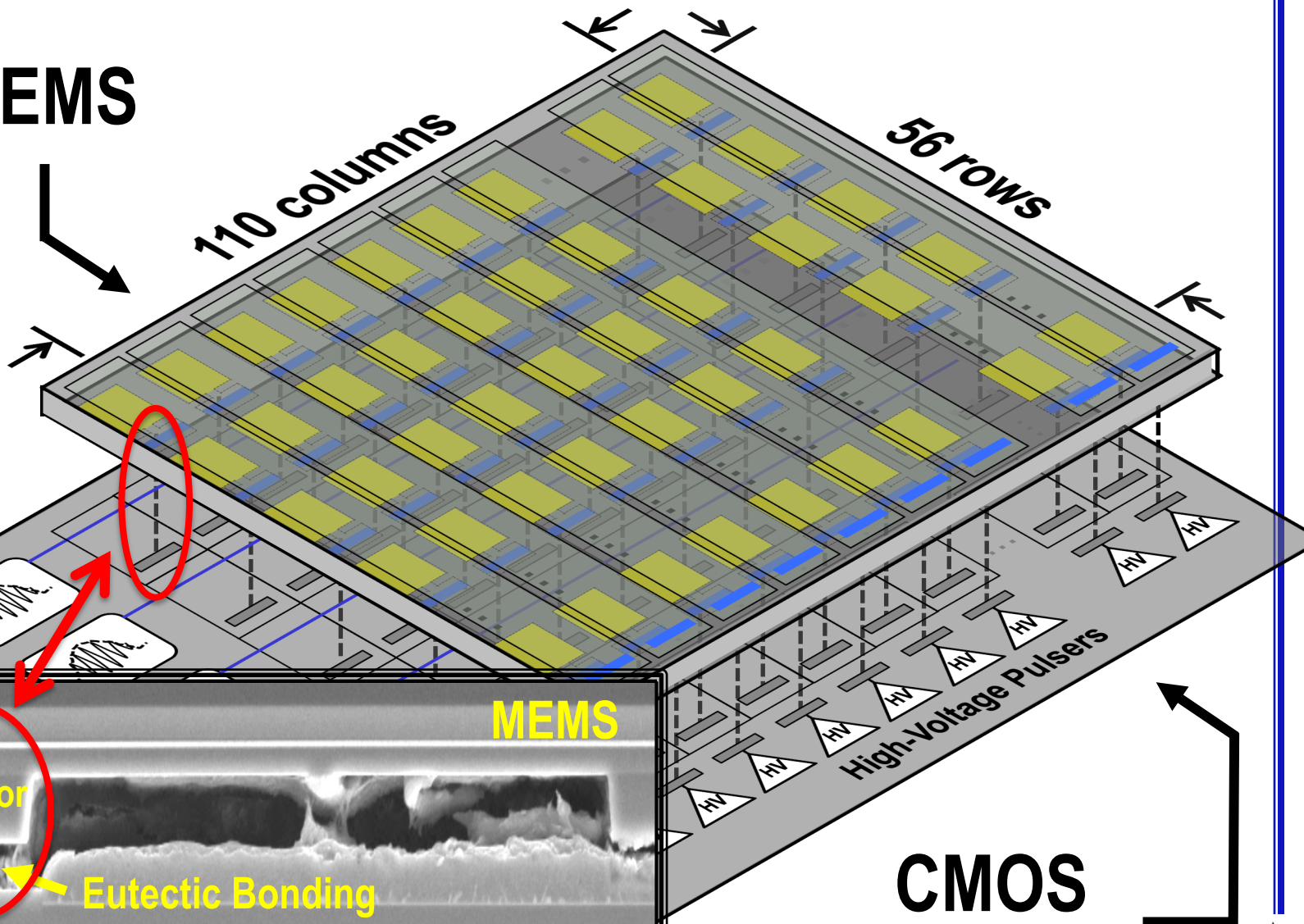
$$Z_{PDMS} = 1.5 \text{ MRayl}$$

System Integration

MEMS

110 columns

56 rows



MEMS

Anchor

Eutectic Bonding

CMOS

CMOS
(0.18 μ m, 24V)