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Near-Zero Power Mechanical Shock-Resistant Inertial Wakeup System with Scaled Inputs

Sean Yen, Benjamin A. Griffin, Bryson Barney, Adam M. Edstrand,
Andrew I. Young, Tammy Pluym, Emily Donahue, and Robert W. Reger

Applications

Unattended, persistent sensing of infrequent events

- Perimeter sensing
- Mechanical health monitoring

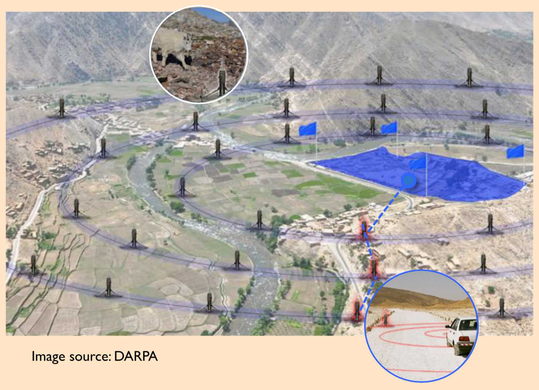


Image source: DARPA

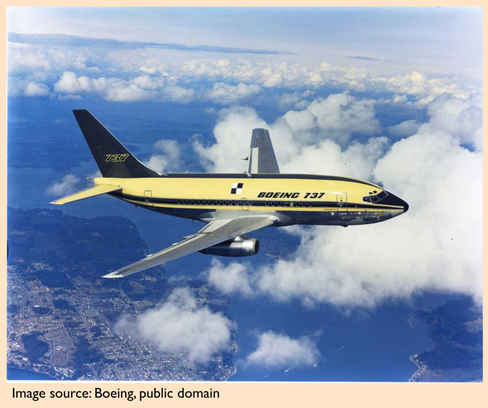
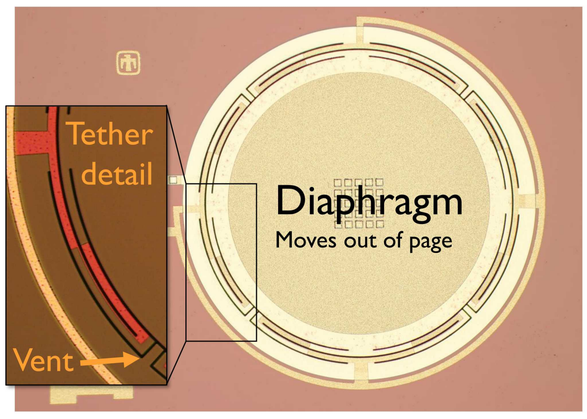
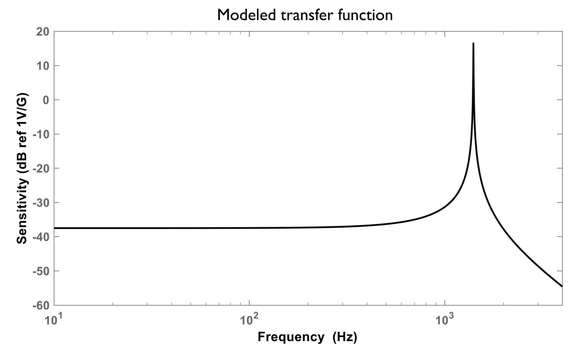


Image source: Boeing, public domain

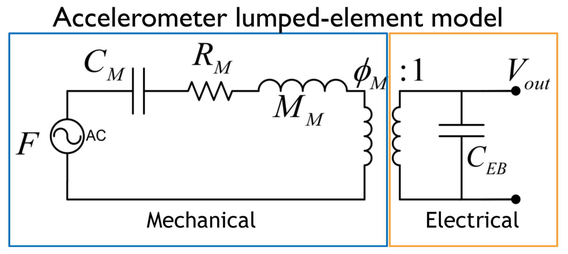
Resonant accelerometers

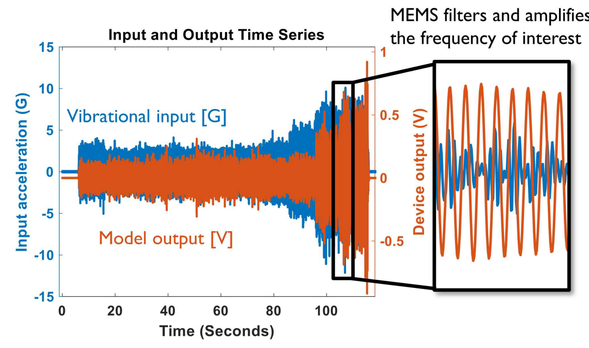
Repurposed resonant microphones to accelerometers



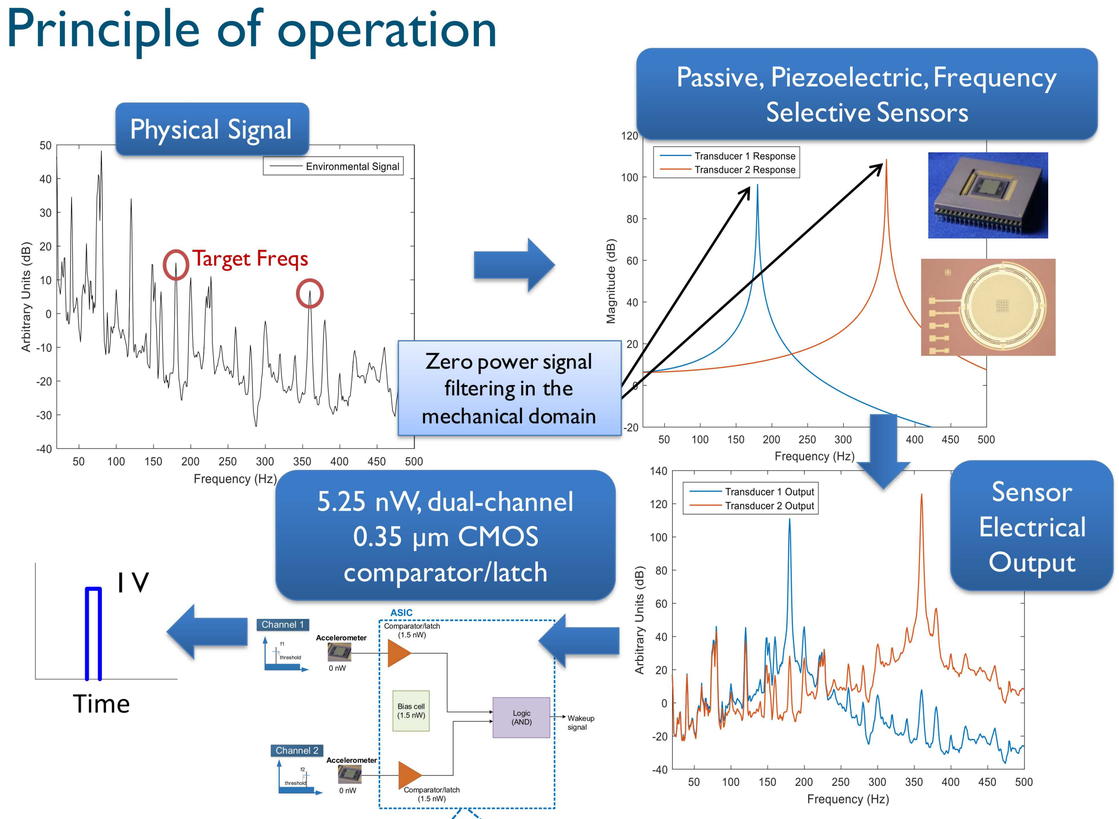


Accelerometer lumped-element model





Principle of operation

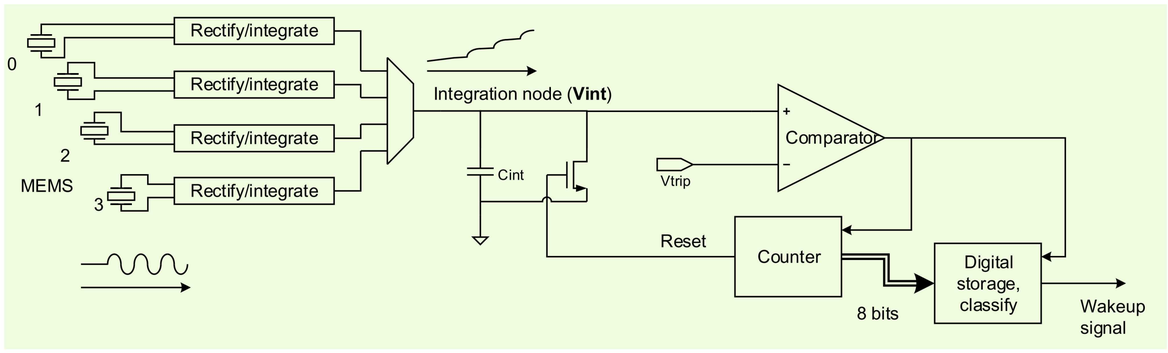


Readout circuit

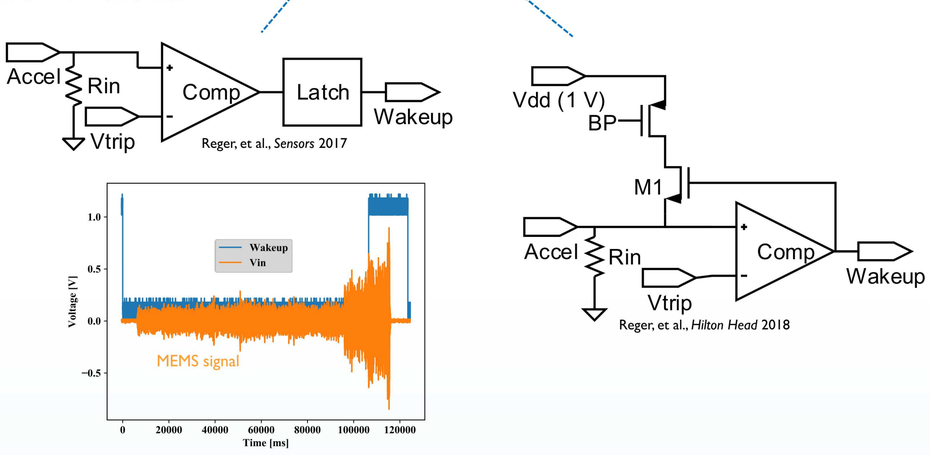
Implements learned threshold by Support Vector Machine:

$$\sum_{k=ch0}^{ch3} w_k x_k + bias \overset{?}{>} 0$$

- Weighted sum of four integrated amplitudes determines wakeup
- Integrating analog-to-digital converter



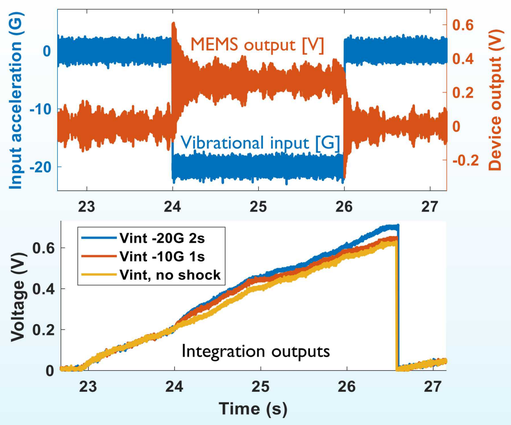
Prior work

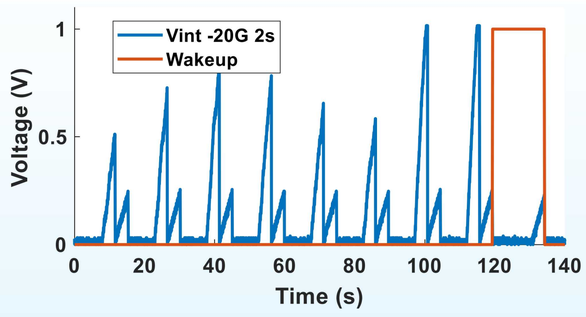


- <6 nW power consumption
- Poor rejection of mechanical shocks
  - False alarms, loss of latching

Measurements

- Wakes up to machinery pre-failure conditions filtered by MEMS
- 6.5 nW power consumption
- Resists -20 G 2s shock inserted into vibrational data





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