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# EE C245 - ME C218 Introduction to MEMS Design Fall 2011

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Lecture Module 15: Gyros, Noise, & MDS

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## Lecture Outline

- Reading: Senturia, Chpt. 14, Chpt. 16, Chpt. 21
- Lecture Topics:
  - ↳ Gyroscopes
  - ↳ Gyro Circuit Modeling
  - ↳ Minimum Detectable Signal (MDS)
    - Noise
    - Angle Random Walk (ARW)

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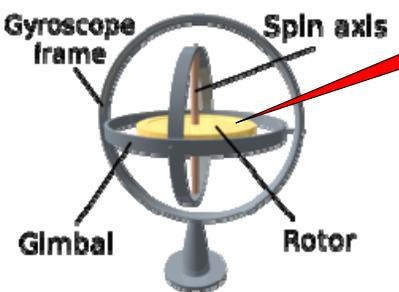
# Gyroscopes

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## Classic Spinning Gyroscope

- A gyroscope measures rotation rate, which then gives orientation → very important, of course, for navigation
- Principle of operation based on conservation of momentum
- Example: classic spinning gyroscope



Rotor will preserve its angular momentum (i.e., will maintain its axis of spin) despite rotation of its gimbled chassis



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### Vibratory Gyroscopes

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- Generate momentum by vibrating structures
- Again, conservation of momentum leads to mechanisms for measuring rotation rate and orientation
- **Example:** vibrating mass in a rotating frame

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### Basic Vibratory Gyroscope Operation

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**Principle of Operation**

- Tuning Fork Gyroscope:

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### MEMS-Based Gyroscopes

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Tuning Fork Gyroscope [Ayazi, GA Tech.]

Tuning Fork Gyroscope [Draper Labs.]

Vibrating Ring Gyroscope [Michigan]

Nuclear Magnetic Resonance Gyro [NIST]

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