

# CS164: 2D and 3D Transformations

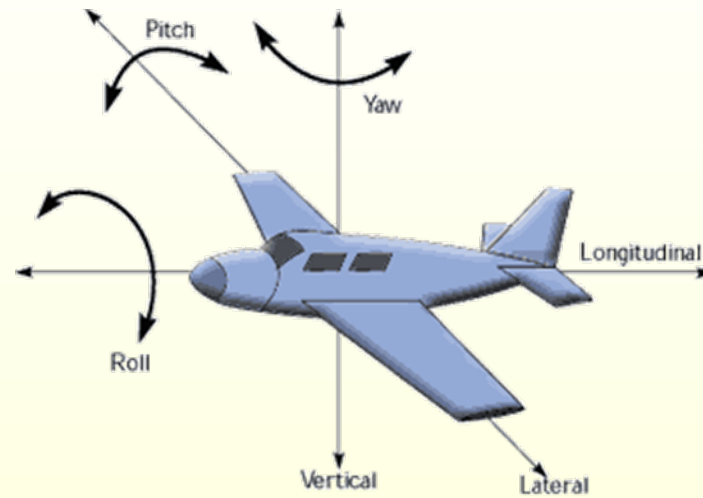
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# Pitch, Yaw, and Roll



# Leonhard Euler



1707 -- 1783

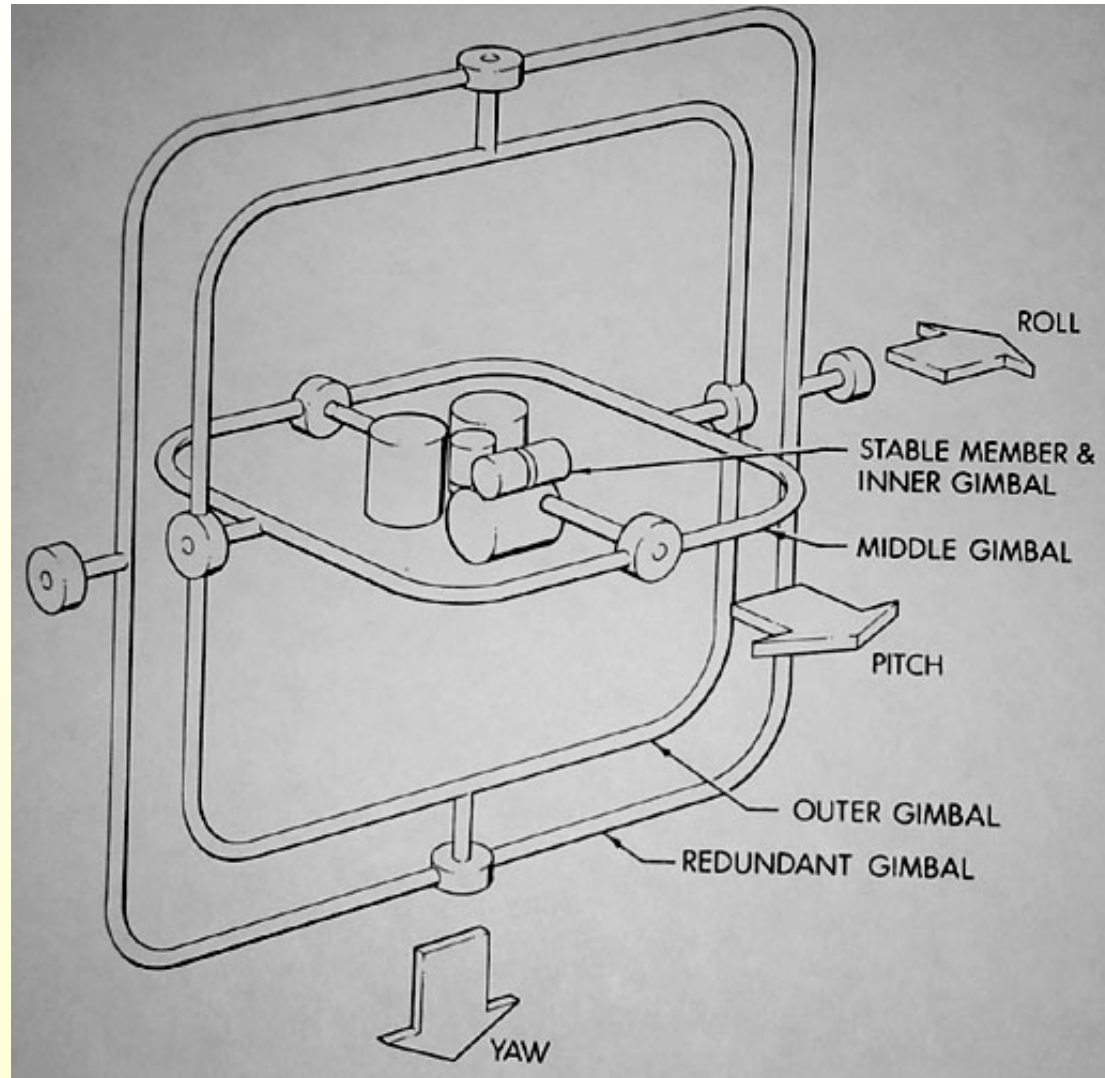
# Euler Angles

- ***Gimble***
  - Hardware implementation of Euler angles
  - Aircraft, Camera



# Euler Angles

- Rotation about three orthogonal axes
  - 12 combinations
    - XYZ, XYX, XZY, XZX
    - YZX, YZY, YXZ, YXY
    - ZXY, ZXZ, ZYX, ZYZ
- ***Gimble (or Gimbal) lock***
  - Coincidence of inner most and outmost gimbals' rotation axes
  - Loss of degree of freedom



# Gimbal Lock

Gimbal Lock

