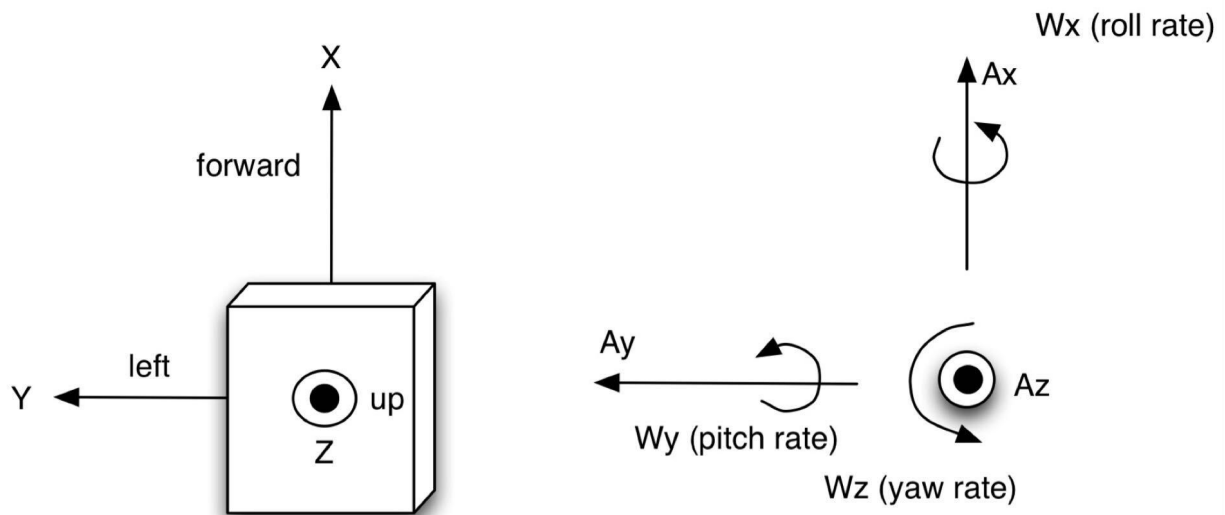


# IMU Reference

## Body Reference Frame Conventions



**Ax, Ay, Az** = accelerations along the corresponding axes (measures Normal force)  
**Wx, Wy, Wz** = rotation rates about the corresponding axes (right-hand rule)

The camera's optical axis is aligned with the x-axis.

## Data Formats

**IMU Measurements** (raw 10 bit ADC values):

- $7 \times N$  numpy array (holding N samples)

$[Time\_Stamps \quad Ax \quad Ay \quad Az \quad Wx \quad Wy \quad Wz]$

Time\_Stamps in unix time.

**Vicon Measurements:**

- $3 \times 3 \times N$  numpy array (holding N rotation matrices)
- $1 \times N$  numpy array of time stamps (unix time)

**Images:**

- $M \times N \times 3 \times K$  numpy array (holding K RGB images)
- $1 \times K$  numpy array of time stamps (unix time)

## Raw ADC Value Conversion to Physical Units

The equation to convert from the raw A/D values to physical units is

$$\begin{aligned}\text{value} &= (\text{raw} - \text{bias}) \times \text{scale\_factor} \\ \text{scale\_factor} &= \text{Vref}/1023/\text{sensitivity}\end{aligned}$$

Vref=3.3V=3300mV=reference voltage for A/D converter

The A/D converter is 10 bit, so maximum value is 1023

sensitivity for accelerometers is measured in mV/g and for rate gyros in mV/degree/sec

For example, the value in radians for a given raw rate gyro measurement is:

$$\text{value} = 3300/1023 \times \pi/180/\text{sensitivity}$$