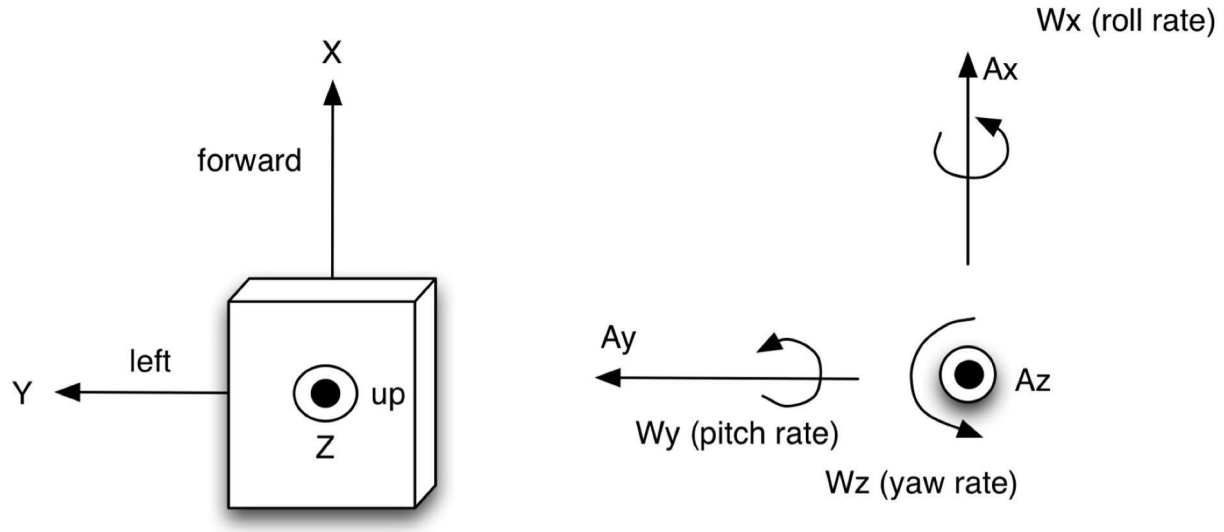
IMU Reference

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×N numpy array (holding N samples)

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

Time_Stamps in unix time.

Vicon Measurements:

- 3×3×N numpy array (holding N rotation matrices)
- 1×N numpy array of time stamps (unix time)

Images:

- M×N×3×K numpy array (holding K RGB images)
- 1×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

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

The A/D converter was 10 bit, so the maximum value is 1023. The reference voltage for the A/D converter when collecting the data was Vref = 3.3 V = 3300 mV. The sensitivity for accelerometers is measured in mV/g and for gyroscopes in mV/deg/sec. At 3300 mV reference voltage, you can see from the data sheets that the accelerometer sensitivities should be 330 mV/g, while the gyroscope sensitivities should be 3.33 mV/deg/sec = $3.33 \times 180/\pi$ mV/rad/sec.