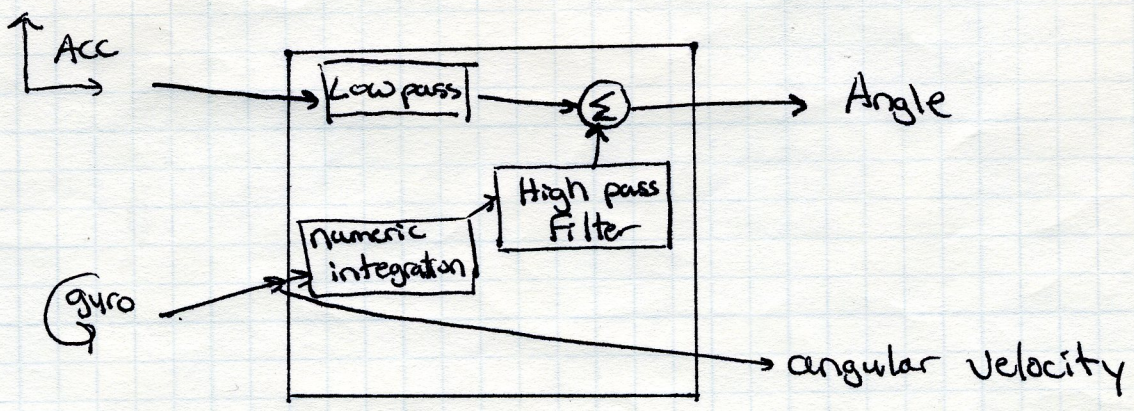
Complimentary Filter



* combines gyro and acc data into one.
* cleans up the data

- Each part:

Low pass Filter: Lets all long term changes. Filters out short term fluctuations

Idea: force changes to build up

$$\text{angle} = \left[\begin{matrix}\text{high pass}\\ \text{constant}\end{matrix} \cdot \text{angle}\right] + \left[\begin{matrix}\text{Low pass}\\ \text{constant}\end{matrix}\right] \cdot X\_acc$$

→ as iterations in Loop increase, angle will increase.

angle estimate will rise until it is level. } build up.

From internet: $\begin{matrix}\text{high pass}\\ \text{constant}\end{matrix} = 0.98$, $\begin{matrix}\text{Low pass}\\ \text{constant}\end{matrix} = 0.02$

Numeric integration: (gyro data)

No typical integration like $\int$.

→ integration can be done with a changing value

angle = angle + (gyro_data)(change in time)

change in time → get from onboard clock

Time Constant

→ relative duration of signal it will act

$$\tau = \frac{(\text{high pass constant})(\Delta t)}{1 - (\text{high pass constant})} \quad \text{or} \quad \frac{\tau}{\tau + \Delta t} = \text{high pass constant}$$

ex) if our loop runs at 50 Hz (50 times per second)

$dt = 0.02 = \frac{1}{50}$

$$\tau = \frac{(0.98)(0.02)}{1 - 0.98} \approx 0.5 \text{ sec}$$

τ represents the variance. Defines the boundary btwn trusting the gyro and accel. data.

weighted values.

- For periods < 0.5 sec, the gyro wins and acc is out filtered.
- For periods > 0.5 sec, acc outweighs gyro.

Rules:

→ choose a τ constant because then you can control the variance and filtering.

→ use τ to calculate HPF constants:

$$\text{hpf}_{\text{constan}} = \frac{\tau}{\tau + \Delta t}$$

So i.e want τ to be 0.6 sec.

$$\text{hpf}_{\text{const}} = \frac{0.6}{0.6 + \frac{1}{50}} \Rightarrow 0.9677$$

~~angle = angle~~

$$\text{angle} = \underbrace{\left[\text{hpf}_{\text{constant}}\right]\left[\text{angle} + \text{gyro}(\Delta t)\right]}_{\text{applies highpass filter on numerical integration}} + \underbrace{\left(\text{LPF}_{\text{constant}}\right)\left(X\_acc\right)}_{\text{applies Low pass on acc data.}}$$

$$= (0.9677)\left(\text{angle} + \text{gyro}\left(\tfrac{1}{50}\right)\right) + (1 - 0.9677)(X\_acc)$$