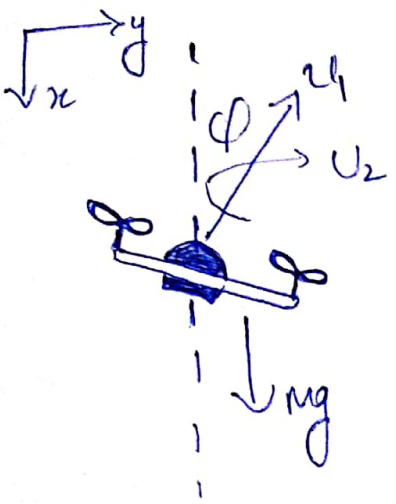
Equation of Motion of UAV Quadrotor



$$\ddot{x} = g - \frac{u_1}{m}\cos(\phi)$$

$$\ddot{y} = \frac{u_1}{m}\sin(\phi)$$

$$\ddot{\phi} = \frac{u_2}{I_{zz}}$$

Considering, $M = 0.4\,kg$

$I_{zz} = 0.2$ units

~~Linear~~ Linerization

- $\ddot{x} = g - \frac{u_1}{m}\cdot\cos\Delta\phi \rightarrow g - \frac{u_1}{m}$
- $\ddot{\phi} = \frac{u_2}{I_{xx}}$, stays the same
- $\ddot{y} = \frac{mg}{m}\cdot\sin\Delta\phi \rightarrow g\phi$, small

The system is linearized around hover point, where $u_2 = 0$, $y = y_0$, $x = x_0$, $u_1 = mg$, $\phi = 0$.

- $\phi = 0 + \Delta\phi$, $y = y_0 + \Delta y$, $x = x_0 + \Delta x$, $u_1 = mg + \Delta U_1$, $u_2 = \Delta U_2$

CONTROL DESIGN

Two control variables (u_1 and u_2)

Controller input $u_1 \rightarrow \dddot{x} \rightarrow \ddot{x} \rightarrow \dot{x} \rightarrow x$, loop.

Controller input $u_2 \rightarrow \ddot{\phi} \rightarrow \dot{\phi} \rightarrow \phi$, loop

$\rightarrow \dddot{y} \rightarrow \ddot{y} \rightarrow \dot{y} \rightarrow y$. loop - Cascaded.

Considering, reference trajectory (input)

$x = 4\sin(t)$, $y = 0.4\sin(0.5t)$

Path defined