Lengths and Masses

```
m_pr_cm = 0.4284/0.28;

L_tilt_vert = 0.21;
L_tilt_horz = 0.28;
L_pan_vert  = 0.207;
L_pan_horz  = 0.43;

m_tilt_vert = m_pr_cm * L_tilt_vert
```

```
m_tilt_vert = 0.3213
```

```
m_tilt_horz = m_pr_cm * L_tilt_horz
```

```
m_tilt_horz = 0.4284
```

```
m_pan_vert = m_pr_cm * L_pan_vert
```

```
m_pan_vert = 0.3167
```

```
m_pan_horz = m_pr_cm * L_pan_horz
```

```
m_pan_horz = 0.6579
```

Inertia

Tilt Axis

```
I_tilt = 2 * ( (1/12 * m_tilt_vert * L_tilt_vert^2) + 2 * m_tilt_horz *
(L_tilt_vert/2)^2 )
```

```
I_tilt = 0.0213
```

Pan Axis

Inertia of the base pan frame

```
I_pan_base = (1/12 * m_pan_horz * L_pan_horz^2) + 2 * m_pan_vert *
(L_pan_horz/2)^2
```

```
I_pan_base = 0.0394
```

Inertia of the tilt system as a function of its angle

```
I_pan_tilt_asm_horz = @(theta_tilt) 2 * ( 1/12 * m_tilt_horz * L_tilt_horz^2
+ m_tilt_horz * (L_tilt_vert * sin(theta_tilt))^2 );
I_pan_tilt_asm_vert = @(theta_tilt) 2 * ( 1/12 * m_tilt_vert *
(m_tilt_vert*sin(theta_tilt))^2 ) + m_tilt_vert * (m_tilt_horz/2)^2;
I_pan_tilt_asm = @(theta_tilt) I_pan_tilt_asm_horz(theta_tilt) +
I_pan_tilt_asm_vert(theta_tilt)
```

```
I_pan_tilt_asm = function_handle with value:
    @(theta_tilt)I_pan_tilt_asm_horz(theta_tilt)+I_pan_tilt_asm_vert(theta_tilt)
```

Adding them up!

```
I_pan = @(theta_tilt) I_pan_base % * I_pan_tilt_asm(theta_tilt);
```

```
I_pan = function_handle with value:
    @(theta_tilt)I_pan_base
```

```
I_pan = @(theta_tilt) I_pan_tilt_asm(theta_tilt) + I_pan_base
```

```
I_pan = function_handle with value:
    @(theta_tilt)I_pan_tilt_asm(theta_tilt)+I_pan_base
```

```
syms theta
vpa(I_pan)
```

ans = $0.0433130440995\,\sin(\theta_{\text{tilt}})^2 + 0.059756512931999988813558388756064$

```
fplot(I_pan, [0, 2 * pi])
```

```
Warning: Function behaves unexpectedly on array inputs. To improve performance, properly vectorize
your function to return an output with the same size and shape as the input arguments.
```