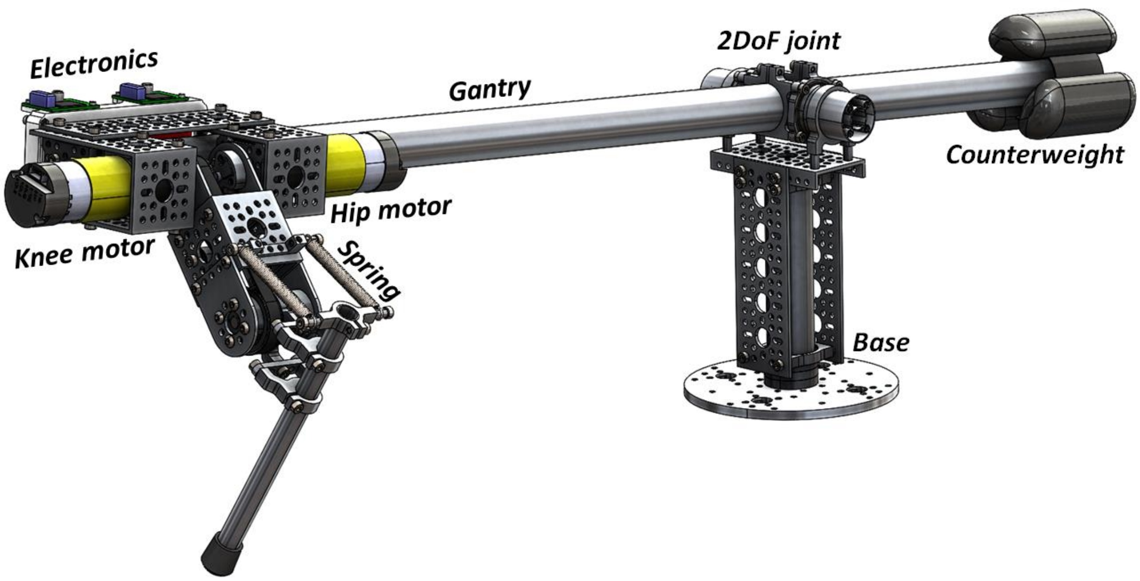
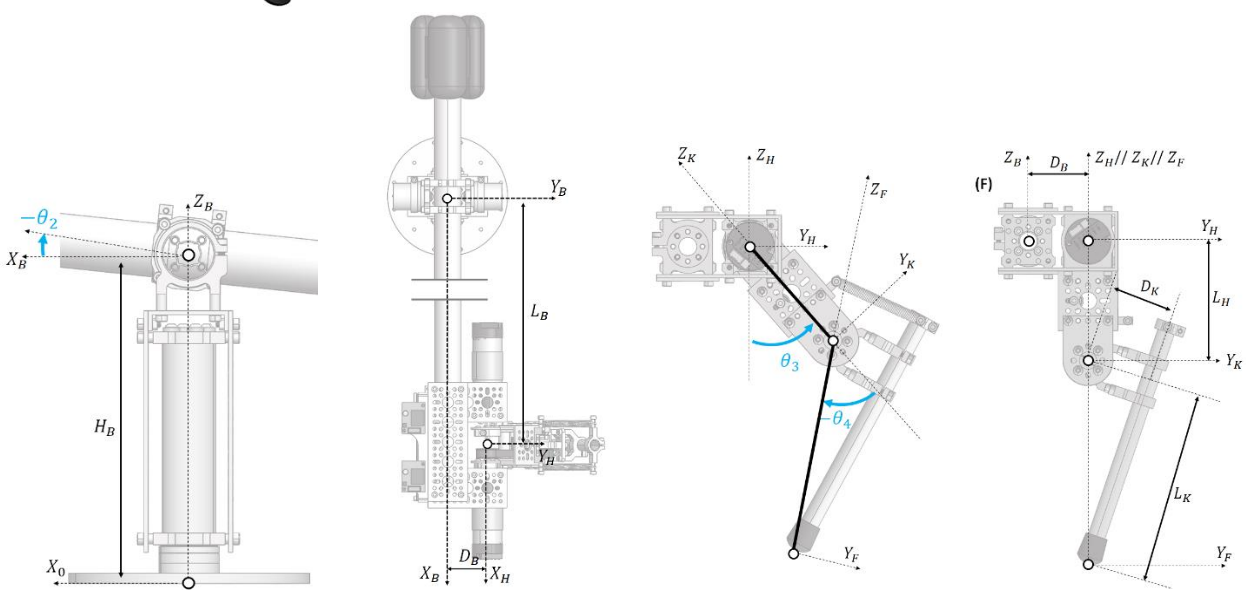
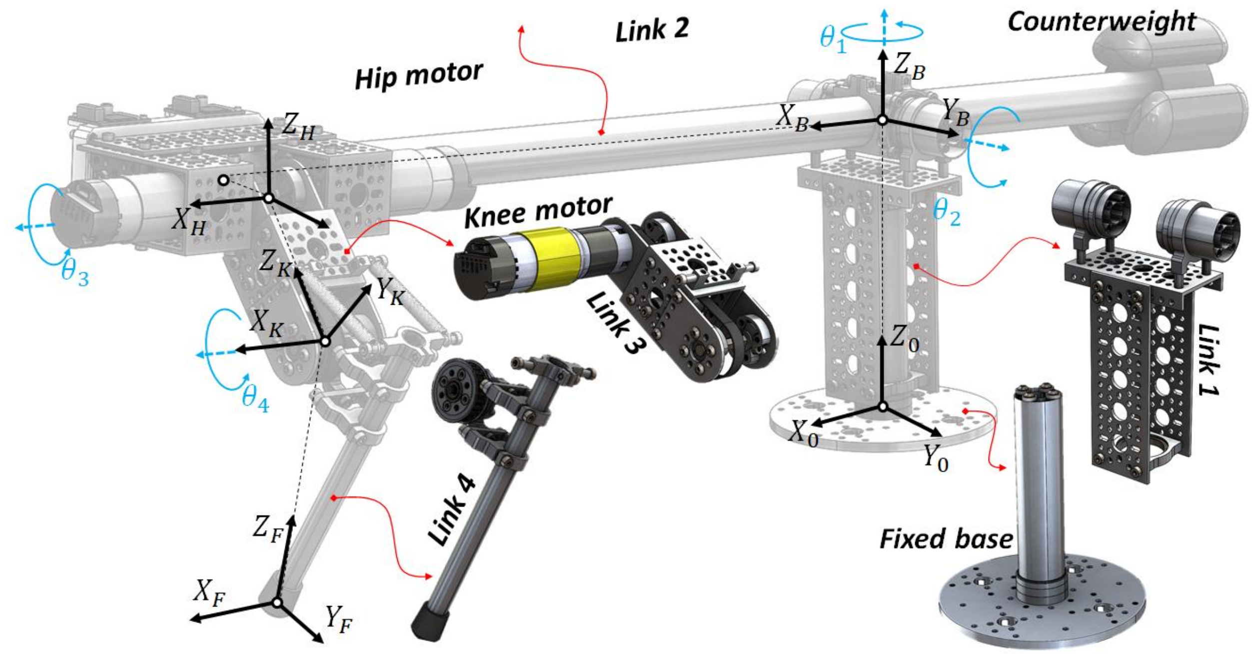
Nominal dimensions of HOPPY:





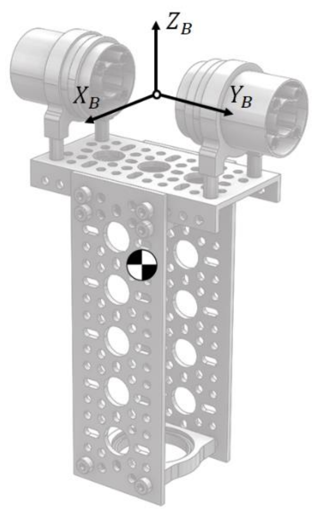
Parameter	Value $[mm]$
H_B	196.5
L_B	556
D_B	48
L_H	96
L_K	154.5
D_K	52

Rigid body parameters:



For each link i we list the total mass m_i in kg, the location of center of mass (CoM) in respect to the local frame in m, and the inertia tensor J_i taken at CoM and aligned with local coordinate frame in $kg\ m^2$.

Link1:



$$m_1 = 0.268$$

$$r_1 = \begin{bmatrix} -0.00056660 \\ 0 \\ -0.06176511 \end{bmatrix}$$

$$J_1 = \begin{bmatrix} 0.00115952 & 0 & -0.00000703 \\ 0 & 0.00104649 & 0 \\ -0.00000703 & 0 & 0.00030518 \end{bmatrix}$$

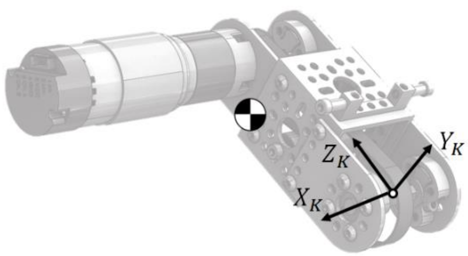
Link 2:

$$m_2 = 2.365$$

$$r_2 = \begin{bmatrix} -0.50195830 \\ -0.03678363 \\ 0.00001342 \end{bmatrix}$$

$$J_2 = \begin{bmatrix} 0.00270252 & 0.01161483 & -0.00006434 \\ 0.01161483 & 0.30208952 & -0.00000838 \\ -0.00006434 & -0.00000838 & 0.30305924 \end{bmatrix}$$

Link 3:

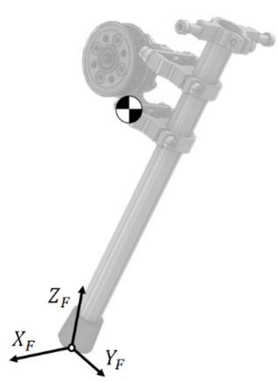


$$m_3 = 0.656$$

$$r_3 = \begin{bmatrix} 0.04825821 \\ 0.00027269 \\ 0.07708701 \end{bmatrix}$$

$$J_3 = \begin{bmatrix} 0.00082110 & -0.00002821 & 0.00058518 \\ -0.00002821 & 0.00235762 & -0.00001795 \\ 0.00058518 & -0.00001795 & 0.00168340 \end{bmatrix}$$

Link 4:



$$m_4 = 0.149$$

$$r_4 = \begin{bmatrix} 0.00207136 \\ 0.02086667 \\ 0.14511501 \end{bmatrix}$$

$$J_4 = \begin{bmatrix} 0.00039424 & -0.00000379 & -0.00000066 \\ -0.00000379 & 0.00032191 & 0.00003269 \\ -0.00000066 & 0.00003269 & 0.00010442 \end{bmatrix}$$

Actuator parameters:

$N_H = 26.9$ hip gearbox ratio

$N_K = 28.8$ knee gearbox ratio

$I_r = 7 \times 10^{-6} kg\, m^2$ motor rotor inertia

$R_w = 1.3\Omega$ motor winding resistance

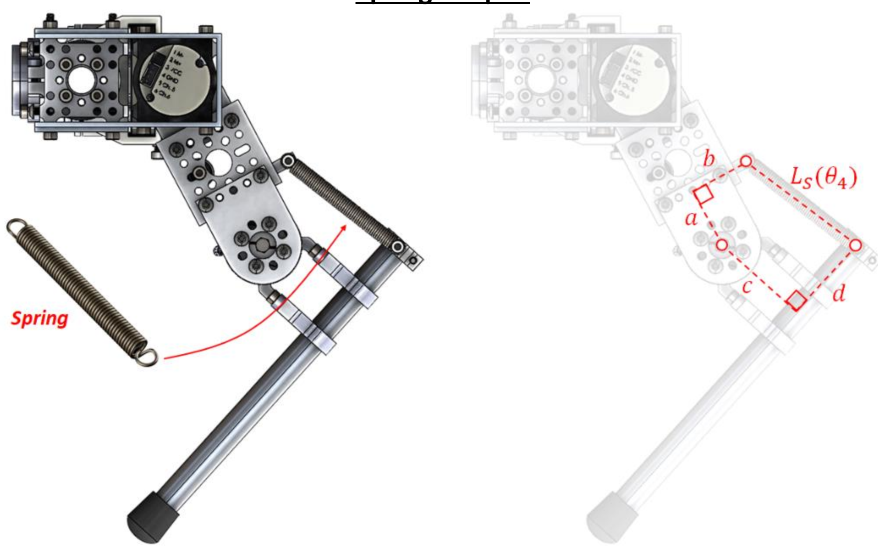
$k_T = 0.0135 \frac{Nm}{A}$ brushed electric motor torque constant

$k_v = 0.0186 \frac{V\, s}{rad}$ brushed electric motor speed constant

$V_{max} = 12V$ power supply voltage

$I_{max} = 30A$ maximum (peak) current the motor driver can supply

Spring torque:



Length	Value [mm]
a	32
b	32
c	52
d	46 (nominal)

Approximate the spring length using a second order polynomial. The coefficients for $L_s(\theta_4)$ will change for different d values. For the nominal case:

$$L_s(\theta_4) \approx a_2\theta_4^2 + a_1\theta_4 + a_0$$

The torque per spring is given by:

$$\tau_s(\theta_4) = \frac{\partial L_s}{\partial \theta_4} K_s\big(L_0 - L_s(\theta_4)\big) \approx (2a_2\theta_4 + a_1)K_s(L_0 - L_s) \text{ for } L_0 \le L_s \le 120mm$$

Where:

a_2	-12.09
a_1	10.75
a_0	112.4
Spring constant K_s	$1.67kN/m$
Resting spring length L_0	$80mm$