Figure 1: Mallard and its thruster configuration. Arrows show forward force direction produced by each thruster ($T_1, T_2, T_3$ and $T_4$).
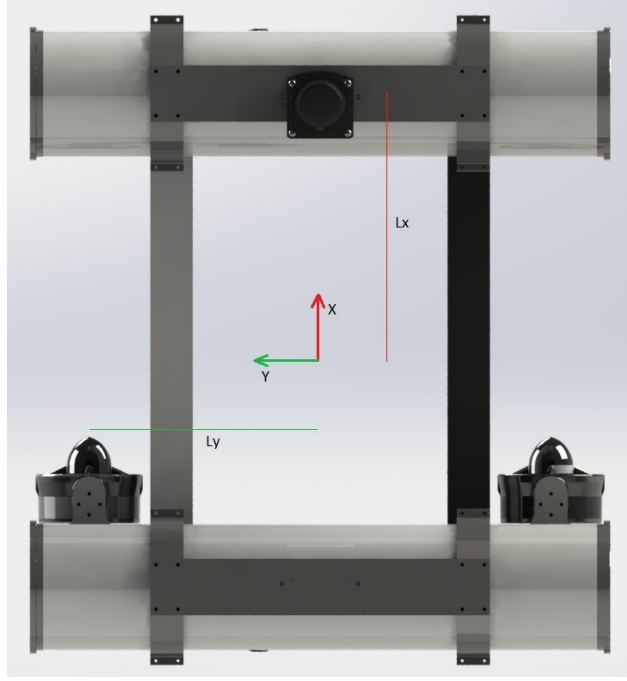
Figure 2: Top view. Moment arms $L_x$ and $L_y$ that are measured from the centre of Mallard, i.e. half the distance between thrusters.

$\boldsymbol{\tau} = [U \ V \ R]^T$ - velocity vector in body (Mallard's) reference frame
$\boldsymbol{u} = [T_1 \ T_2 \ T_3 \ T_4]^T$ - forces to be allocated for each thruster
$L_x, L_y$ - moment arms

$$\begin{bmatrix} U \\ V \\ R \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ L_y & -L_y & L_x & -L_x \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \end{bmatrix} \tag{1}$$

$$\boldsymbol{\tau} = \boldsymbol{B} * \boldsymbol{u} \tag{2}$$

$$\boldsymbol{u} = \boldsymbol{B}^{+} * \boldsymbol{\tau} \tag{3}$$

$$\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \end{bmatrix} = \begin{bmatrix} 0.5 & 0 & a \\ 0.5 & 0 & -a \\ 0 & 0.5 & b \\ 0 & 0.5 & -b \end{bmatrix} \begin{bmatrix} U \\ V \\ R \end{bmatrix} \tag{4}$$