

Diagram illustrating a three-link robotic arm system. The first link (red) has mass  $m_f$  and moment of inertia  $I_m$ . The second link (blue) has mass  $m$  and moment of inertia  $I_t$ . The gripper (grey) has mass  $m$  and moment of inertia  $I_t$ . The angle between the first and second links is  $\tau$ . The force exerted by the gripper is  $F_g$ .

Diagram illustrating a two-link robotic arm configuration in a 2D plane. The base is at the origin  $(0,0)$ . The first link has length  $l$  and makes an angle  $\gamma_1$  with the horizontal. The second link has length  $l_v$  and makes an angle  $\gamma_2$  with the horizontal. The end effector is at position  $(x,y)$ . The angle between the two links is  $\phi = (\gamma_1 + \gamma_2)/2$ . The angle  $\theta$  is shown between a vertical dashed line and the line connecting the origin to the end effector.

A diagram of a two-link robotic arm. The base is a black circle with a white crosshair. A vertical arrow labeled  $mg$  points downwards from the base. The first link is a black line segment. At its end is a white circle. A red curved arrow labeled  $\tau_2$  points clockwise around this joint. A blue curved arrow labeled  $\tau_1$  points counter-clockwise around the same joint. The second link is another black line segment. At its end is a black circle. A blue arrow labeled  $F_I$  points along the second link towards the base. At this end point, a coordinate system is shown with a vertical dashed line and a horizontal dashed line. A blue arrow labeled  $F_y$  points upwards along the vertical dashed line. A blue arrow labeled  $F_x$  points to the right along the horizontal dashed line.







