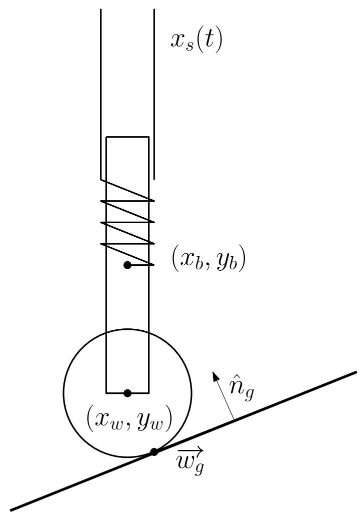
PGS Suspension Solver

December 17, 2021

The suspension can be modeled as two rigid bodies, the bar and the wheel. The bar is connected to a socket with a prismatic constraint, and the socket moves with some specified motion $x_s(t)$. The wheel connects to the bar with positional constraint. The bar is attached to a spring at its center of mass, which acts as an external force on the bar.



Each constraint introduces linear and angular impulses:

$$\overrightarrow{\lambda}_i = \begin{bmatrix} \lambda_{lin} \\ \lambda_{rot} \end{bmatrix}$$

The location of these impulses depends on the constraint, and will change the form of the Jacobian.

The first constraint we consider is the prismatic constraint of the bar/socket system. We have that

$$x_b = x_s(t) \implies u_b = \dot{x}_s(t)$$

$$\omega_b = 0$$

The second constraint is the position constraint for the wheel/bar system.

$$x_w - \left(x_b + \frac{L}{2}\sin\theta_b\right) = 0 \implies u_w - u_b - \frac{L}{2}\cos\theta_b\omega_b = 0$$

$$y_w - \left(y_b - \frac{L}{2}\cos\theta_b\right) = 0 \implies v_w - v_b + \frac{L}{2}\sin\theta_b\omega_b = 0$$

The laws of motion are

$$Jv_1 = 0 = J(v_0 + M^{-1}F_{ext}\Delta t) + JM^{-1}J^T\lambda$$

TODO collision constraint

TODO elastic collision can be handled by not setting to zero

TODO Baumgarte stabilization