Where we are:

Chap 2 Configuration Space
Chap 3 Rigid-Body Motions
Chap 4 Forward Kinematics
Chap 5 Velocity Kinematics and Statics
5.1 Manipulator Jacobian
5.2 Statics of Open Chains
Chap 6 Inverse Kinematics
Chap 8 Dynamics of Open Chains
Chap 9 Trajectory Generation
Chap 11 Robot Control
Chap 13 Wheeled Mobile Robots

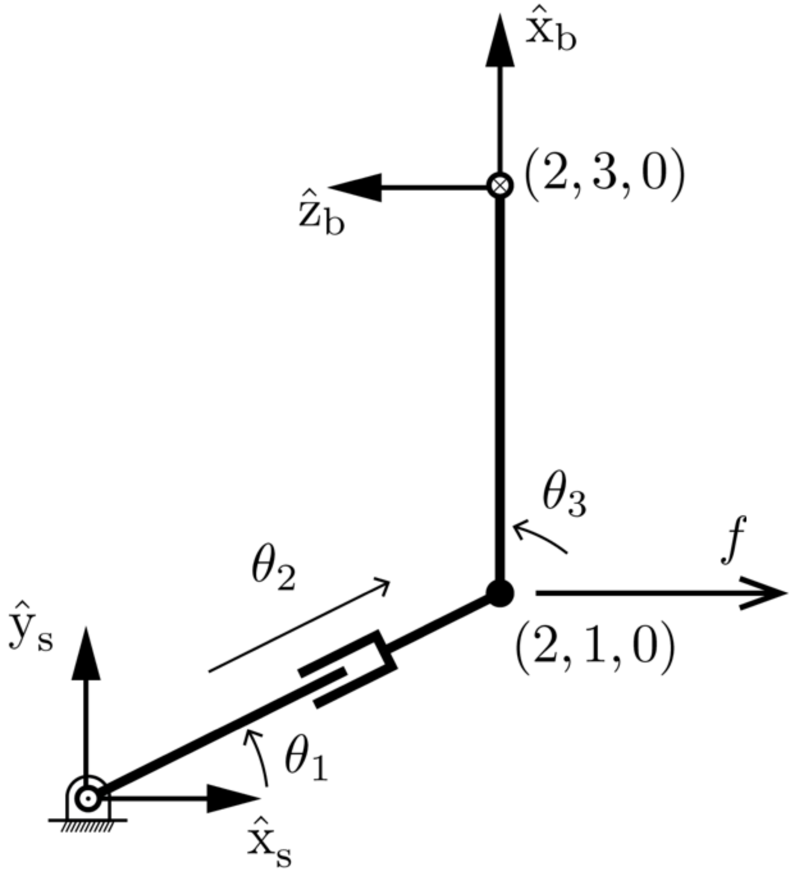
Important concepts, symbols, and equations

Robot statics: $\tau = J_*^{\mathrm{T}}(\theta)\, \mathcal{F}_*$, where $* = s$ or b.

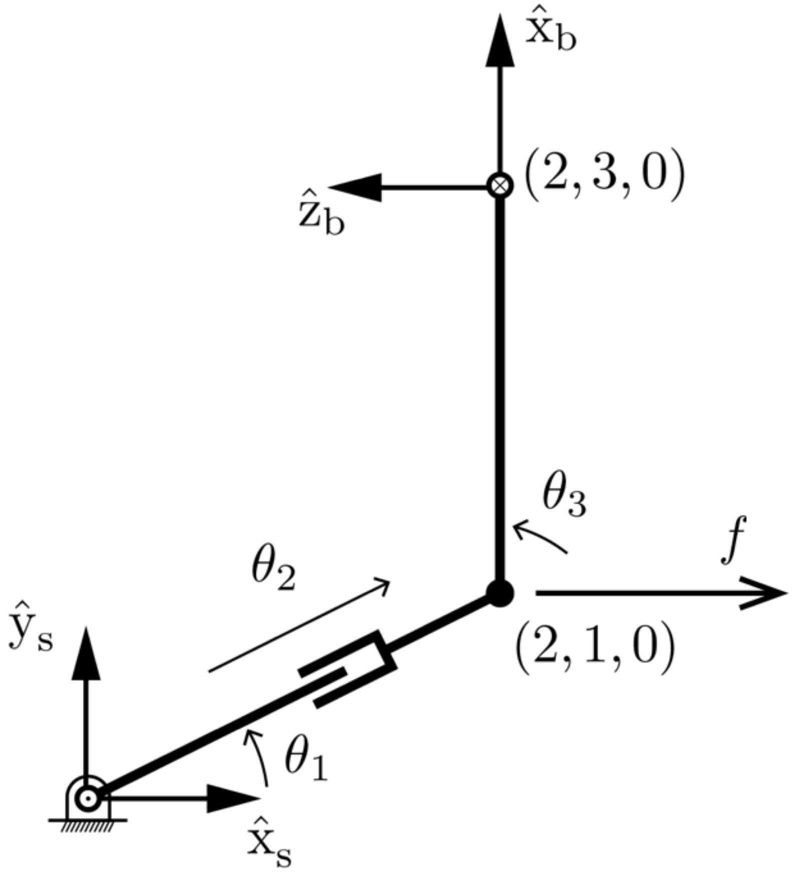
Proper interpretation: if a wrench $-\mathcal{F}$ is applied to the last link, then $\tau = J^{\mathrm{T}}(\theta)\, \mathcal{F}$ is required to resist it.

If $J(\theta)$ has rank 6, then the robot can *actively* generate an end-effector wrench in any direction. The static equation is useful for force control.

If $J(\theta)$ has rank $k < 6$, then any applied wrench can be decomposed into the sum of components in k directions requiring motors to resist and components in $6 - k$ directions that are resisted by the bearings.



What is the 6×3 Jacobian J_b? What is its rank? What wrenches can be resisted without using the motors?



A linear force f to the right is applied to link 3 at the point shown. What is the corresponding wrench $-\mathcal{F}_b$? τ needed to resist it?