Perching Aircraft

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Problem

We have a 1 meter wingspan glider, launched from a slingshot, that we want to land on a perch (a wire 10 feet away). We design control systems (command elevator deflection angle) to get the plane there. Problem: the aerodynamic modeling: wish to predict aerodynamic forces and moments given 8-dimensional observable state (2D position, pitch angle, elevator angle, and derivatives). Flow adds state, but it's not observable.

System Identification

We want to learn the dynamics by collecting data on the real system. Naturally, we can imagine fitting arbitrarily complex models, so we'd love to use some sort of model-reduction-inspired technique for limiting the complexity of our identified models. The data we collect is position, orientation, and elevator angle, at 120 Hz using a motion capture system. We are interested also in how to design trajectories for sysID – what parts of state space do we most need to improve our model for, and how to we get there?

What's hard?

Known issues:

1. Transient aerodynamics have lag, at least with respect to the state we can observe
2. Identified models are (most likely) nonlinear. Stability of these models in sim?
3. Unknown model structure. Combo of physically inspired terms w/ nonlinear basis functions?

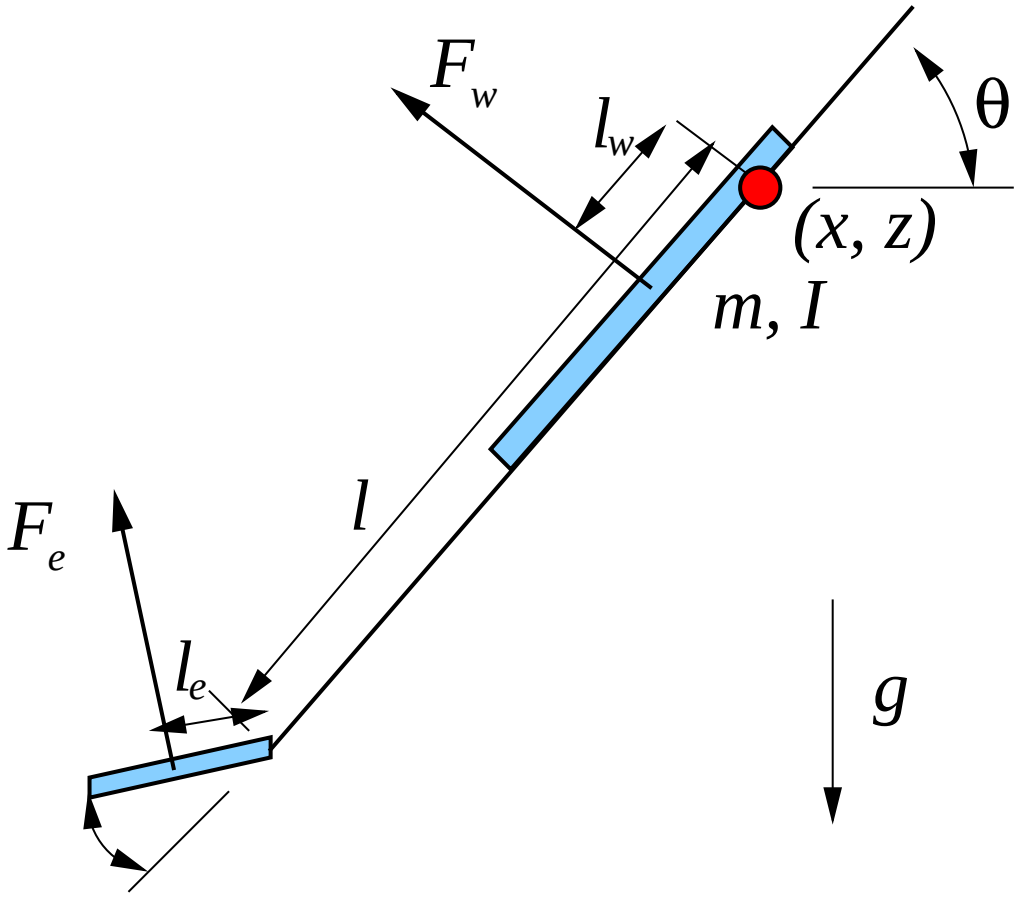

Figure 1: Figure courtesy Russ Tedrake