21. Multibody Parameter Estimation

Physics based reasioning and do physics inspired neural networks, Physics inspired neutral networks.

Today's Topic outline

- Goal: generate plant model for control
- In real world, if we know the multibody equation, we can do way better. Zero shot

1. Dynamics of Throwing

Estimating the parameters determines take off conditions

2. Parameters to identify

Separate kinematics & dynamics

$\alpha = [m, h, \sum]^{'}\ 1 + 3 + 6\ for\ each\ link$

3. Lesson 1 adds additional constraints

Positive semi definite matrix:pseudo inertia

Two approaches:

- Semi Definite Programming
- Gradient Decent Programming

  Break pseudo matrix into products of uptriangular matrix, $J = U \cdot U^{'}$

4. Lesson 2 Equation Error VS. Simulation Error

- Equation error is one step error, reset at every step, no compounding accumulation
- Simulation error is long term perdiction with compounding error

5. Lesson 3 Use Inverse Dynamics (Not Forward Dynamics)

Multibody dynamics equation is convex in inertia parameters. Write dynamics in linear in lumped parameters.

6. Lesson 4 not all multibody quantities are identifiable

- Idea 1: optimize only identifiable parameters
- Idea 2: add regulaizer
- Idea 3: optimal experiment design
- Idea 4: online parameter identification, i.e. Adaptive Control, the Controller takes in the lumped parameter.

book:<Applied Nonlinear Control>, Jean-Jaeques