ME 425/625 – Robotics

Closing Remarks

Review

Lecture 01: Simple Machine I: Levers, Shafts, And Cranks

Hands-on Lab

- Simple Crank
- Crank 3-bar
- Crankshaft
- Complex Crank

Homework

- Constructed slider-crank mechanism

Lecture 02: Simple Machine II: Cams, Springs, And Linkages

Hands-on Lab

- Cam Follower
- Cam Follower Vehicle
- Torsional Linkage
- Multi-jointed Torsional Linkage
- 4-bar linkage walker

Homework

- Flat folding chair

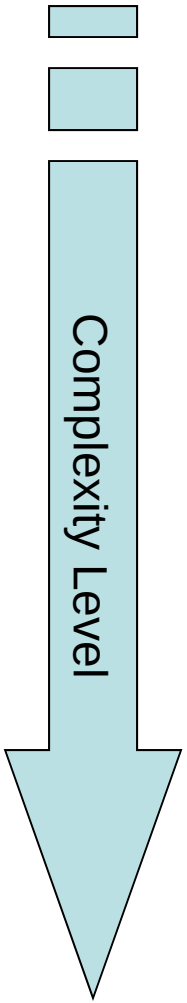
Lecture 03: Simple Machine III: Ratchets, Drives, And Gearing

Hands-on Lab

- Planetary Gears
- Bevel Gears (and Pin Wheel)
- Worm Gears
- Rack-and-Pinion

Homework

- Windshield Wiper



Result is a cookbook with fundamental recipes. Now, you can create a meal

Project : Automata Project “Putting it all together”

Mid-term assessed

- fundamentals learned about simple machines
- hands-on realization of simple machines

Lecture 04-07: NXC Programming

- Motors, Sensors
- File handling
- Timers

Lecture 08-10: Robot (Wheeled Inverted Pendulum), Intro to PID

Lecture 11-13: DC Motor Characterization (Winch-and-Cart)

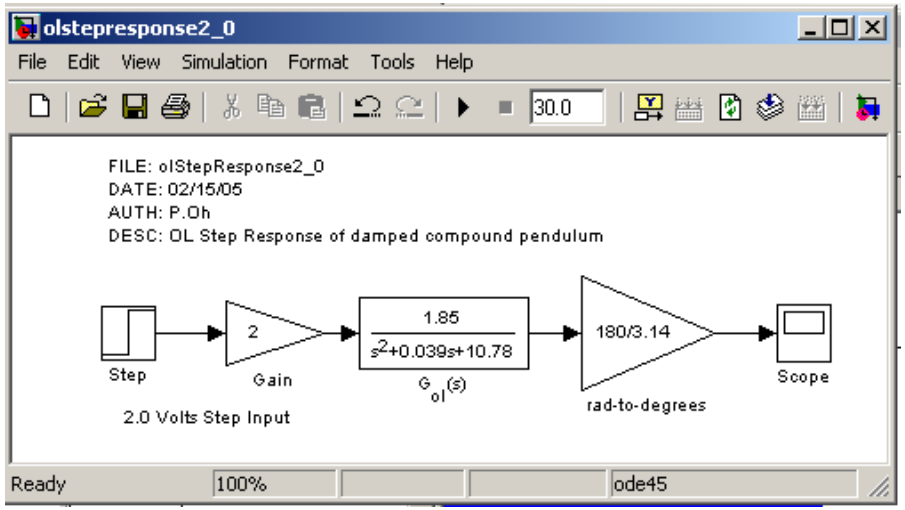
Lecture 14-15: System ID and PID

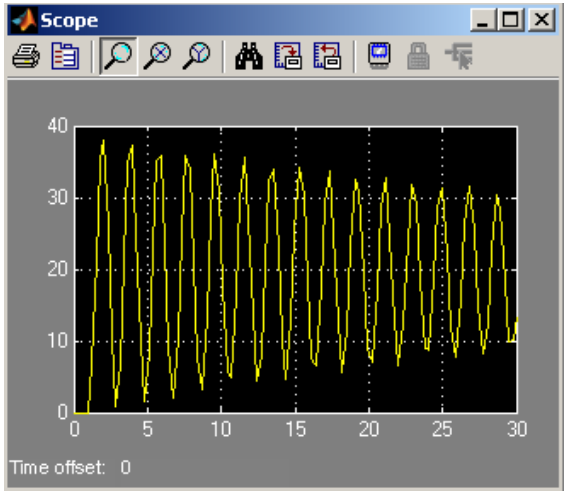
Reinforce Fundamentals

Exploration

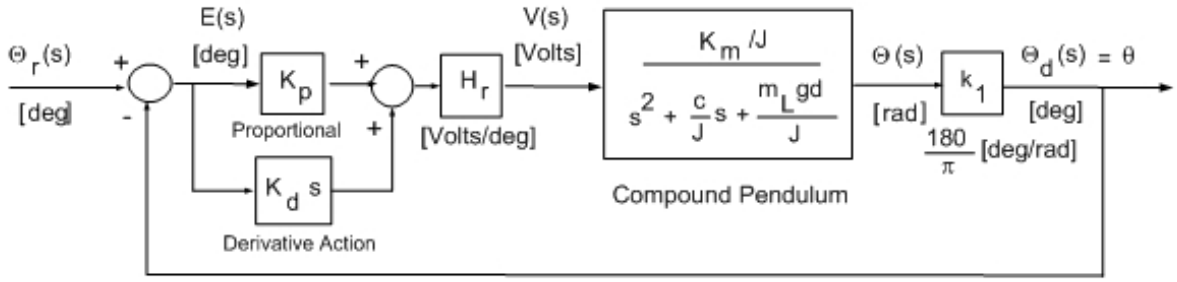
Clearly – Control Improves Performance!

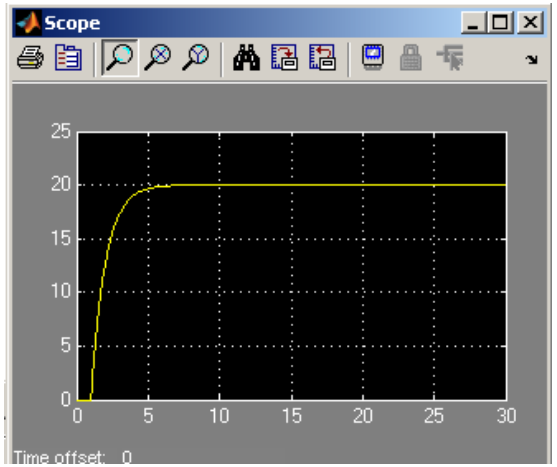
Open-Loop





PID





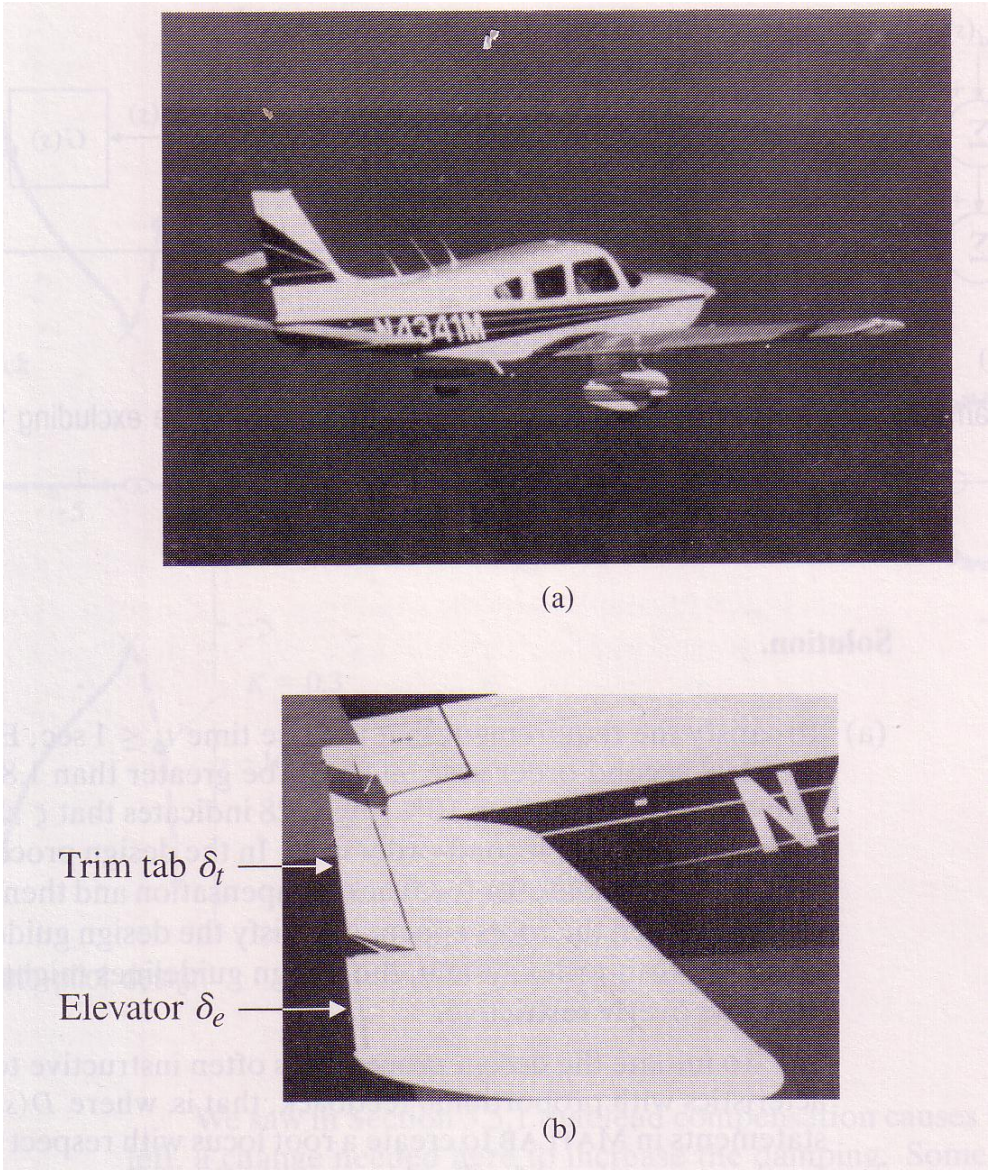
PID Control Used Throughout the Industry

6-DOF Flight Simulator

Talk to pilots and tune gains

Control Designer's Goal: Place poles in desired locations to yield desired response (damping, settling time etc)

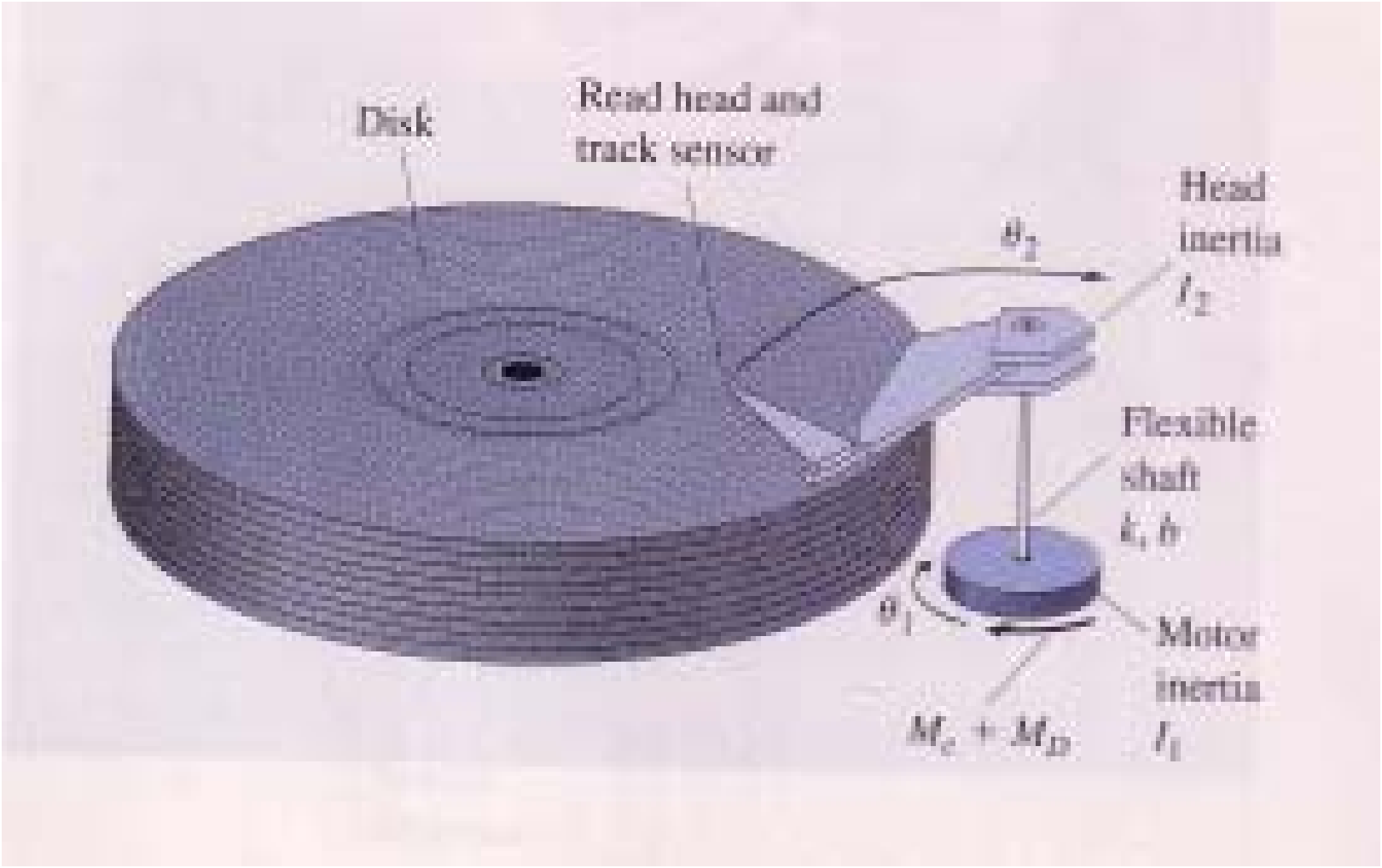
Other Examples where you can go…



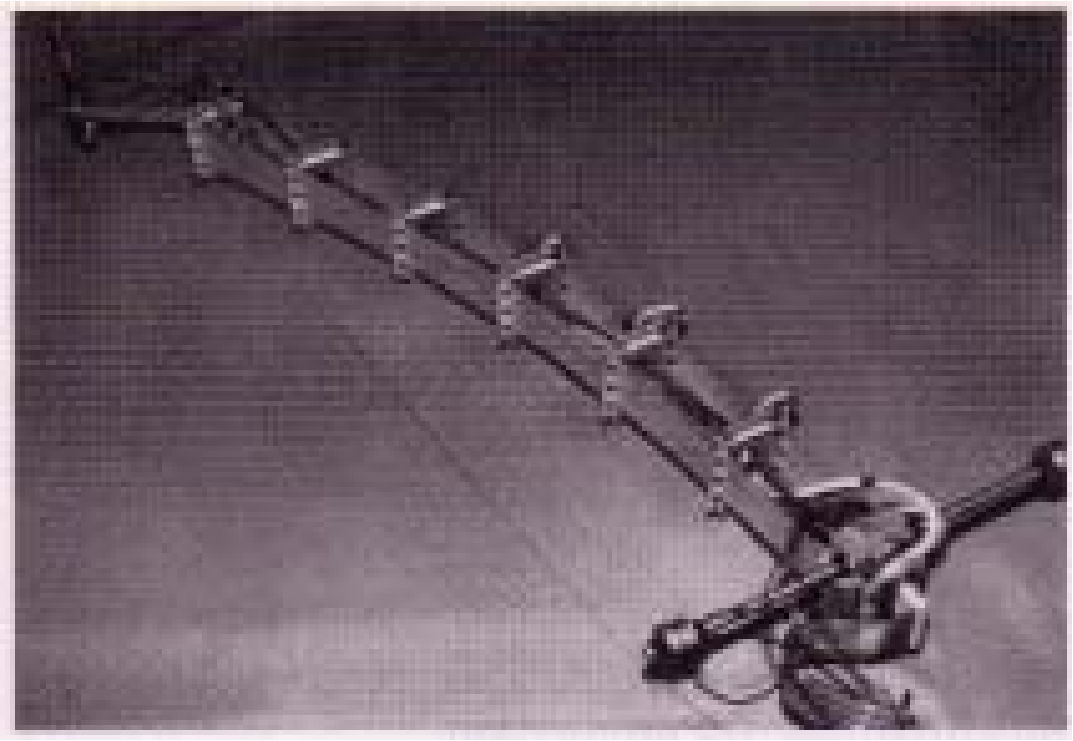
Airplane aileron: 4th order

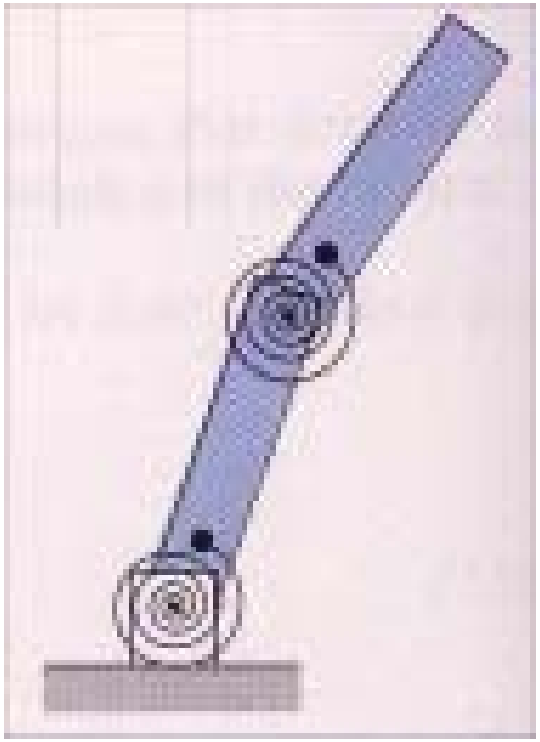
- **2nd order "pendulum"**
- **2nd order hydraulics**

Hard Drive: double-pendulum…



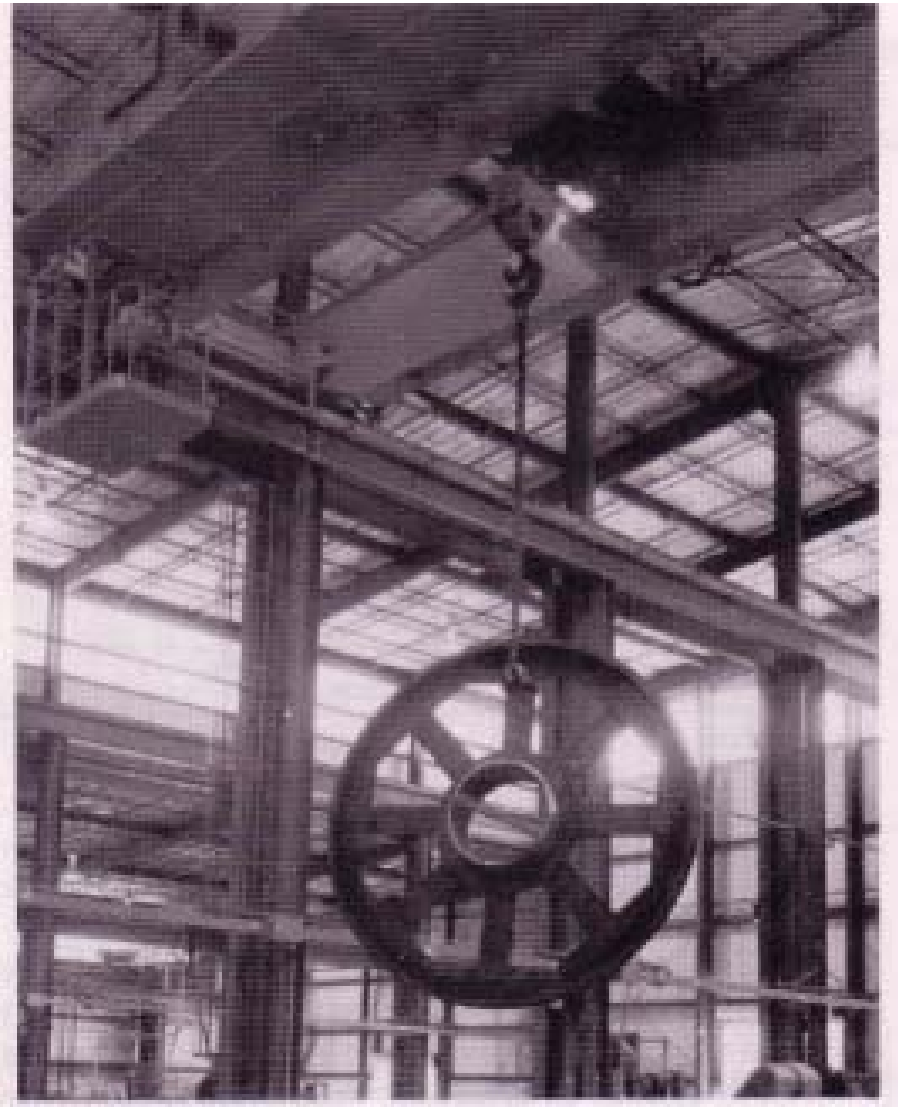
Robot Arms and Manipulators

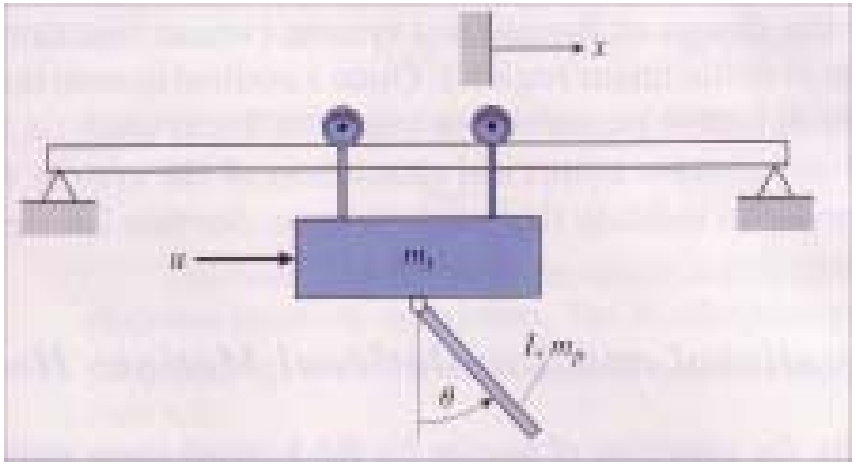




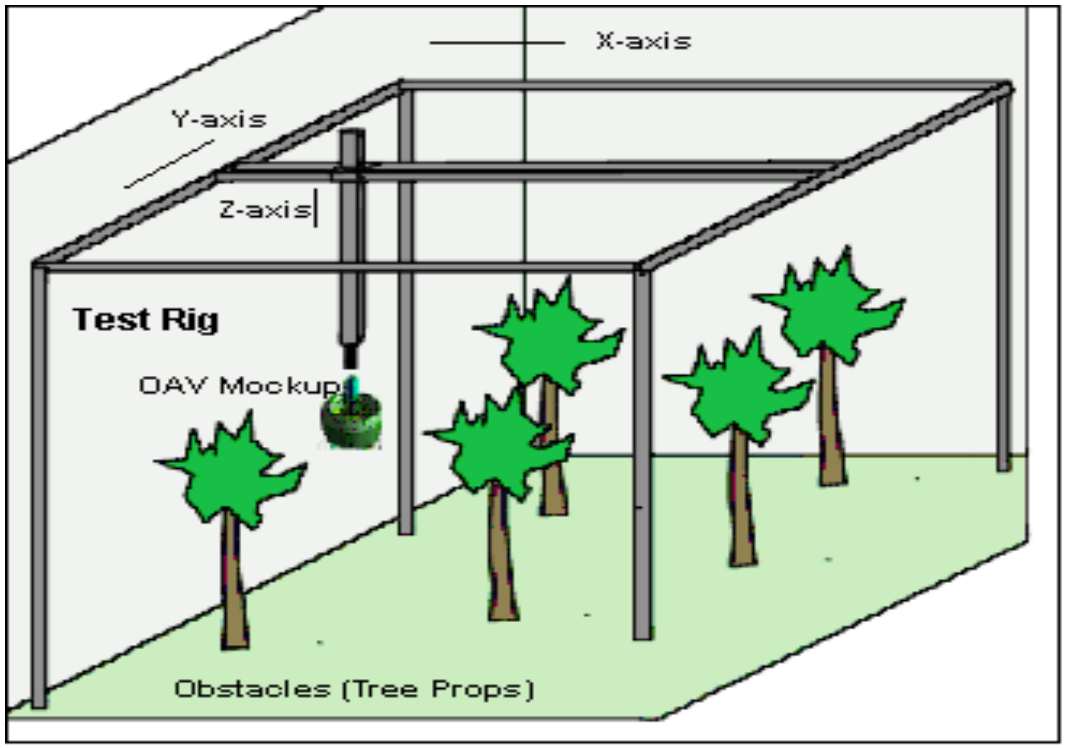
- **2nd order system for each link**

Cranes, Gantries, Booms





- **4th order system**



- **Future Combat Systems**
- **UAV Test Rig**