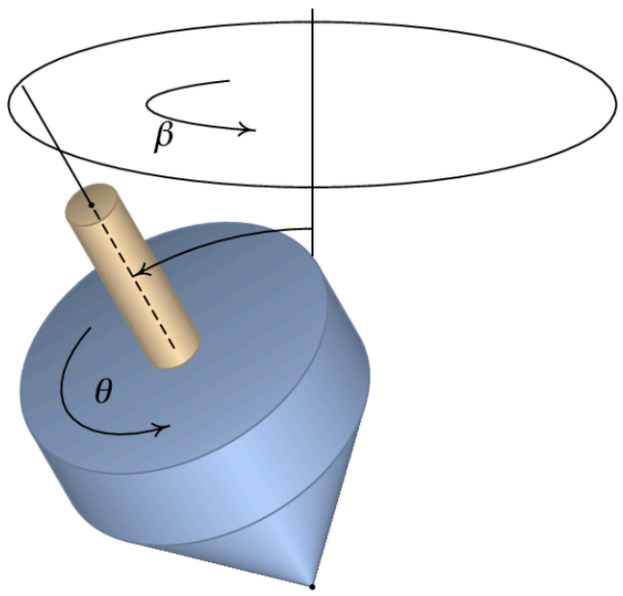
April 14, 2020

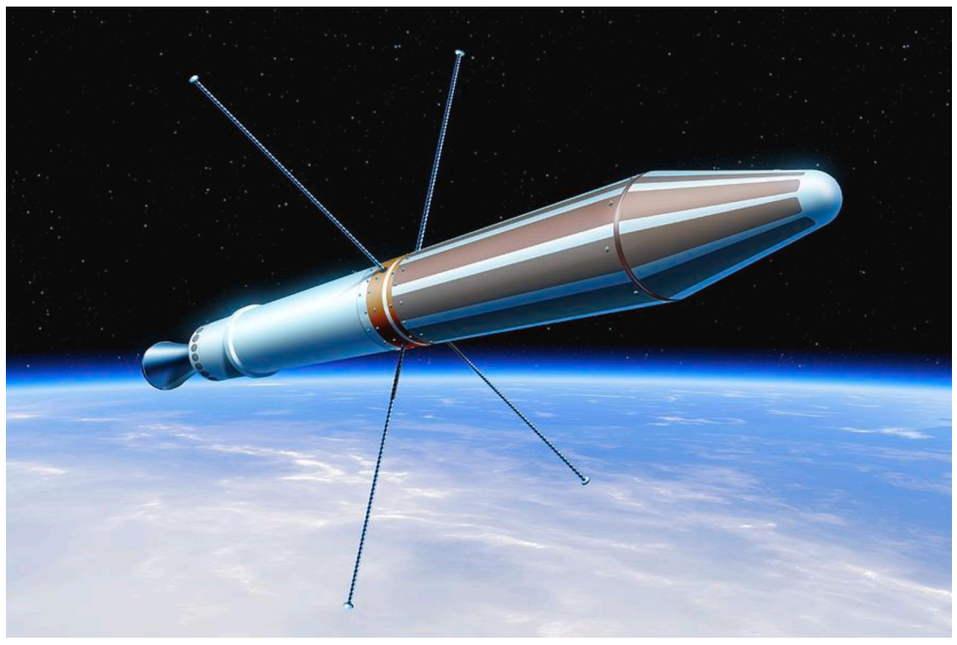
# F=ma

In an inertial frame of reference, the vector sum of the forces $\vec{\mathbf{F}}$ on an object is equal to the mass $m$ of that object multiplied by the acceleration $\vec{\mathbf{a}}$ of the object: $\vec{\mathbf{F}} = m\vec{\mathbf{a}}$.

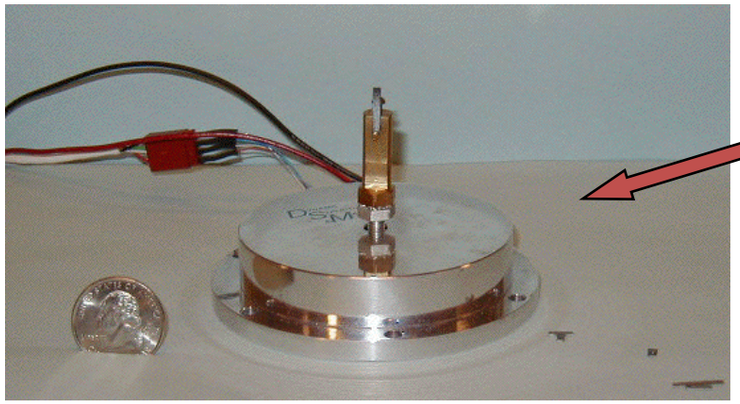
In their original form, Newton's laws of motion are not adequate to characterize the motion of rigid bodies and deformable bodies. Leonhard Euler in 1750 introduced a generalization of Newton's laws of motion for rigid bodies called *Euler's laws of motion.*

—https://en.wikipedia.org/

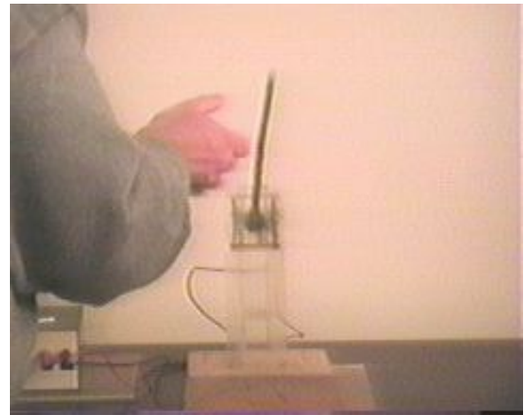


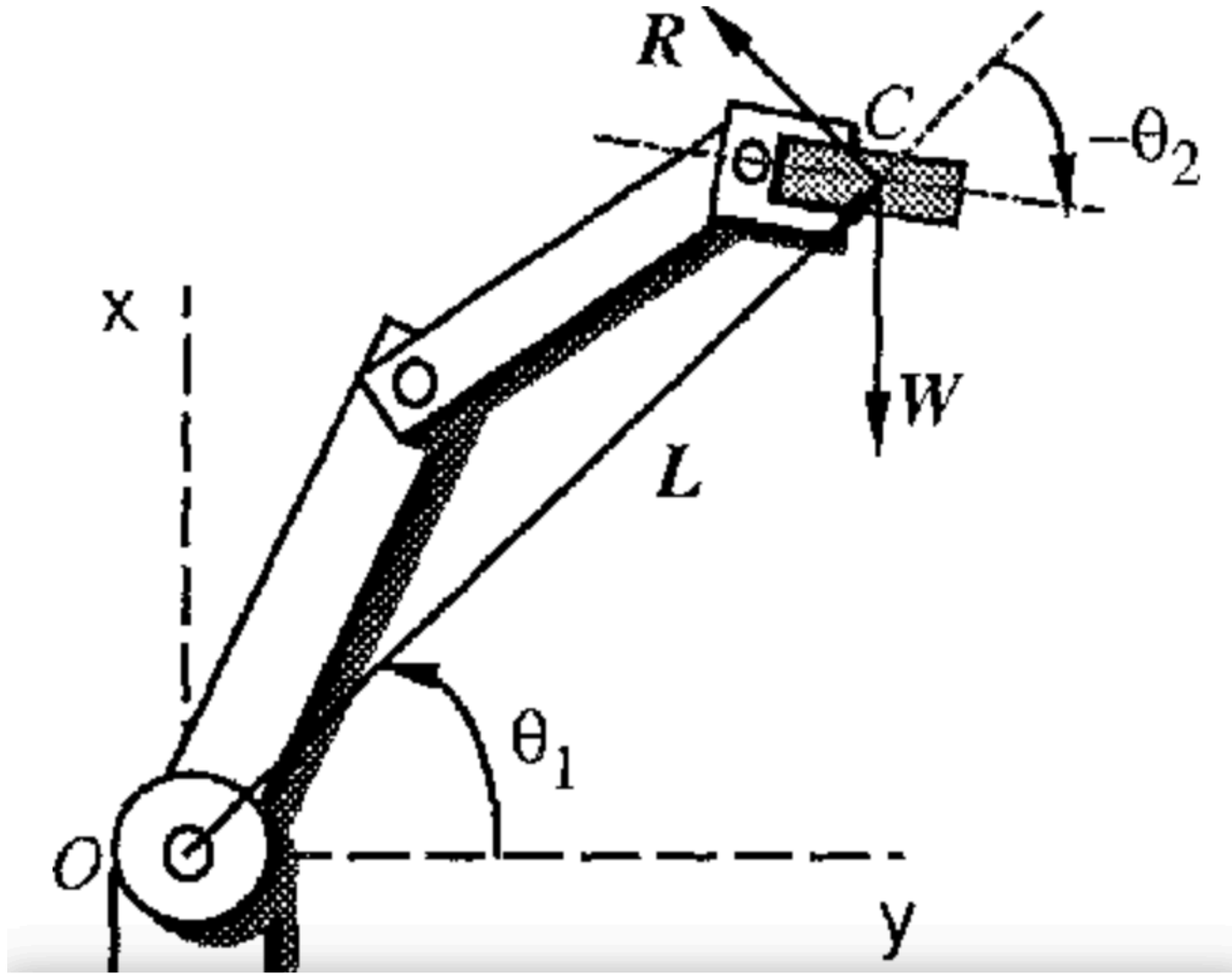



# Time constants, mass, and inertia come important

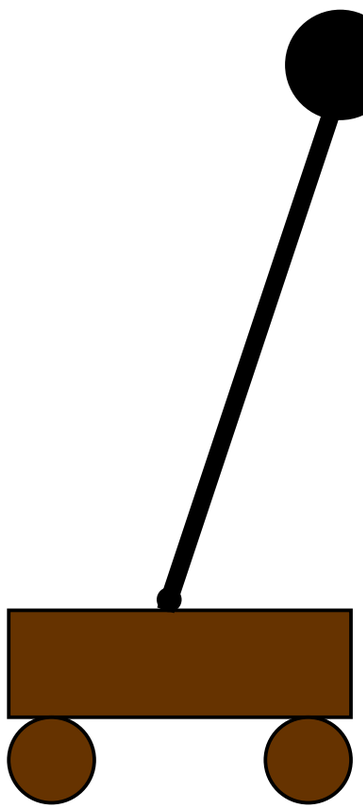


*The world's smallest inverted pendulum--- stabilized by vertical oscillation of the base.*



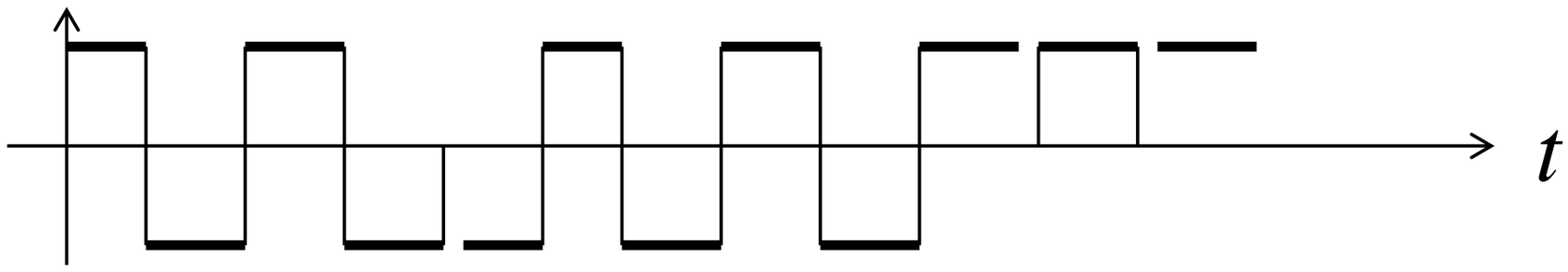
## Suppose there are only two (finitely many) actions that can be taken:



- Jerk the cart left or right one centimeter

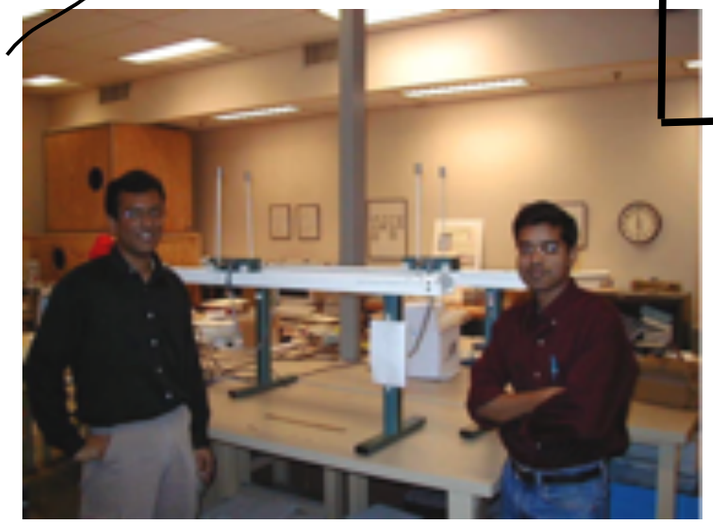
- Under what circumstances can one keep the pendulum upright using this very coarse type of "control?"

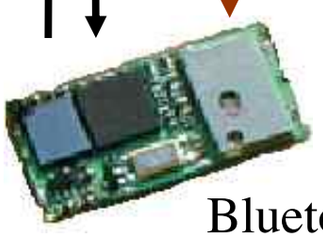
- Ans: If and only if there is a sufficiently high actiel rate.

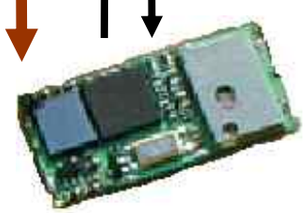



*u* vs *t*

| 12 bits | 4 bits | 16 bits | 16 bits | 16 bits | 0-65535 bytes (theoretic) |
|---|---|---|---|---|---|
| Connection handle | Flag | Data total length | Overall size | L2CAP handle | Payload |
| Overhead = 8 bytes | | | | | Data = 0-65535 bytes |







G(s)

Event Packet

HCI Command Packet

HCI Data Packet

HCI Data Packet

Event Packet

HCI Command Packet

Air Packets: 17 bytes payload

Air Packets: ≤ 366 bits total

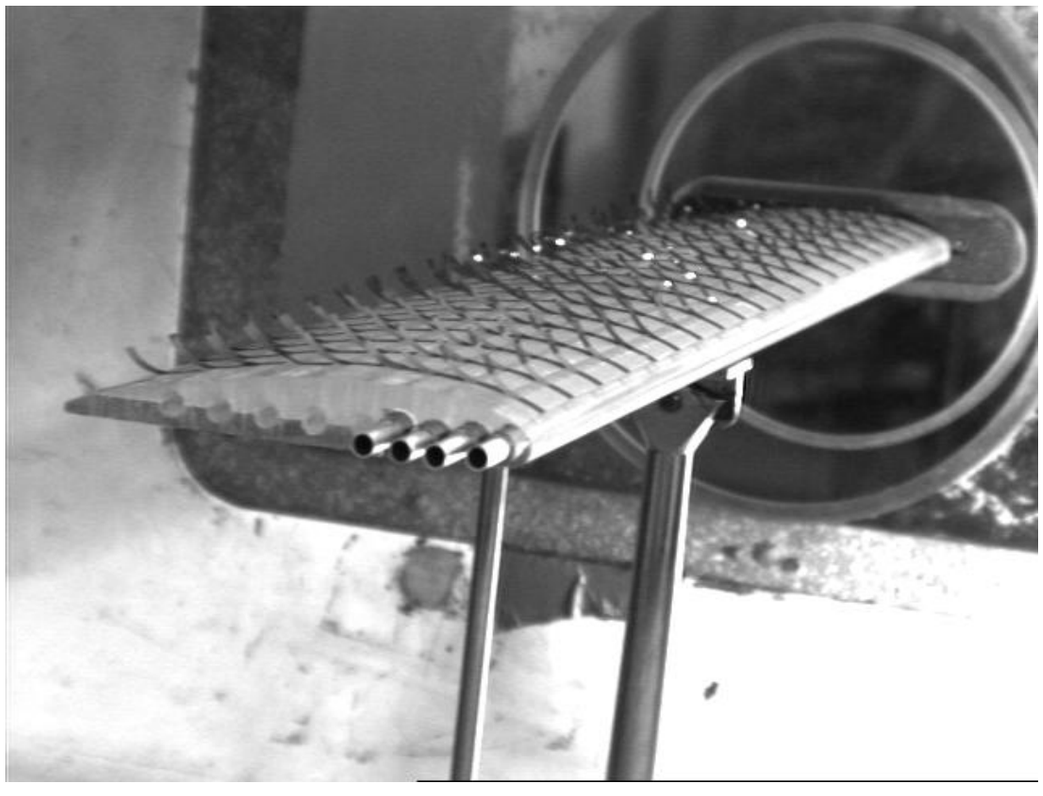
Bluetooth radio

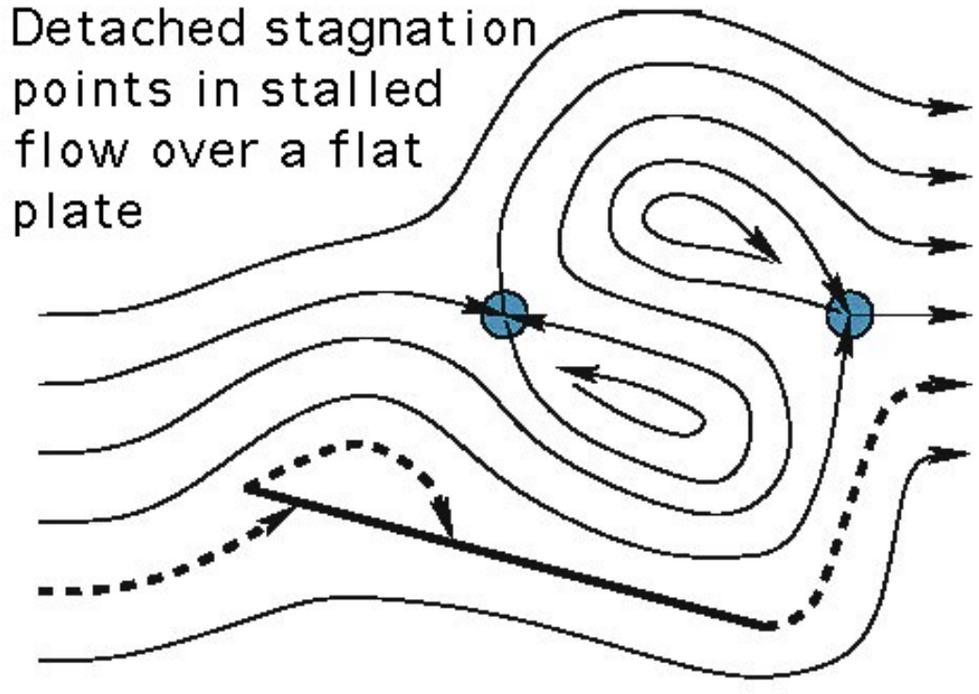
Bluetooth radio

# *Distributed and asynchronous control under communication constraints*

Key Problem:

- Combined control and data-compression






Control of boundary flow using distributed arrays of micro-jet actuators is one target application for use of communicating sensor/actuator networks.

# Housekeeping

- Three people still need to sign up for presentation slots.
- Homework 6 is posted.
- Shout-out to Joanna Thelen

http://www.bu.edu/articles/2020/introducing-dart-a-robot-inspired-by-creatures-in-netflixs-stranger-things/