EE/AA 449
Control Systems Capstone
Project Ideas

Instructor: Eric Klavins

Teaching Assistant: Charlie Matlack

Course Structure

- Groups of three
- Must have a “customer”
- Projects should include feedback control
- Can be hardware or software based
- Five milestone reports / five presentations
- Lab visit / demo
- Grades based on
  - Reports
  - Presentations
  - Lab demo
  - Evaluation of you by your partners
  - Evaluation by the customer
  - *General awesomeness of the project*

High Throughput Chemostat

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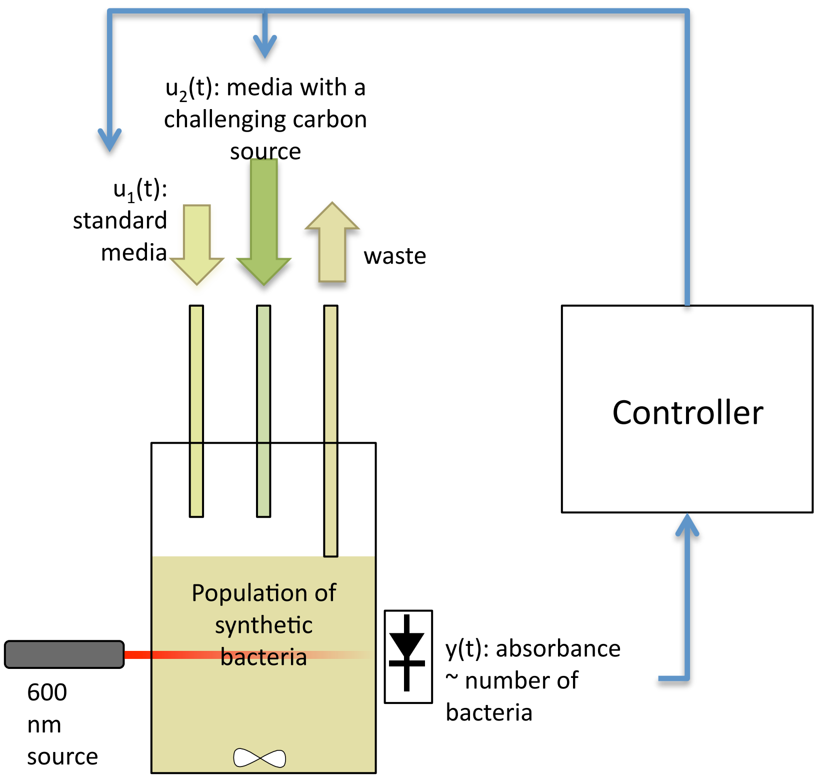

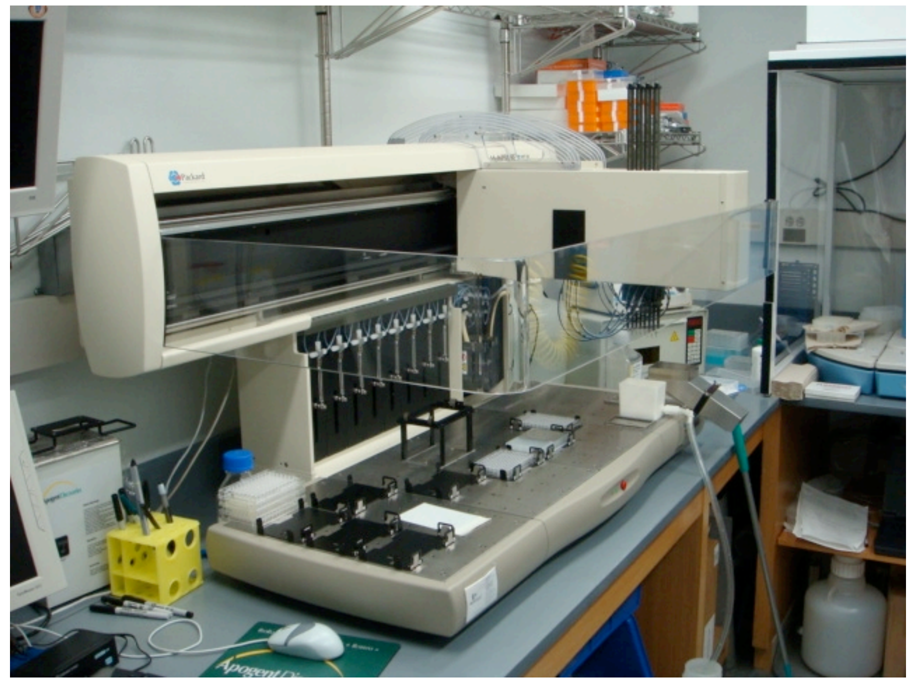

Goals:

- •Program / configure the liquid handler to act as a chemostat
- •Interface with other pieces of equipment
- •Create a “directed evolution experiment configuration tool
- •Perform demonstration experiments in direct evolution

Mini Plate Reader

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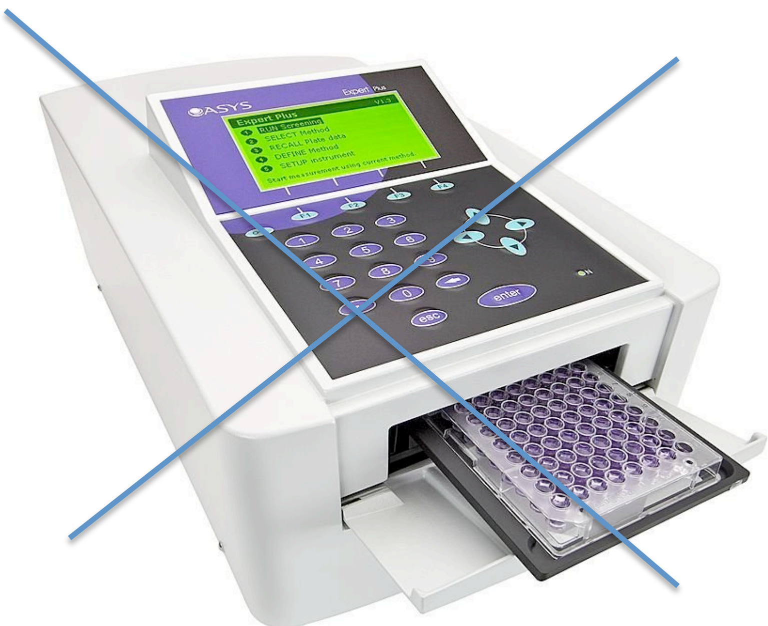
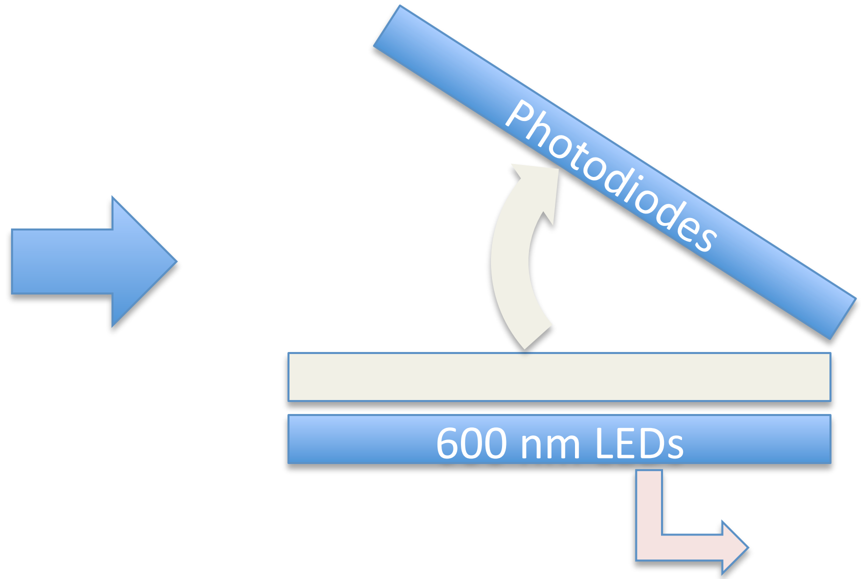
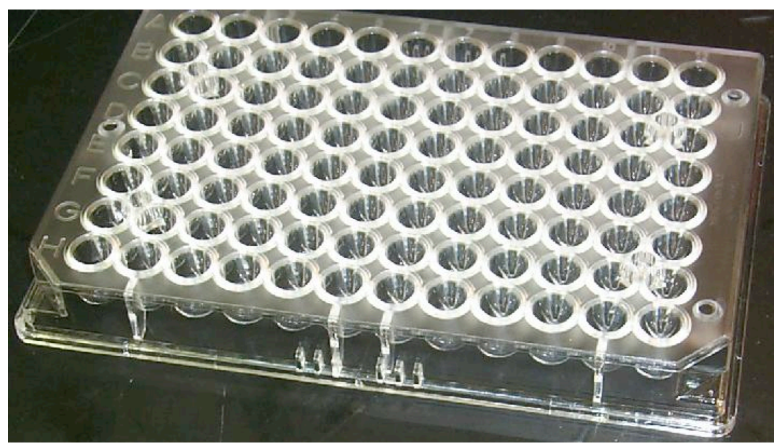




USB Interface to liquid handler



Goals:

- Interface with chemostat team to demonstrate "turbidostat" behavior!

Microfluidic Chemostat

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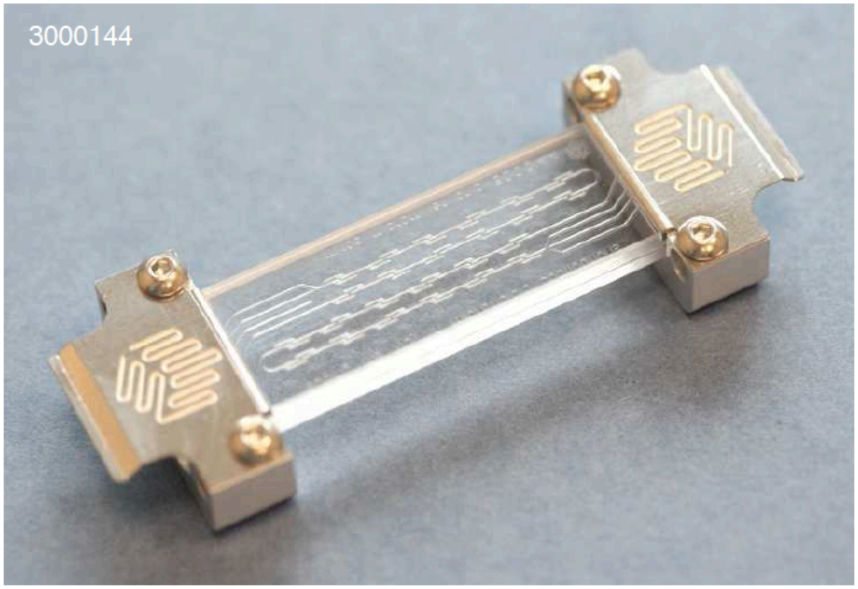

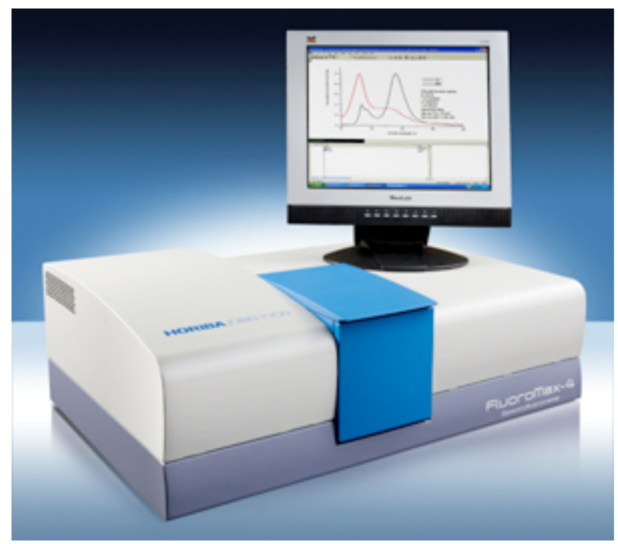

E + S <-> ES -> E+P
Requires “fuel strands”
P is fluorescent
Goal: replenish reactants to keep the reaction going indefinitely.

Electrokinetic Mixer

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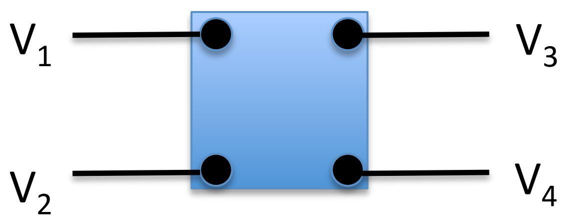

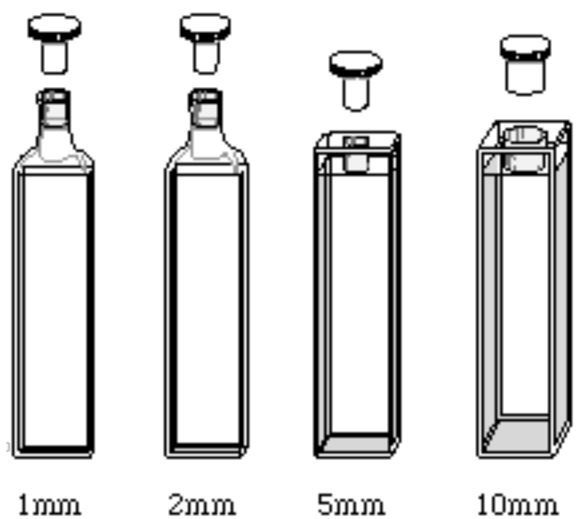

Idea: Polar molecules move in response to electric field increasing interactions = increasing the effective rate of diffusion!

Goal:

1) Demonstrate electrokinetic mixing with simple DNA reactions.

2) Design a computer interface (USB or similar + GUI)

3) Scale up to 96 well plate attachement.

Factory Floor Robots

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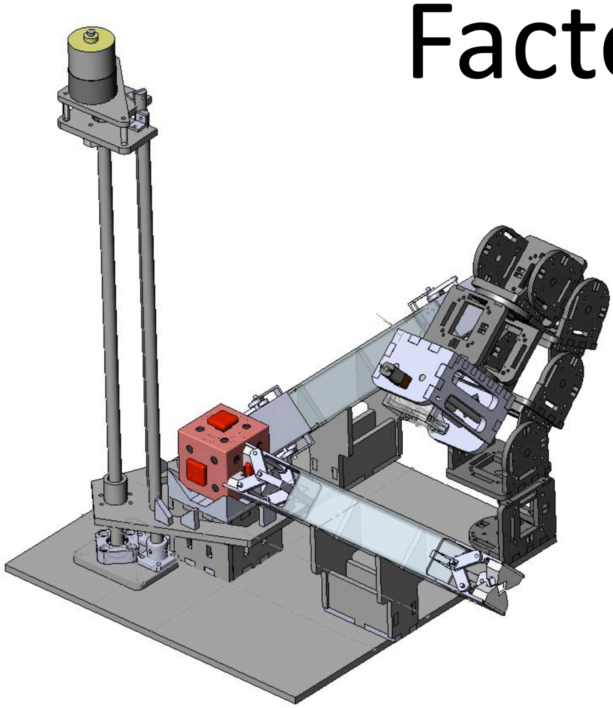
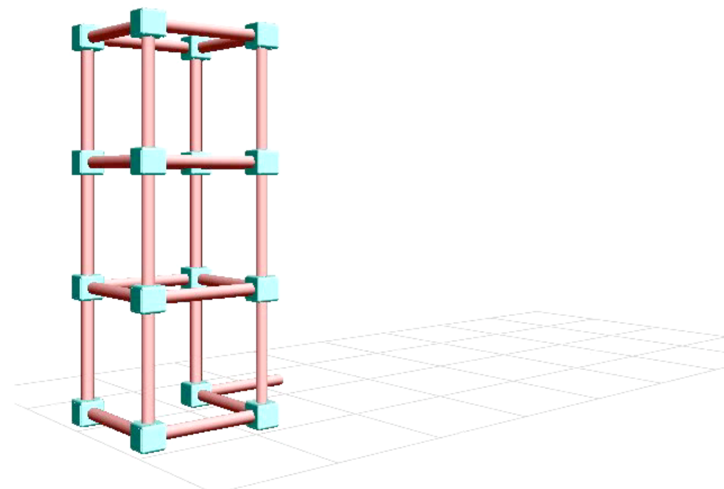
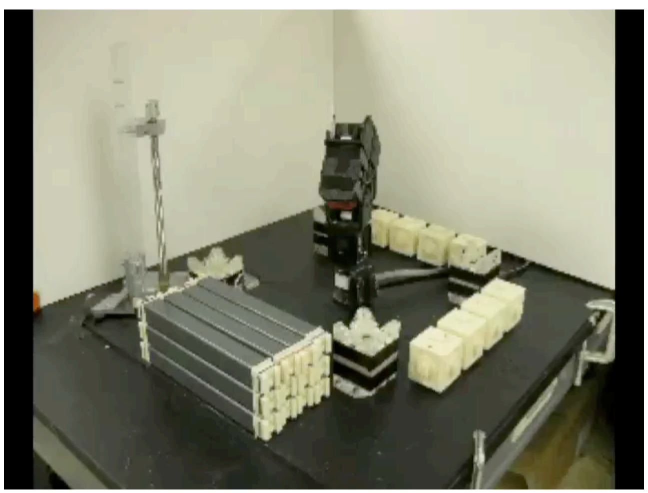






UW Just received first shipment of robots.

Goals: Program robot in CCL with distributed algorithms for assembly.

Software in the loop.

Travel opportunities.

Energy-Based Feedback Control of Communication and Coordination of Underwater Vehicles

Goal: Construct an algorithm for multivehicle control that uses more or less communication (transmissions of bits per second) to perform a task with more or less accuracy (error between desired and actual states)

Steps:

- Determine accuracy relation for a given task based on received information (e.g. headings of other vehicles at a given update rate)
- Change transmission rate (feedback) based on desired accuracy relative to measured accuracy
- Implement algorithm on fish robots and potentially on Seagliders

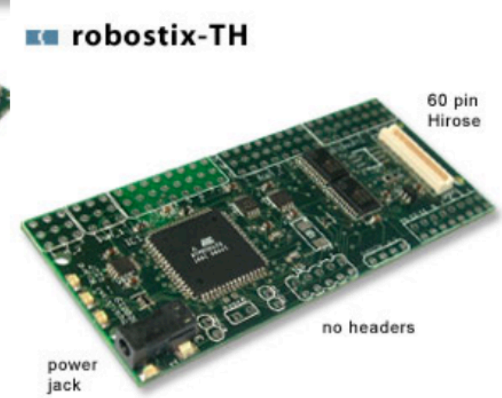
Skills: Programming in Matlab, interest in working with hardware

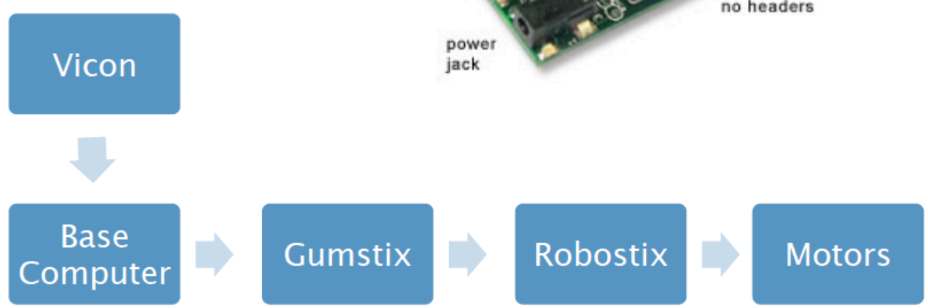
This work is in support of ongoing grants from NSF and ONR

Department of Aeronautics and Astronautics
Nonlinear Dynamics and Control Lab
Prof. Kristi Morgansen
http://www.aa.washington.edu/research/ndcl

Quadrotor Control (DSSL- Mesbahi)

- Given the equations of motion governing the quadrotor, develop the control law based on the nonlinear or linearized dynamics of the vehicle.
- **Primary Objective:** To get the quadrotor to a specific position in a well-defined grid (X,Y,Z) and hover at that point.
- **The Quadrotor:** Draganflyer XP by Draganfly Innovations, Inc.
- **Sensors:** Hi-Res motion capture IR camera system from Vicon. It is used to determine the position and orientation of the vehicle.
- **Control System:** Candidate Control Laws have been developed that need to be refined and tested.
- **The computer-on-module:** The Gumstix-Robostix-wifi assembly sits on the Quadrotor. The Gumstix receives commands and data from the base (Linux) machine through the 802.11g wireless interface and sends the signals to Robostix(AVR) which drives the motors.





Feedback Controlled Spotter

- Goal: Add visual feedback to a spotter
- Customer: Prof. Michael Hochberg (EE)