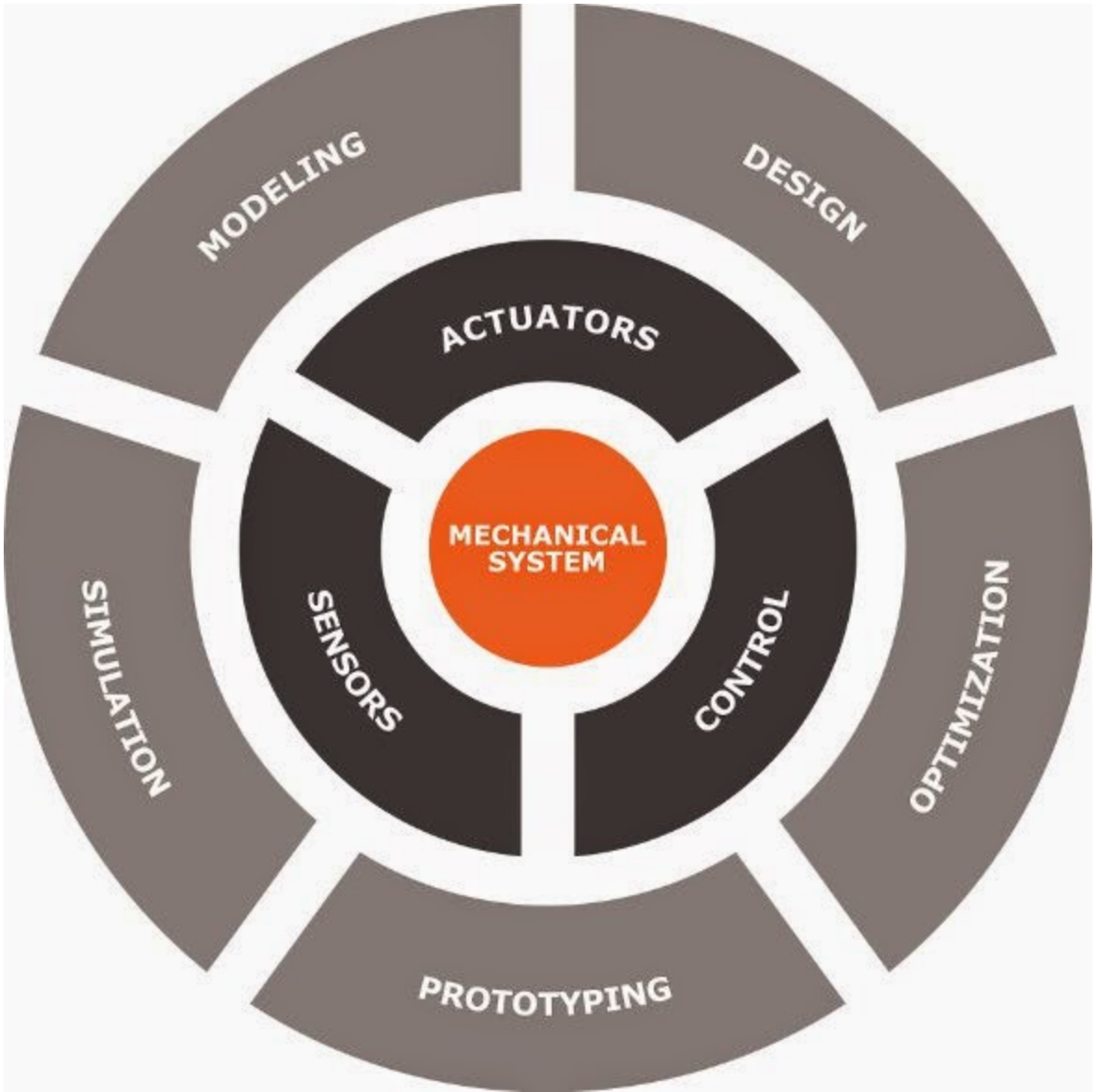
Mechanical & Industrial Engineering Course and Option Talk - **Mechatronics**



3rd Year Curriculum Overview

FALL

- **MIE301: Kinematics and Dynamics of Machines (my course)**
- MIE312: Fluid Mechanics I
- **MIE342: Circuits with Applications to Mechanical Engineering Systems**
- MIE258: Engineering Economics and Accounting
- Natural science requirement

WINTER

- MIE315: Design for the Environment
- MIE313: Heat and Mass Transfer
- MIE334: Numerical Methods I
- **Two stream option courses**

4th Year Curriculum Overview

FALL

- MIE491: Capstone Design
- **Two stream option courses**
- **One Technical Elective**
- Other: HSS or CS Elective

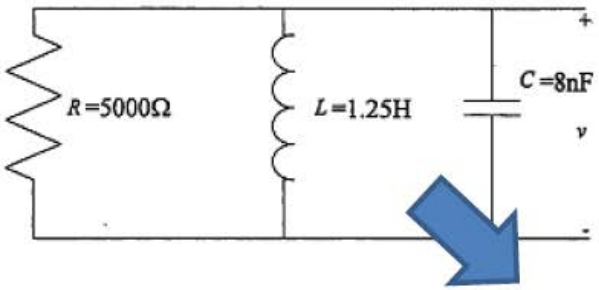
WINTER

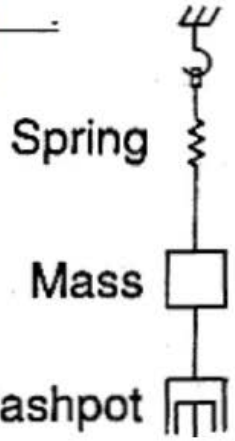
- MIE491: Capstone Design
- **Three Technical Elective courses**
- Other: HSS or CS Elective

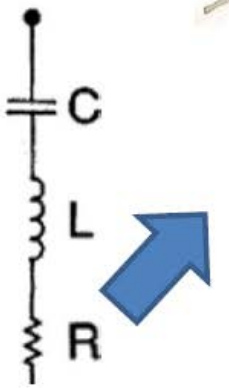
Mechatronics – Core Courses

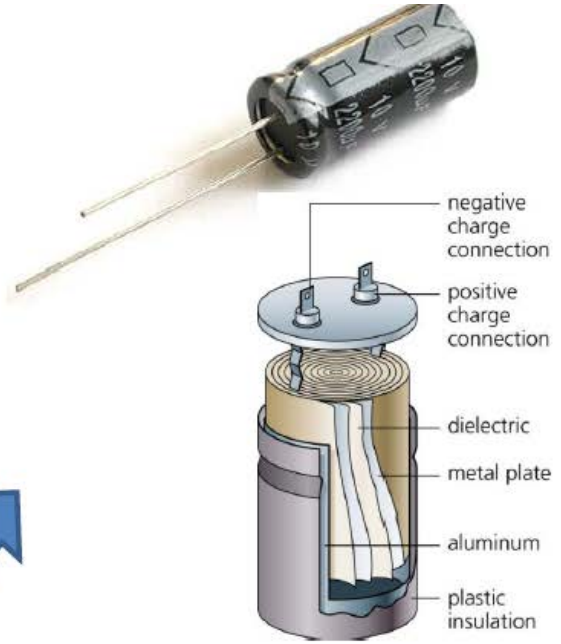
3F Term – **MIE342 – Circuits with Applications to Mechanical Engineering Systems**

- **Course Description:** Teaches basic techniques for analyzing circuits (things like current and voltage laws) and circuit components (such as sources, inductors, capacitors, op-amps etc.)





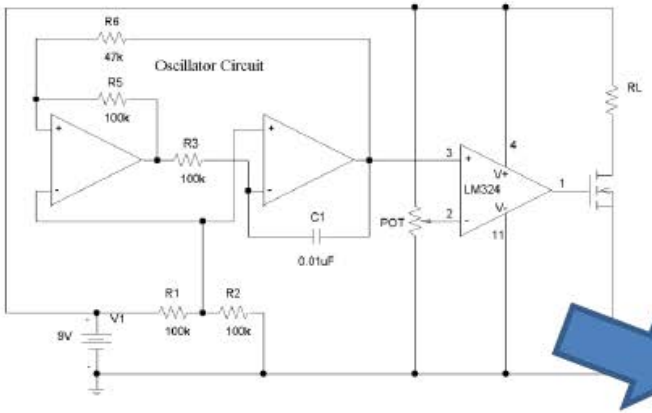


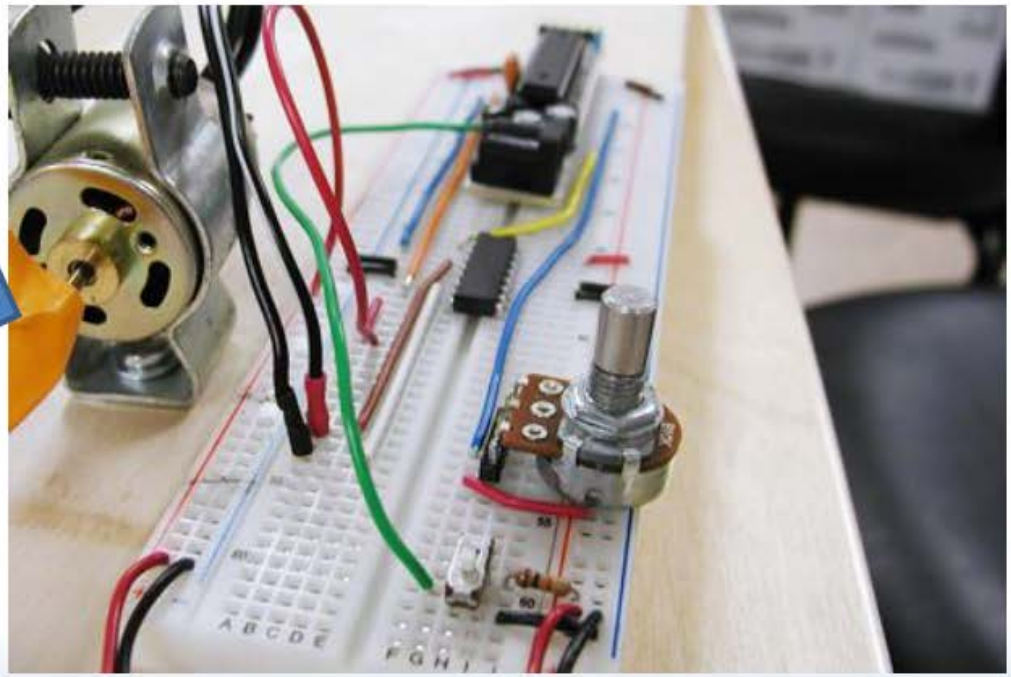


Mechatronics – Stream Courses

3W Term – **MIE346 – Analog & Digital Electronics**

- **Course Description:**. Teaches advanced circuits – motor drivers, oscillators, filters, plus new semiconductor devices (diodes, MOSFETs, BJTs), plus real world design and analysis

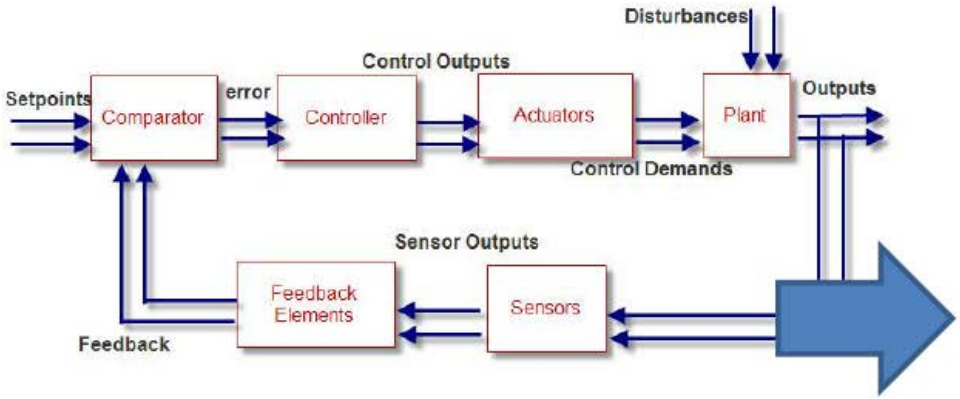


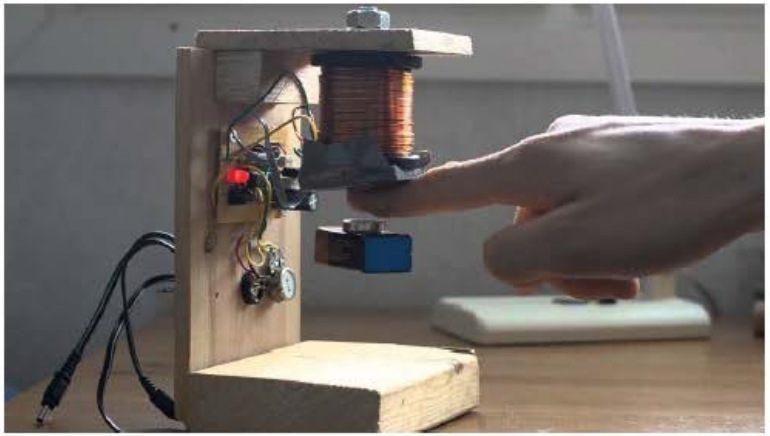


Mechatronics – Stream Courses

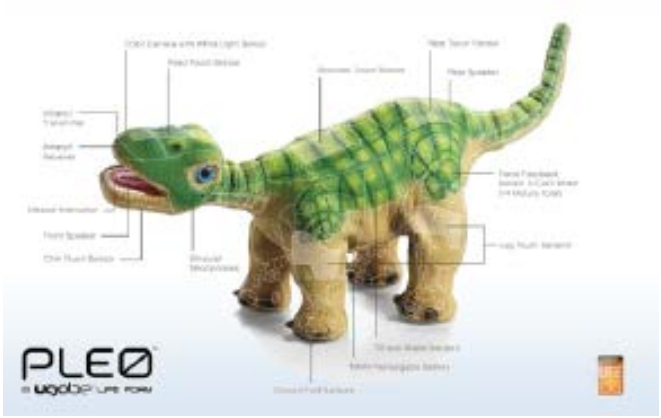
4F Term – **MIE404 – Control Systems I**

- Teaches **general methods to control a feedback system**; both mathematical and practical (i.e.: Magnetic Levitation control lab)





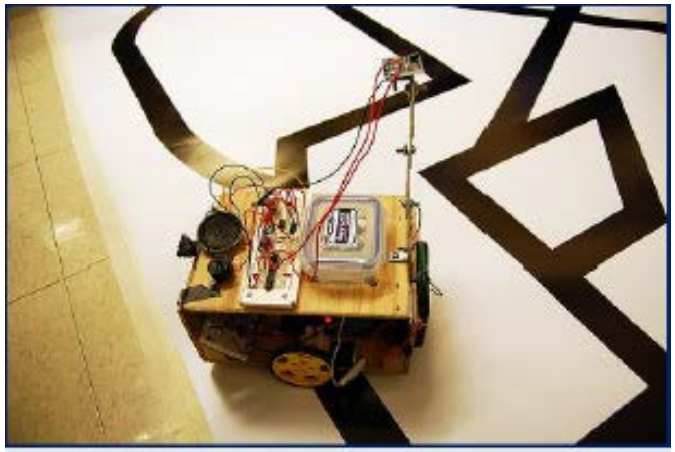
Notable Technical Electives



MIE443

Mechatronic Systems Design and Integration

Design Course – Teaches the design process, automation, and integration of real-world Mechatronics systems (practical design)



MIE444

Mechatronics Principles

Design Course – Smart Systems, Interfacing and Control, Modeling, and a **practical project** (build a line follower)

Technical Elective: MIE438 – Microprocessors and Embedded Microcontrollers

- **Embedded Systems** – Everything from home and office appliances to video game consoles, cars to cell phones, etc.

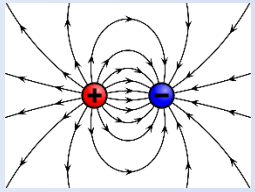
What is MIE438 about?

- Number representations (175 = 10101111 = 0xAF)
- Machine-level programming
- Translation between high level code (C, Python, etc.) and low level (Assembly) codes
- Interfacing with inputs and outputs (sensors, motors, LCD, etc.)
- CPU-based control
- …

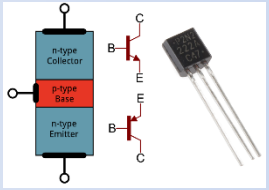
Course Project: **Design** and **build** a Mechatronics-related embedded system using a microcontroller

Past Project Examples:

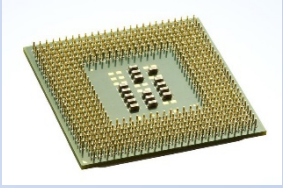
- Automatic Card Dealer
- Gesture-Controlled Helicopter
- Cell-phone Controlled Robot
- Rubik's Cube Solver
- Pendulum Damping Cart
- Shooting Gallery Game



Electrons



Transistors



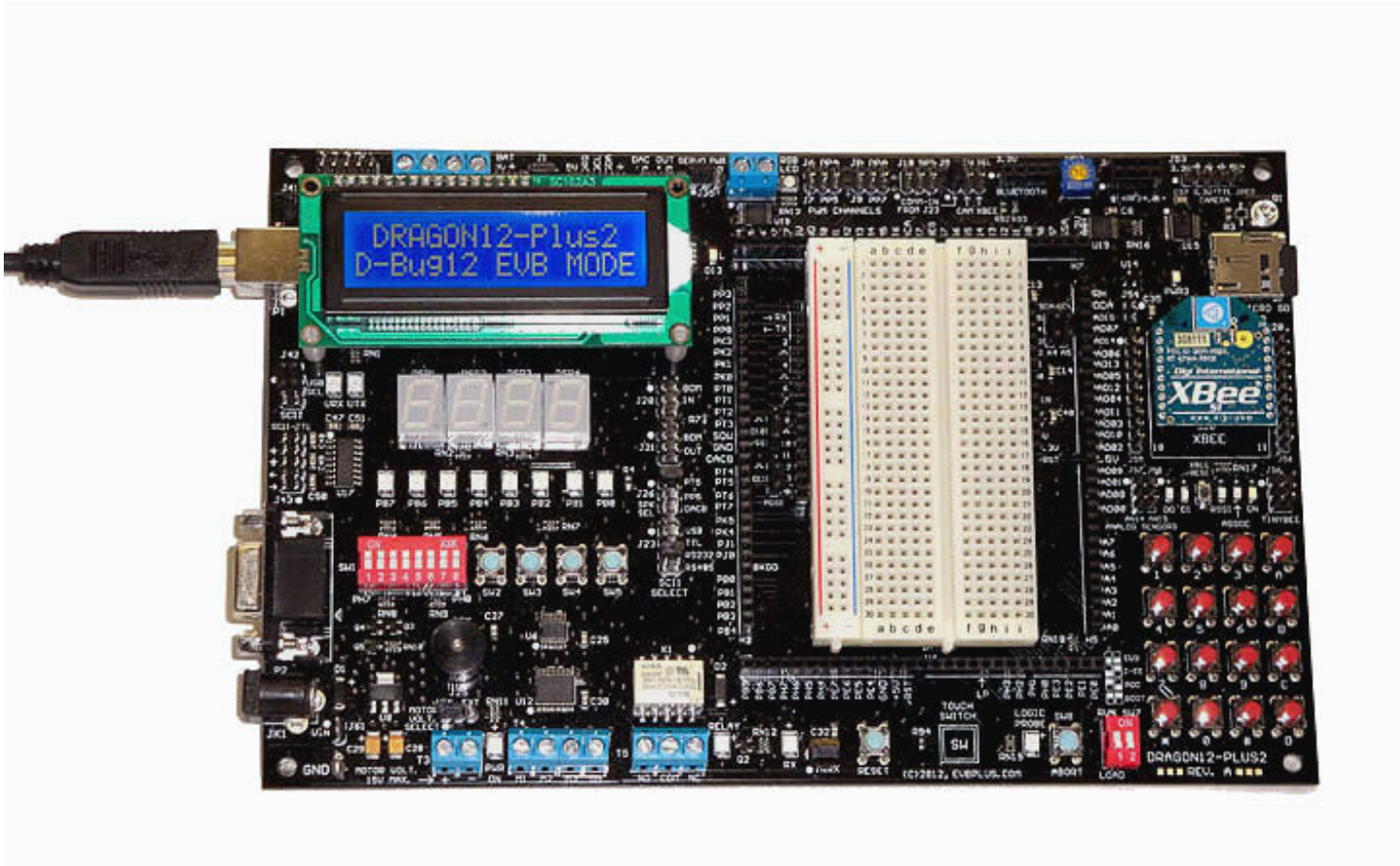
Processors

Data Storage

Microcontrollers

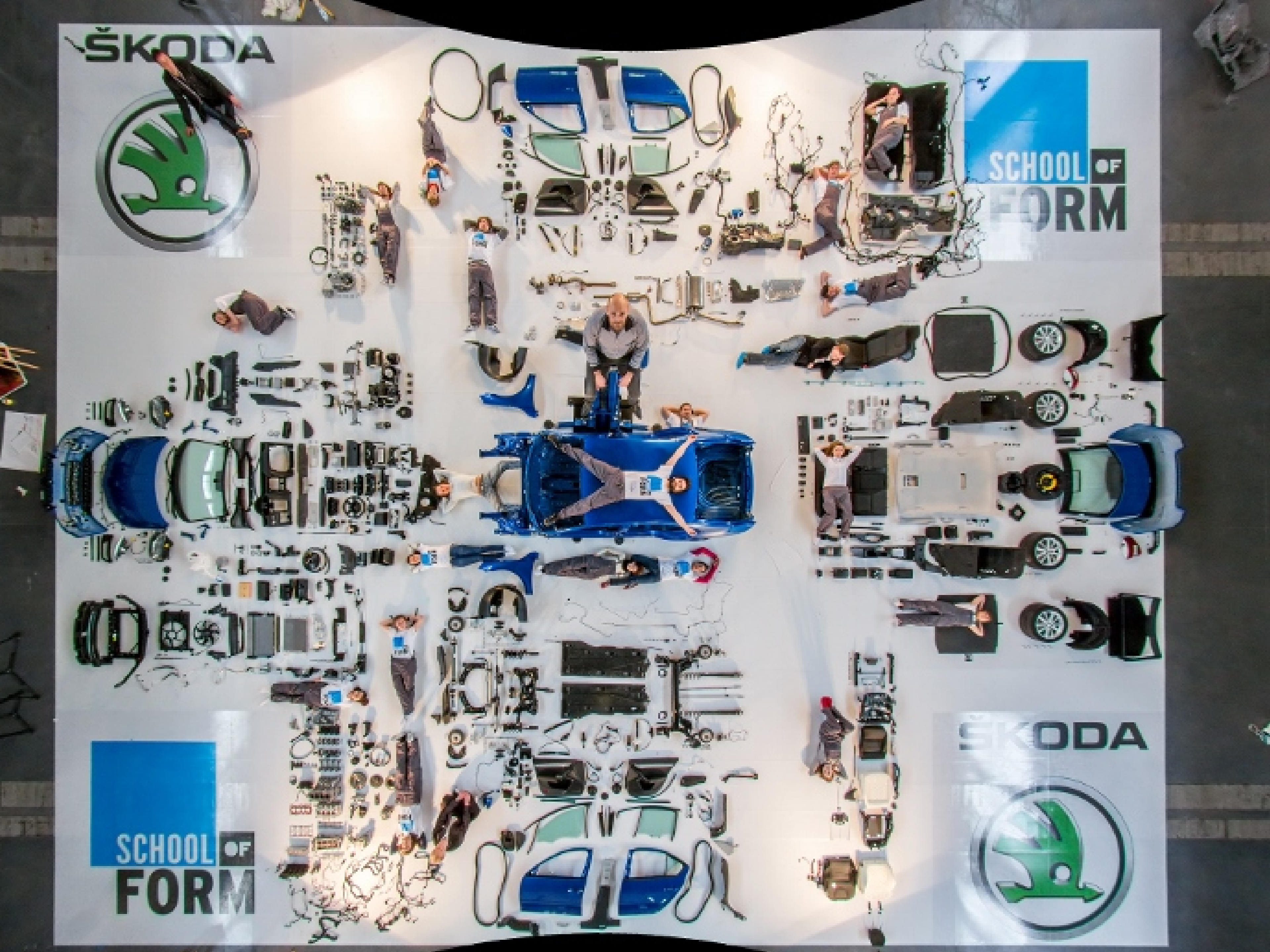
Embedded Systems

MIE438 Labs



Mechatronics Overview

- Interdisciplinary:
  - Mechanical, electrical, computer science
- Design of **complete** modern mechanical systems with integrated electronic components
- Examples: robots, appliances, cars, aircraft, spacecraft…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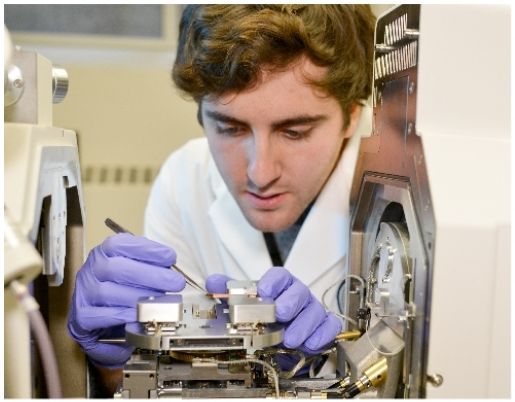
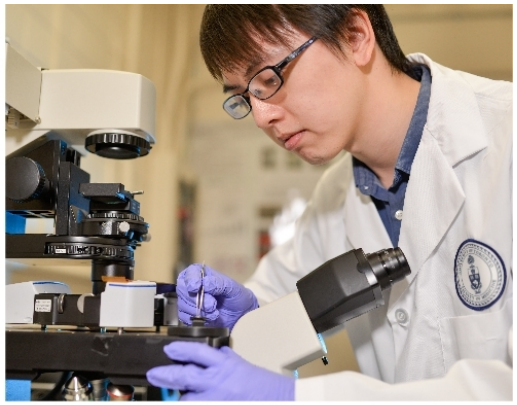
Mechatronics - Jobs

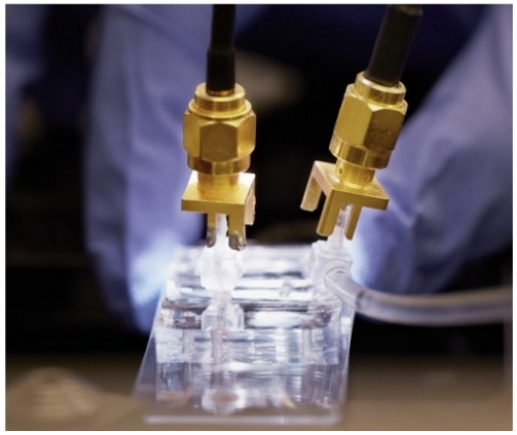
- Mechatronics is often misunderstood as a field:
  - "Control Engineer", "Electrical Engineer", "Automation Engineer", "*Industrial* Engineer", etc.
- Most commonly listed by **secondary** specialization, when the real goal is still to hire someone with **mechatronics** background
- **Suggestion**: Explore a secondary specialization, especially after graduating, and highlight this to potential employers. Build a design portfolio.

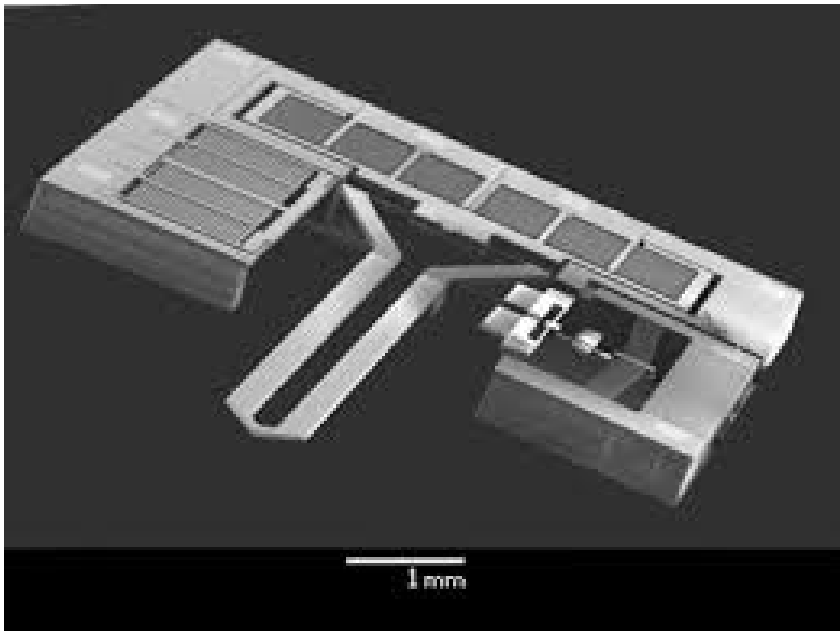
Mechatronics Research: MEMS

(Micro-Electro-Mechanical Systems)





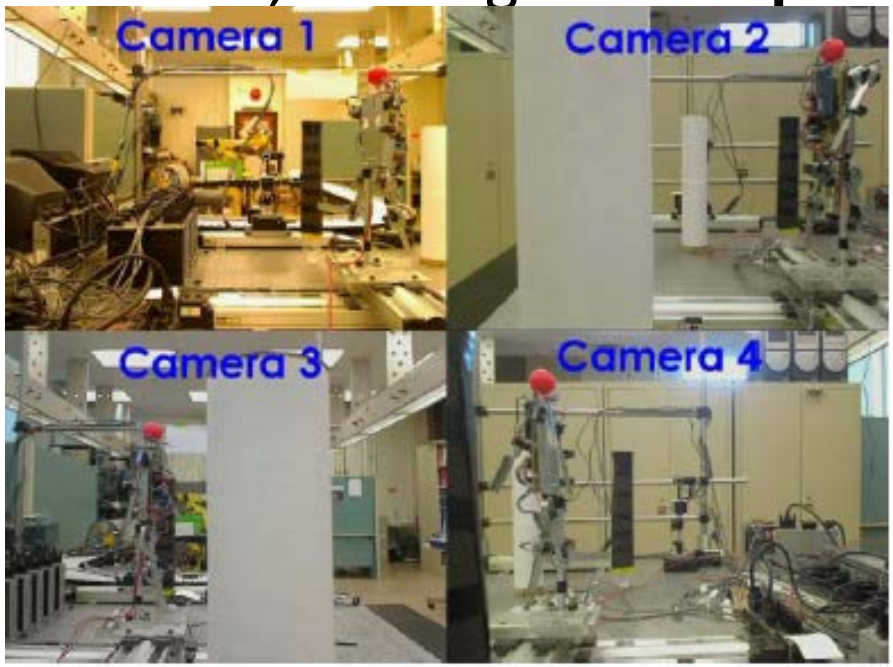




Relevant Labs: Profs. Liu, Sun, Mills, Ben Mrad

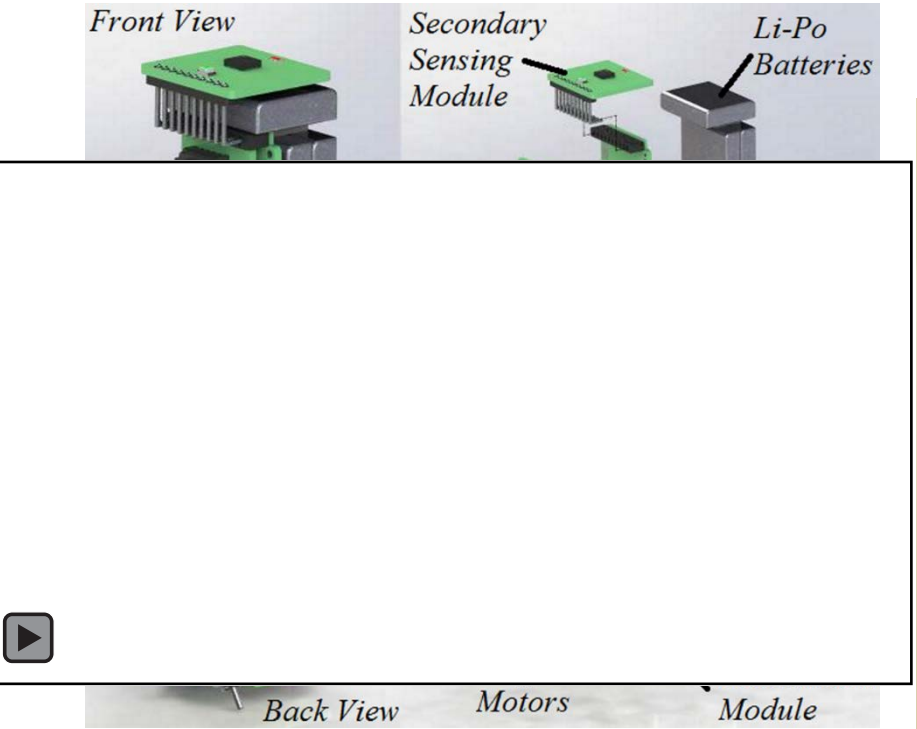
Mechatronics Research: Computer Vision

Example: active vision: Using cameras that **move** in response to what they are seeing, in order to see **better** in the future. May also be **predictive**, moving in **anticipation** of future actions.



Relevant Labs: Profs. Benhabib, Nejat

Mechatronics Research: Robotics



Swarm Robotics and mROBerTO

Human-Robot Interaction (Goldie Nejat)

Relevant Labs: Profs. Diller, Sun, Nejat, Mills, Benhabib

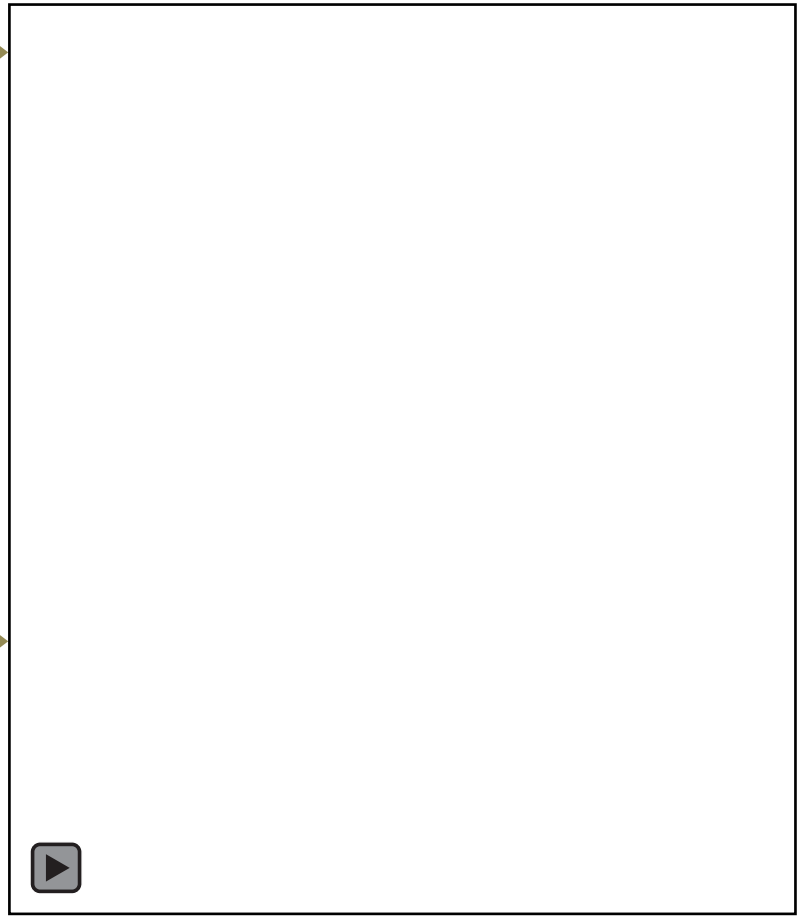
Wireless Medical Microgripper

- 3D symmetric structure
- controlled by a single magnetic field
- reliably grip cargoes of various shapes
- fast grip-and-release up to 20 Hz in water
- no adverse effect on living cells
- -> applying to biopsy tasks

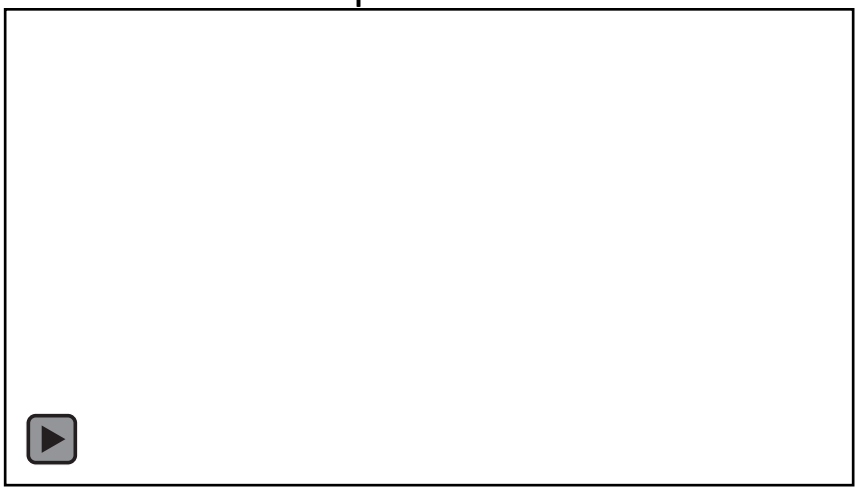
Real-time autonomous microgripping and cargo delivery

top view

side view



concept illustration



magnetic field field gradient

J. Zhang, O. Onaizah, K. Middleton, L. You, and E. Diller," *IEEE Robotics and Automation Letters* 2017

Course and Option Talk – **Mechatronics**
Questions?

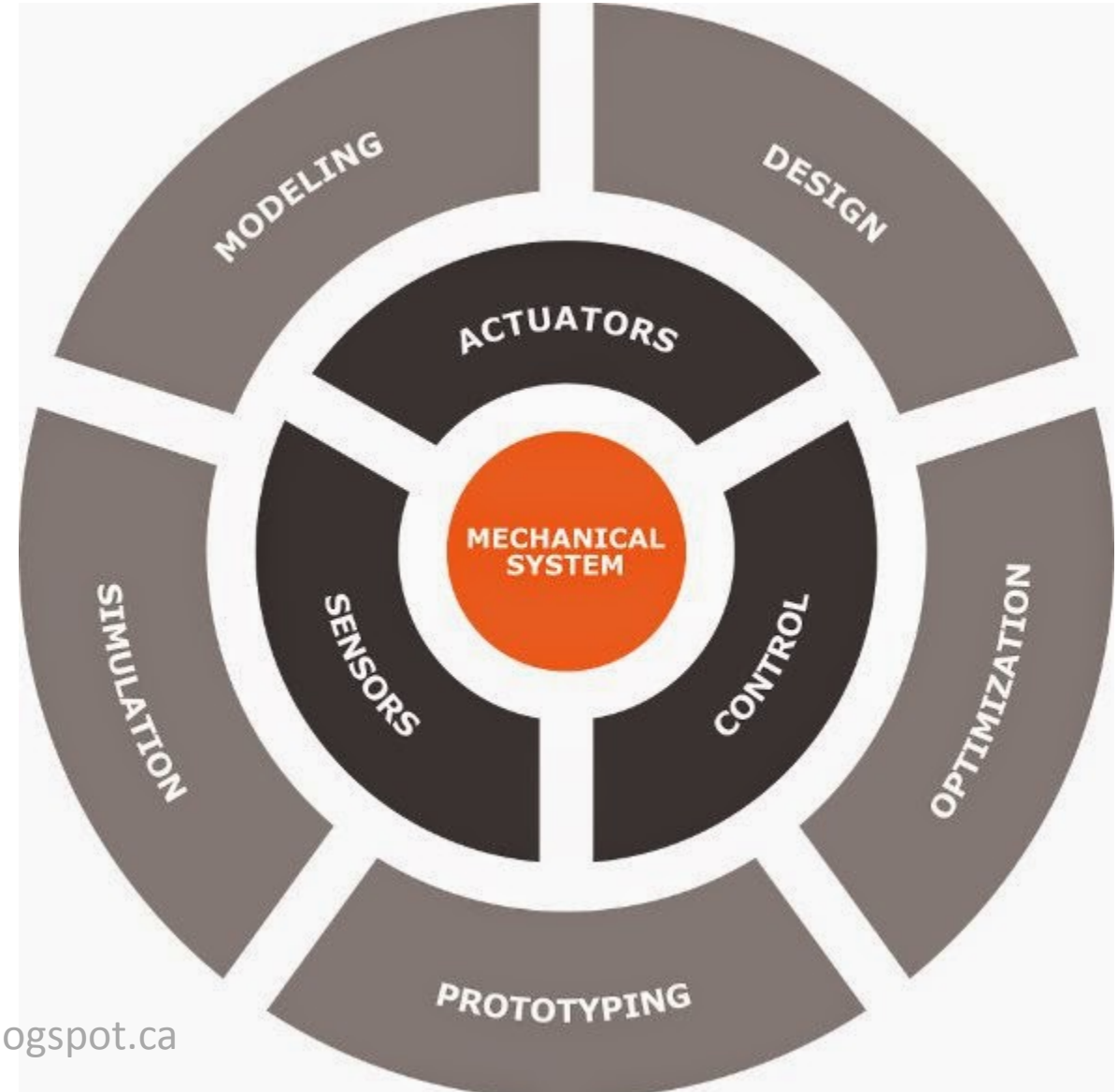


Image from
i-mechatronics.blogspot.ca