ME 425/625 – Robotics

Closing Remarks

Review

Part 1: Mechanisms

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

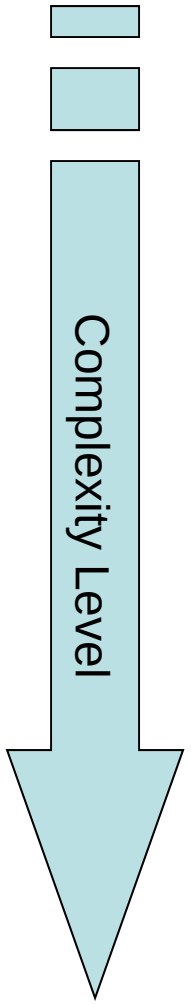
Lecture 03: Simple Machine III: Ratchets, Drives, And Gearing

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

Reinforce Fundamentals

Exploration

Part 2: Hardware and Software

Week	Focus	Learning Outcome
9	Robot Sensing	- Files and timers - Voltage dividers, ADC, op-amps - Touch sensors, voltage drivers - I2C, relays, motor drivers
10	Robot Actuation	
11	Robot Communications	

Project : H-Bridge Project “Putting it all together”

- Digital inputs: read sensors (12-key keypad)
- Algorithms: action based on sensor (direction control)
- Digital outputs: transistor-based H-bridge motor control

ME425/625 was a “buffet” approach that “taste” various aspects of robotics with broad utility for mechanisms, data acquisition, automation and digital interfacing

ABET Relation to Program Objective

(0 = No content; 1 = some content; 2 = significant content)

Objective	Content	Explanation	Evidence*	Specific Examples
1. To deliver a comprehensive mechanical engineering curriculum which emphasizes both the **foundations** and breadth of the mechanical engineering profession	**2**	Advanced laboratory experience in robotics	Project reports and lab exercises	• Fundamental mechanisms (culminated by Automata Project) • Fundamental micro-electronics (culminated by Brick microprocessor H-bridge project)
2. To provide an education that equips students with the tools necessary to become successful mechanical engineers based on their experience, strong **communication skills** and awareness for the need of continuous professional development.	**2**	Students are exposed to hardware and software tools, simulation and report writing.	Class discussions, project reports, class handouts.	• Automata Project class presentation (written and oral) • Online content e.g. code (sometimes cut-and-paste, sometimes force students to create on their own)
3. To provide an education that will allow mechanical engineering students to understand the **social, economic, environmental, political and ethical** importance of their future profession.	**1**	Digital concepts through hardware and software are essential in the design of robotic systems in automobiles, power plants and other vital areas of the economy.	Brief videos of robots and robot-based platforms for society e.g. driverless cars are introduced and discussed.	• 6 videos (once per week) on robotics and ethics, with 10-15 minute of class discussion including: robots and jobs, existentialism, robot companionship
4. To provide mechanical engineering students with a thorough understanding of impact of mechanical engineers and the mechanical engineering profession in the development, implementation and creation of future technology	**2**	Development and innovation of robotics will be part of the future technology	Brief videos of robots and robot-based platforms for society e.g. driverless cars are introduced and discussed.	• Humanoid robot demonstration and importance of training for international research collaborations and complex systems engineering

Relation to ABET Criteria 3 Learning Outcomes

(0 = No content; 1 = some content; 2 = significant content)

Criteria a – k	Content	Explanation	Evidence (Specific Examples)
a. An ability to apply knowledge of mathematics, science and engineering	2	Relevant physics, equations of motion, state space realizations and control techniques are derived	Mechanism design, 1st order motor dynamics (rise time), robot sensing, actuation, interfacing
b. An ability to design and conduct experiments as well as to analyzed and interpret data	2	Students write software and interface mechanical and electrical hardware. They are also required to analyze and interpret the experimental data in the report.	Sampling exercises (signal analysis and application of Shannon sampling theorem)
c. An ability to design a system, component or process to meet desired needs	2	Controllers are both simulated and implemented experimentally.	Projects: Automata (exercised CAD and Bill-of-Materials) and H-bridge (exercised Bill-of-Materials and schematics)
d. An ability to function on multidisciplinary teams	2	Students work as a team to use their knowledge in electronics, and computers to achieve the objective of each experiment in this course.	Weekly hands-on lab; students sat next to each other and helped each other; Projects (2-3 students per team)
e. An ability to identify, formulate and solve engineering problems	2	The students are required to formulate and solve the H-bridge motor control problem based on theory and to verify their experimental results with expected theoretical results.	Project: H-bridge and keypad
f. An understanding of professional and ethical responsibility	1	This is emphasized as part of the design engineer's overall responsibility.	6 (or 12 weeks) of weekly videos and 15-min class discussion
g. An ability to communicate effectively	2	Oral and written presentations of the experimental procedure and results are required.	Project reports (written and oral)
h. The broad education necessary to understand the impact of engineering solutions in a global or societal context	1	The impact of engineering design on the environment (pollution, greenhouse effect, etc.) and society are covered.	Videos and discussion
i. A recognition of the need for and an ability to engage in lifelong learning	1	Improvements in control come from innovations and advanced technology. Need for lifelong learning is recognized.	Videos and discussion
j. A knowledge of contemporary issues	1	Design of control systems is related to contemporary issues	Videos and discussion
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice	2	Students use modern engineering instrumentation and software	Lab exercises and project reports

Next Steps

Study Week (this week):

- Complete course evaluation
- Complete LEGO Inventory online sheet, return Kit

Finals Week (next week): All content after Automata project

- Part 1: 90-min closed-book Theory (no NXC-specific or syntax questions)
- Part 2: 90-min open-book Practical (no I2C circuit-related questions)
- Return Electronics tackle box and contents
- Return NXT Brick, cables, and USB cable

It’s been a pleasure! Hope you enjoyed the experience!