Mens et Manus

Final Projects Session 1

Ideas for Projects

November 10, 2020

Final Projects

Use remaining sessions in 6.A01 to work on project of your choice.

November 10: Final Projects Session 1
November 17: Final Projects Session 2
November 24: Thanksgiving Vacation (no class)
December 1: Final Project Presentations

Possible Projects: can be individual or with a partner
• test a different motor
• characterize and/or improve an electrical generator
• make a new or improved electronic game

Presentations: nothing fancy, just tell us what you found
• three minute presentation
• can include a few Powerpoint slides
• can include videos

Focus today on choosing a topic.

First Motor

We have focused on one of many possible motor configurations.

First Motor: 4x6

Four coils, six magnets, and two sensors.

Flip Geometry: 6x4

Would it work better or worse to flip the geometry?

Compare: 4x6 versus 6x4

Which is faster? Which is stronger?

Need three sensors: one to control each coil
More Magnets: 6x8
Use eight magnets instead of four.

Compare: 6x4 versus 6x8
Which is faster? Which is stronger?

Simpler: 3x4
Try something simpler: three coils, four magnets, and three sensors.

Compare Big and Small Rotors
Compare big and small rotors; same number of permanent magnets.

Compare Big and Small Rotors
Compare big and small rotor; different number of magnets.

Compare Different Configurations of Magnets
The magnets in the right rotor are arranged in a Halbach array.

The Halbach magnets (red) are rotated to better focus the magnetic field outward.
**Compare Different Configurations of Magnets**

Or would it be better to use the four Halbach magnets to directly intensify the fields?

**Optimize Electrical Generation**

Design a different configuration of motor and generator coils to increase electrical output power?

Possible approaches:
- choose motor coils to maximize speed, or
- choose generator coils to maximize output voltage, or
- choose generator coils to maximize output current, or
- minimize # of motor coils while maximizing # for generator.

**Improve the Simon Game**

Make the task more challenging.

- make more complicated challenges as the player improves:
  - increase length of sequences from 4 to 5 to 6 to ..., or
  - show the challenge sequence faster, or
  - challenge with sequence of chords (multiple simultaneous LEDs).
- use both red and green LEDs for challenges, expect different responses

**Control Diagrams**

The following slides illustrate torque and sensor voltages as functions of rotor angle.

The red, green, and blue curves in the top plots show the clockwise torque generated by the red, green, and blue electromagnets as a function of rotor angle.

The red, green, and blue curves in the bottom plots show the output voltages from the red, green, and blue Hall sensors as a function of rotor angle.
Control Diagrams: 4x6

Control Diagrams: 6x4

Control Diagrams: 6x4

Control Diagrams: 6x4
Control Diagrams: 6x4

[Diagram of control diagrams with rotor angle (degrees) and clockwise torque]

Control Diagrams: 6x4

[Diagram of control diagrams with rotor angle (degrees) and clockwise torque]
Control Diagrams: 6x8

Control Diagrams: 6x8

Control Diagrams: 6x8

Control Diagrams: 6x8
Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360

Control Diagrams: 3x4

rotor angle (degrees)
clockwise
torque
rotor angle (degrees)

sensor

30 60 90 120 150 180 210 240 270 300 330 360