Lab: MIPSI for a dynamic system (one lab per group)

PreLab: Brainstorm a physical system with an interesting question (not a Ph.D. dissertation), e.g., system identification, design, stability, control, ...

1. Picture of you and your team
2. Picture/sketch of your system
3. Question you would like to answer

The objective of a **MIPSI** is to ask and answer a question for a system of your own choosing. The **3**-page report **clearly communicates** its question, technical information, and answer.[13]

- **Question** Ask an interesting question about a dynamic system e.g., in biology (exercise, protein folding, muscle activation, nature), mechanics (vehicles, boat, swing, yo-yo, kitchen/laundry equipment, pump, motor), aerospace (aircraft, helicopter, balloon), fluid mechanics, heat transfer, thermodynamics, economics, electronics, chemistry, control-systems, vibrations, modal analysis, input shaping, robotics, mechatronics, haptics, machine design, biomechanics, molecular dynamics, financial modeling, etc.

- **Model.** Draw one or more sketches. Use engineering insight to determine the relevant system components and simplify the model. Report modeling assumptions/approximations.

  Type a **short** problem statement starting with "The following figure shows", and then describe all objects. Ensure all physical objects are clearly labeled on sketches and described in text (e.g., name and label airplane A, book B, point P, etc).

- **Identifiers (symbols and values).**

  Include a table of relevant scalar identifiers with four columns labeled:

Quantity	Identifier	Type	Value

  (**estimate** numbers for constants and initial values).
  Show relevant scalar identifiers on the sketch(es) without clutter.

- **Physics.** Form equations relating the identifiers to system behavior. Report processes and calculations for forming the system's governing ODEs (attach long calculations in an appendix).

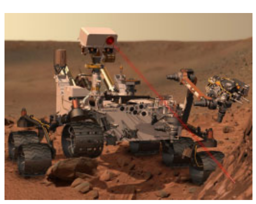
- **Simplify and Solve.** If helpful, make small angle or linear approximations [e.g., $\sin(\theta) \approx \theta$]. Discuss the process for solving for the unknown identifiers [e.g., numerical solution via **M**otion**G**enesis, MATLAB®, or WolframAlpha or analytical (closed-form) solutions].

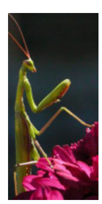
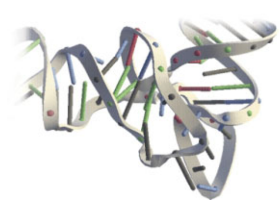
- **Interpret** **(design and control).** Answer your question with results easily interpreted by a non-technical person (use words, numbers, plots, video, etc., with descriptive text **adjacent** each plot).
  Optional:** Build the physical system, validate the analysis, physical demonstration, video.

Model	10%	**Cover-page**: Ask, answer, and present (question, system picture, team picture, result).
Identifiers	15%	Detailed modeling assumptions and comprehensible schematics (preferably with photo). Precise description of all physical objects.
Physics	10%	Concise accurate tabular description of all **scalar** symbols.
Simplify and solve	40%	Correctness of analysis. **Short (2-3 pg.)**, solid report.
Interpret and design	15%	Interpret: Relevant text interspersed with relevant plots.
	10%	On-schedule. Met with instructor. Technical difficulty, demo/video, interesting problem.

Communicate!





[13] For ideas, see videos at www.MotionGenesis.com ⇒ Textbooks ⇒ Resources or www.YouTube.com.