EGR598

Project Introduction

Constraints

- **bioinspiration:** Develop a robot inspired by the motion of something in the natural world.
  - Demonstrate knowledge of your animal.
  - Translate features and attributes from animal template to robot design.
  - Biomimicry is not required
- **kinematics:** the robot should have a clear, well-thought-out through transmission design facilitated by the concepts taught in this class (and confimed through analysis).
  - Use a kinematic or dynamic work loop to perform locomotion (rather than rely on friction) or single-path motion.
  - Use a kinematic transmission design to transform rotary or linear actuation into a designed motion path.
  - Analyze the kinematics and dynamics of your system.
  - solve constraint equations and plot motion of transmission using a nonlinear solver
  - compute numerical jacobian of transmission to determine gear ratios
  - Use dynamics software to analyze forces and motion of system.
  - Demonstrate knowledge and mastery of layer-based design and manufacturing topics
- **dynamic:** the robot should feature some element(s) that require analysis of motion as a function of time, mass, inertia, stiffness, damping, etc. Ideally, your robot bounces, hops, etc, incorporating those factors into its primary motion.

Constraints Continued

- **laminate manufacturing:** This robot should be made using the techniques taught in this class. 3d printing, soft robotics, off-the-shelf parts, and metal should take a back seat.
  - May feature 3d printed connectors for convenience, but must primarily create motion through laminate hinge devices.
  - Must discuss kinematics with Instructor.
  - Use a five-layer laminate design reflecting design practices outlined in class.
  - Automate the workflow from design parameters to cut files. Hand-drawn dxf's by the end of this project will not be allowed
- **design:** you should incorporate traditional engineering design principles into your process, by factoring in models, design parameters / variables, and try to optimize or design for some goal via a combination of iterative simulation, prototyping, and/or (ideally) optimization.
- **prototyping:** you should iterate your robot often. I shouldn't see the same robot 3 weeks in a row.
- **sensing:** you should know the state of your robot via one or more methods, and use that in your analysis.
  - Example sensors include joint angle sensors, encoders, IMU, voltage/current sensors, etc.
  - External sensing is okay provided you have discussed with the instructor. Examples include force-plate data, load cell data, etc, for the purposes of verifying models and improving the design.
- **experimentation:** you should confirm the models you use. This should be discussed and planned with me early, and planned out with your sensor selection, your kinematic design, and your particular dynamics.
  - Coordinate this activity with your sensor selection.
- **stiffness analysis:** you should analyze one or more of the structures on your device in order to tune its stiffness / compliance for the intended type of locomotion you need.
  - compute the deflection of a 2d laminate beam design using bernoulli-euler bending equations.
  - Designs should be integrated, analyzed, and tuned in your final device

First Presentation

- Introduce biomechanics of Animal
- Basic Calculations
- Proposed Mechanism(s)
- Report Outline
- Address Project Constraints
- Address issues raised by class, instructor, mentor

Other Presentations

- Presentation II: Kinematics, Forces, Manufacturing, Mechanism II
- Presentation III: Dynamics & Simulation, Mechanism III, 2nd Mechanism I, Actuation
- Presentation IV: Prototype I, Sensing
- Presentation V: Prototype II, Workflow
- Presentation VI: Experimentation Results & Final Prototype Design
- Presentation VII: Final Video

Schedule

- Presentations every 2 weeks
  - Sometimes all teams, sometimes half
  - See course calendar(on blackboard)

Final Project Submission

- Videos
  - 1-minute elevator pitch of your device
  - 5-minute extended video
    - Evolution of your design
    - Manufacturing process
    - Sensing and Control
- Final Report
  - Cleaned up & version of your weekly reports following agreed-upon outline
- Other Files
  - Glamor Shots: Publication worthy photos with black or white background and good lighting
  - Manufacturing files for each iteration
  - Microcontroller / PC code for each iteration
  - Raw Data Collected from Experiments
  - Raw videos and images