First-Year Engineering Program:

ADVANCED ENERGY VEHICLE
DESIGN PROJECT

AEV Mission Concept Review

Background: Jurassic Park wants to re-open its doors to visitors after being dominant for over a decade. The park is looking for a monorail network system to transport its visitors into the park safely through the means of a green, energy efficient, and cost effective system. The need for an energy efficient system, like an Advance Energy Vehicle (AEV), is due to the park being located on an island and power is a luxury. The vehicle will be unmanned so the tour guide can focus on human safety and providing a full focused tour.

Your team will need to build a concept of the system on a scaled level and defend your selection to the park owners and various board members to determine if the AEV is worthy of full-scale production. The vehicle constraints are as follows:

1. The AEV must traverse along a monorail track system above ground traffic (see Figure 1).
2. The AEV must be able to operate both forward and backward along the monorail track system.
3. The main propulsion system must be air driven (propeller) and hang below the track system.
4. The vehicle must utilize provided Li-PO batteries to supply the power to the electric motors.
5. The Arduino Controller must not be placed on the vertical support arm.
6. There must be a clearance area of two by two inches between the Arduino Controller and the caboose connection (magnet). The front of the AEV will have a mating erector set part similar to the bracket shown below, but without a magnet. The Caboose will initially be positioned at the park storage facility which is also where the visitors will sit and look for the dinosaurs.

Operational Objectives: The scaled transport-AEVs will focus on energy management, operational efficiency and operational consistency. Energy used per mass of the AEV will be measured and recorded during AEV operation. The goal is to successfully pick up and deliver the precious cargo while meeting the operational requirements, design constraints and minimizing the energy/mass ratio.

Operational Requirements: The transport-AEV must:

1. Start at the Visitor’s Center (Station 1).
2. Traverse to the entrance gate of Jurassic Park (Station 2).
3. Stop at the entrance gate and wait for clearing to ensure no dinosaurs escape.
4. Navigate the park storage facility (Station 3).
5. Stop at the storage facility to pick up baby dinosaurs (stored in a hitched caboose) for the Visitor’s Center petting zoo.
6. Travel back to the park’s entrance gate and stop to be cleared.
7. Traverse back to the Visitor’s Center to drop off the baby dinosaurs.

The circuit must be completed within 2.5 minutes. At the facility entrance, the AEV must stop for a minimum of 7.0 seconds to allow the gate to open. At the loading zone, the AEV must stop for a minimum of 7.0 seconds to load/attach the cargo; details are provided in the AEV Track Layout.
ADVANCED ENERGY VEHICLE

Note: The AEV can accelerate, decelerate, and run at constant speeds in between stops in order to make the transport system increase energy-efficiency while meeting operational requirements.

AEV Size Constraints: The AEV must fit within the team's storage box. The monorail support arm does not have to be attached to the vehicle for storage.

AEV Design/Layout Constraints:
1. The transport-AEV must have at least one and no more than three* electric motors and propellers; and the propellers can be mounted in puller, pusher, or both configurations.
2. The AEV must have a clearance area that has dimensions of at least 2 x 2 inches between the Arduino and the magnet that will be used to attach to the caboose.
3. The AEV must have an Automatic Control System (Arduino Motor Controller & Battery) area designated and cannot be attached to the vertical support arm, or be contained within the AEV clearance area.
4. The Arduino controller does NOT come into contact with metal.
5. Additional components used that are obtained outside the classroom are not to be connected/attached/secured permanently and they must not damage or alter ANY hardware provided in the AEV kits.

* Two electric motors are provided in the AEV kits. Under special circumstances, if the team can justify the use for a third electric motor to the instructional staff then a team may be granted a third motor for use. An optional servo motor is also supplied.

AEV Test Track Layout: The AEV track layout can be seen in Figure 1. There are two loop tracks each divided into two half sections. Specific track half sections are designated according to which seating column your team resides.
**Individual Competition:** During the last week of the semester there will be individual competitions with three design and project based criteria:

1. Engineering design – to be decided by instructional staff over the course of the semester.
   a. Creative use of materials (includes cost of the overall system)
   b. Engineering Ingenuity
   c. Overall energy used versus total weight of the AEV
2. Project documentation – to be decided by instructional staff
3. AEV operation – based on operational objectives and requirements

**Engineering design** will be based on the team’s design decisions made, actions taken, observations made and lessons learned, and justifications made on final AEV design. Each team design will be assessed throughout the semester for design improvisations based on sound engineering principles. Specific design criteria that will be considered include: structural layout, AEV balance, AEV autonomous control strategy, and overall effectiveness of the scaled design in meeting operational requirements and design constraints. Also, engineering ingenuity and creativity use of materials will be considered over the course of the semester.

**Project documentation** will be based on team’s management of the design process through the Project Portfolio. Specific criteria that will be considered include: overall organization, clarity of lab reports and performance test summary reports, and outline and draft of oral presentation. See the *Advanced Energy Vehicle Design-and-Build Project Description Document* for more detail on lab reports and technical writing requirements.

**AEV operation** will be based on the performance of the AEV on the classroom track in meeting the operational objectives under the requirements and design constraints. Grading will be based off of the overall energy used versus the total weight of the AEV and the level of success each group achieves in meeting the operational objectives defined above in “Operational Objectives”. Testing will be during the lab period and the scoring sheet layout and point distributions will be released during the fourteenth week of the term.