NTU-ME 2024 Capstone Aero Rider

Mid-term analysis report

Due April-19,2024 @1700 (printout+COOL upload), 20 pages max

Team :
Members :

Step 1: Provide a detailed exploded view diagram of your vehicle:

Highlighting all components along with their names and dimensions. Identify the crucial components essential for the vehicle's dynamics. For each identified component, create a free-body diagram showing the forces acting on it.

Step 2: Analysis of Components

1. Mass and Inertia Assessment: Delve into the vehicle's overall mass and the distribution of that mass, as these factors play a crucial role in how the vehicle accelerates and maneuvers.
    a. Detail the methodology used to calculate the total mass.
    b. Assess how mass is spread throughout the vehicle.
    c. Determine the vehicle's center of mass.
2. Wheel Traction Evaluation: Analyze the grip (friction) between the tires and the surface, a critical factor for steering and braking efficiency. Consider how the vehicle's weight, the type of surface it's on, and the tire material affect traction.
    a. Outline the approach for assessing wheel traction.
    b. Compute traction values.
    c. Address any uncertainties and propose methods for refining this evaluation.
3. Aerodynamic Force Analysis: Conduct a thorough investigation into the lift and drag forces resulting from interaction with air, considering the vehicle's design in full detail. This includes analyzing the shape, size, and angle of attack (AOA) in relation to desired vehicle dynamics.
    a. Identify the specific aerodynamic forces targeted for optimization.
    b. Justify the vehicle's design configuration in the context of achieving the desired aerodynamic forces.

    c. Confirm the effectiveness of the design with respect to variables such as wind and vehicle speed.
4. Steering and Unfolding Mechanism Overview: Present a detailed explanation of how your steering or unfolding mechanism can harness wind energy to aid in vehicle navigation.
    a. Showcase the mechanism's design and operational principles.
    b. Clarify how the mechanism contributes to vehicle control.
    c. Evaluate the mechanism's current performance and suggest potential enhancements or modifications for the future.

Step 3: Vehicle Dynamics Integration:
Synthesize the previously discussed elements to formulate a dynamic equation for the Aero Rider.

1. Craft an Equation of Motion (in vector or abstract form):
    a. Clearly define each variable, ensuring dimensional consistency across all terms.
    b. Provide a detailed explanation for each component of the equation.
    c. Outline the underlying assumptions made in the formulation.
2. Assess the Validity of Your Equations (through experimental measurements, numerical analyses, etc.):
    a. Outline the methodology for using the equation to predict the Aero Rider's dynamics.
    b. Describe the process for deriving predictions from the equation.
    c. Benchmark these predictions against real-world behaviors or outcomes.
3. Suggest Improvements for the Modeling/Testing Approach:
    a. Reflect on any discrepancies observed between the predictions and actual outcomes.
    b. Speculate on potential sources of error or misalignment in the model or testing process.
    c. Propose strategies to address and rectify these discrepancies for more accurate future modeling.

Step 4: Summary and Conclusions

- Comment on the design and the performance of your Aero Rider
- Analyze the cons/pros with the understanding of the above analysis
- Propose modifications toward better performance
- Reflect on what to do for the final challenge