“Chandler’s” NASA Human Exploration Rover Challenge

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BACKGROUND
The NASA Human Exploration Rover Challenge is an international competition for students to design, build, and race a human-powered rover that can traverse a simulated lunar terrain.
- Competition inspired by challenges faced by the engineers that designed the Lunar Rover Vehicle for the Apollo 15 mission.
- Competition Dates: April 7-9, 2016 in Huntsville, Alabama.

OBJECTIVES
Design a manually operated, all-terrain rover for the NASA Rover Challenge that:
- Fits within a specified volume
- Can be assembled quickly
- Can traverse various competition obstacles

Goals for this year:
- Reducing the assembly time
- Broadening the gear ratio to overcome obstacles more easily
- Develop a wheel design to meet new constraints

ENGINEERING SPECIFICATIONS

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Symbol</th>
<th>Unit</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
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<tbody>
<tr>
<td>Collapsed Volume</td>
<td>V_{coll}</td>
<td>mL</td>
<td>550 mL</td>
<td>650 mL</td>
</tr>
<tr>
<td>Wheelbase</td>
<td>L_{wheel}</td>
<td>mm</td>
<td>300 mm</td>
<td>350 mm</td>
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<tr>
<td>Ground Clearance</td>
<td>S_{clear}</td>
<td>mm</td>
<td>15 mm</td>
<td>20 mm</td>
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<tr>
<td>Angle</td>
<td>θ</td>
<td>°</td>
<td>60°</td>
<td>120°</td>
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<tr>
<td>Center of Gravity</td>
<td>x_{cg}</td>
<td>mm</td>
<td>25 mm</td>
<td>35 mm</td>
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<tr>
<td>Turning Radius</td>
<td>R_{turn}</td>
<td>mm</td>
<td>240 mm</td>
<td>300 mm</td>
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<td>Wheelbase Angle</td>
<td>Θ</td>
<td>°</td>
<td>20°</td>
<td>70°</td>
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<tr>
<td>Angle of Torsion</td>
<td>Φ</td>
<td>°</td>
<td>30°</td>
<td>60°</td>
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TANNIN’ TIGER ROVER

 Spice Wheels with Uniflex Tubing

Double wishbone Suspension System

Plast-Reinforced Triangular Frame

Front-to-Back Steering System

COMPUTER AIDED DESIGN

All of the computer analysis was performed using SolidWorks Simulation.

The loads and magnitudes were determined by either hand calculations of expected loading scenarios or by accepted specifications.

A 3D Model of the complete rover was made to validate:
- Tolerancing
- Kinematics
- Clearances
- Engineering Specifications

WHEEL TECHNOLOGY

COMPUTATION BUDGET

<table>
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<tr>
<th>Type</th>
<th>Cost</th>
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<tr>
<td>Frame</td>
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<td>Steering</td>
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<td>Drivetrain</td>
<td>$177.41</td>
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<td>Wheels</td>
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<td>Suspension</td>
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CONCLUSIONS

- Final Competition Results: 20° out of 49 with a time of 32:53
- Assembly time comparison: Tannin’ Tiger – 18s, Mike 1 – 1m 8s
- Additional improvements were made post-competition to the drivetrain and steering

Afterthoughts:
- Focus more on propulsion and maneuverability
- Use motorcycle chains and sprockets for the drivetrain

Sponsors: Jack Rettig, LSU Mechanical Engineering Department, ExxonMobil

Advisor: Sean King