To Predict ▶ To Design ▶ To Perform

College of Engineering
Department of Mechanical & Industrial Engineering

ME, ECE, BE Capstone Design Programs

"Chandler's" NASA Human Exploration Rover Challenge

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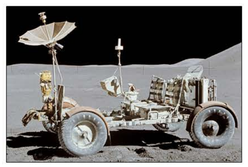
BACKGROUND

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 was 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



Lunar Roving Vehicle for the Apollo 15 Mission

Mike I: LSU's 2014-2015 NASA Human Exploration Rover

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

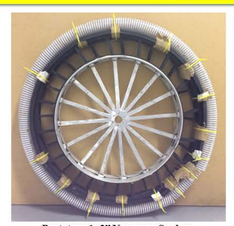
Goals for this year:

- Reducing the assembly time
- Broadening the gear range to overcome obstacles more easily
- Develop a wheel design to meet new constraints

ENGINEERING SPECIFICATIONS

Attribute	Symbol	Units	Lower Limit	Upper Limit
Collapsed Volume	V_{col}	ft^3	-	5 x 5 x 5
Wheelbase	L_{base}	ft	-	5
Ground clearance	c_{ground}	in	15	30
Weight	W	lb	-	250
Center of Gravity	h_{CoG}	in	15	35
Turning Radius	R_{turn}	ft	5	15
Fender Area	A_{fender}	in^2	120	-
Angle of Incline without Tipping	$\measuredangle_{fender}$	°	30°	-

WHEEL TECHNOLOGY



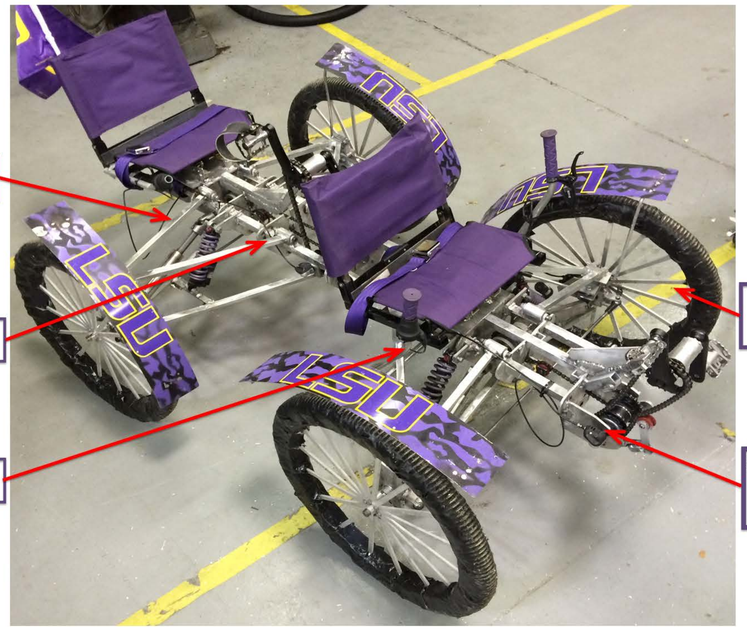
Prototype 1: 3" Neoprene Spokes

Prototype 2: 1" Neoprene Spokes

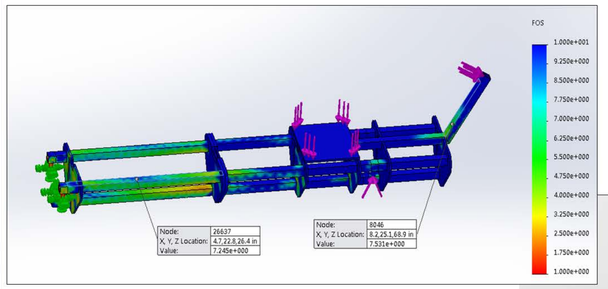
First Attempt Final Design

Second Attempt Final Design

TANNIN' TIGER ROVER



COMPUTER AIDED DESIGN



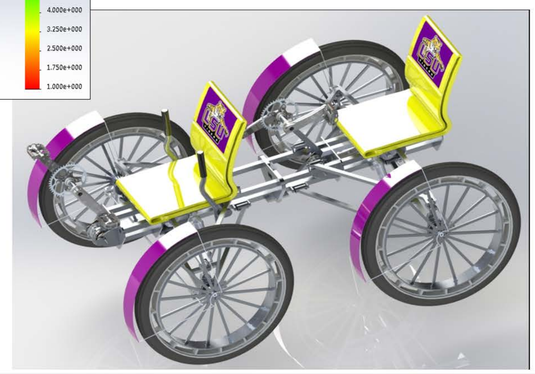
Frame FEA with Expected Applied Forces from Driver and Obstacles

All of the computer analysis was performed using SolidWorks Simulation.

The loads and magnitudes were determined be 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



TESTING METHODS

Pre-Competition

- Maximum speed: 5 mph
- Minimum turning radius: 15'
- Suspension Test
- Wheel Test

Competition

- Loss of drivetrain in both attempts
- Resulted in 16 minutes of penalties
- Final ranking: 20th out of 49 teams

Post-Competition Campus Course

- Second course created on campus to test drivetrain improvements
- Minimum turning radius: 11.5'
- Maximum speed: 8 mph

Boulder Pit

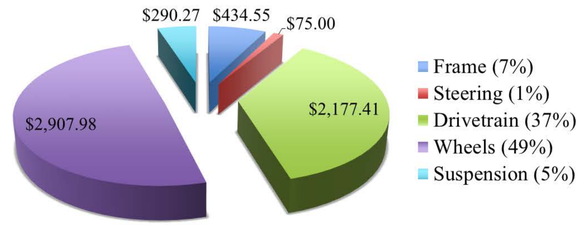
Crevasses

SAFETY

Considerations made during design:

- High Factors of Safety (Range: 3-9) in frame, suspension, and drivetrain
- Front-facing drivers
- Seat-belts
- Wider wheelbase to prevent rolling

BUDGET



CONCLUSIONS

- Final Competition Results: 20th 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