# Allan Will, Bilal Abdelhadi, Colton Cuthill, Hamad Rizwan, Jared Schellenberg, Ronel Del Rosario

#### Introduction

SCHULICH

School of Engineering UNIVERSITY OF CALGARY

The purpose of this project is to develop a tire for a specific in-wheel hub motor used in small 4-wheeled vehicles.

Our tires focus on durability and adaptability, allowing use in a wide variety of applications.

Design must:

- Withstand drop 80-100 inches
- Be easy to install
- Be Temperature resistant (-45°C-60°C)
- Have a lifetime >10 years

#### **Problems**

- Vehicles such as rovers are deployed in hazardous conditions and complex terrain
- Wheels are the weakest link as they are susceptible to punctures
- Wheels need to be constantly repaired or replaced
- Presents the need for tires that are durable and maintenance free

## **Concept Selection**

Category	Category Weight	Non- Pneumatic Tire	Shock Tire	Foam Filled Tire
Rigidity	0.7	4	2	1
Impact damping	1.0	3	4	2
Traction	0.4	4	1	3
Load Capacity	0.8	4	3	1
Puncture/Damage Resistance	1.0	4	2	3
Mass	0.6	3	1	2
Cost	0.6	2	1	3
Manufacturing	0.6	2	1	3
Weighted Average	-	2.35	1.50	1.56

Weight scale 1.0 = Most important

Ranking: High (4) – Best

→ Low (1) – Worst







# **High Inertia Impact Damping Tire For In-Wheel Hub** Motors

Pneumatic Tire
3
1
2
2
1
4
4
4
1.71

#### **Geometric Analysis**



- 4 Potential NPT designs were considered
- Honeycomb design found to be highest performer
- Different variations of honeycomb design were researched

Design	Structural Compliance Test		Uneven- Surface Test		Shear Resistance Test		Torque Test		
Load	250N	450N	250N	450N	100N	200N	300N	32 N*m	70 N*m
B Deform (mm)	2.9	5.36	10.8	19.5	6.6	13.3	19.9	4.1	9
B Stress (MPa)	0.65	1.17	1.59	2.86	0.75	1.5	2.25	0.79	1.73



## **Material Selection**





Honeycomb designs of various dimensions underwent 4 structural tests in Ansys. "Design B" determined to be the best after producing the results shown in the table.



#### Casting

Cheaper production for many sets of tires, on an industrial scale

90A Poly U is best option for this design

#### **Final Test Results** Test coupon was designed to Long-term fatigue analysis was accurately replicate properties of done in Endurica, and physical full-sized tire, was then 3D fatigue test cycled between printed from 90A TPU 250N and ON every 2.5s for 100,000 cycles. • Endurica predicts a nominal lifetime of over 100 million cycles Displacemen **Max Force** Failure? (Y/N Test @ Max Force **Tested N** Norma 3.755 250 250 5.237 Punctured 5.596 Deformation Under 250N Vertical Compression





#### Conclusion





- requirements

#### Possible Improvements:

- Optimize Geometry
- Shear / Rolling resistance tests
- Determine Appropriate Tread Pattern
- Scalability Optimization





• Final Design meets requirements outlined by sponsor:



Proof

Light Weight

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• Under 4mm of deformation under 250 N load meets rigidity

• Tire can be easily attached to hub with single Allen-key