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# Biologically Inspired Telescoping Active Suspension Arm Vehicle: Preliminary Results

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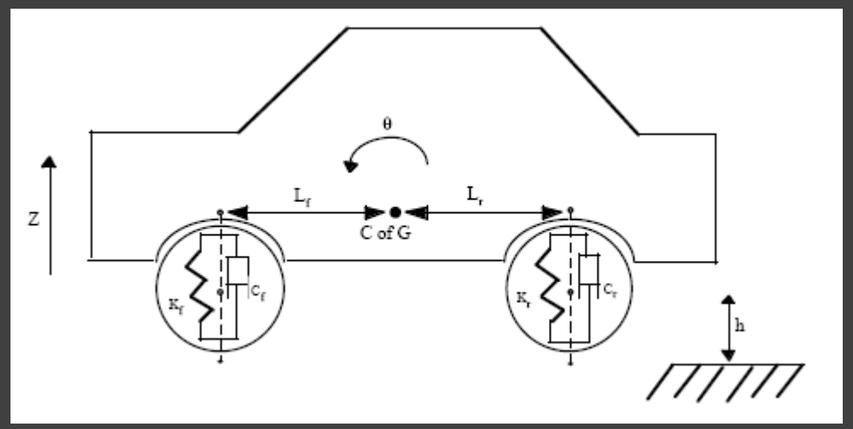
# Introduction

- Introduction to conventional active suspension
- Limitations of current systems
- Improvement possibilities



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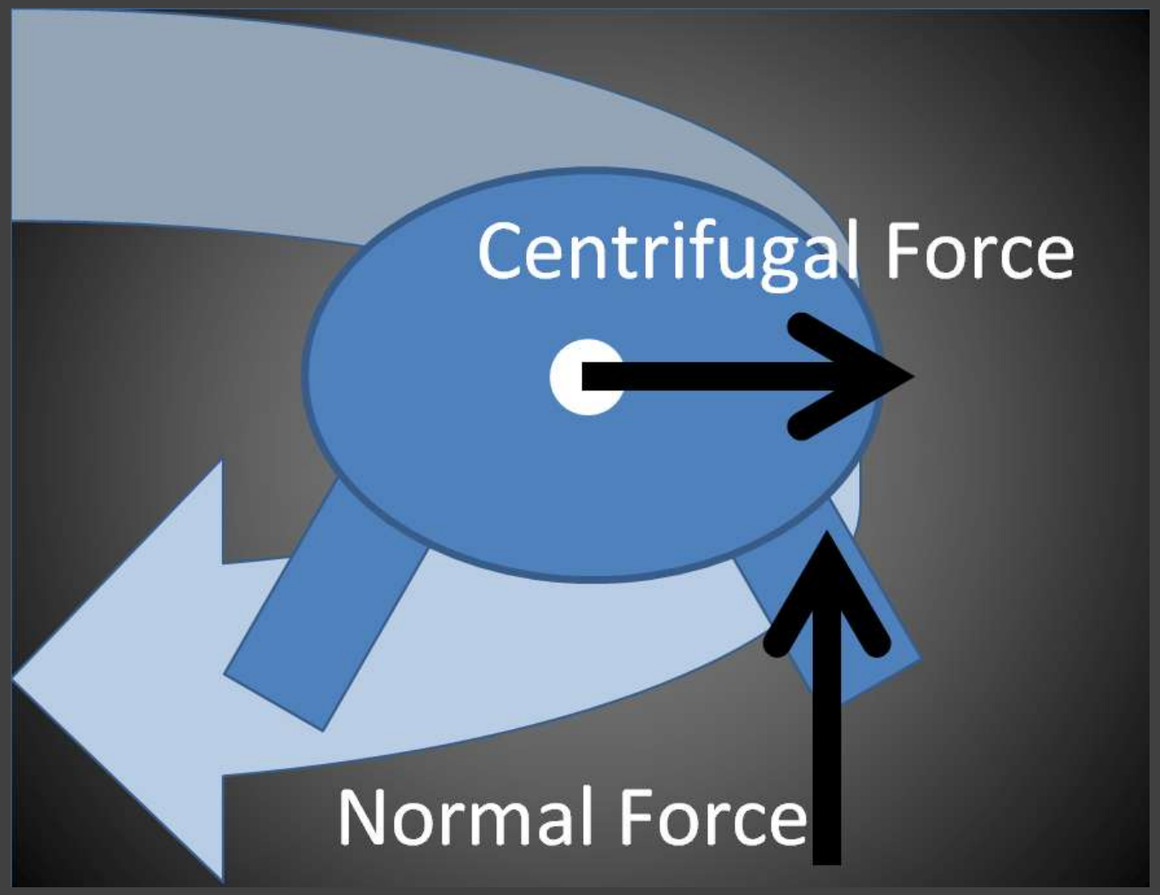
# Motivation

## Bio Inspiration



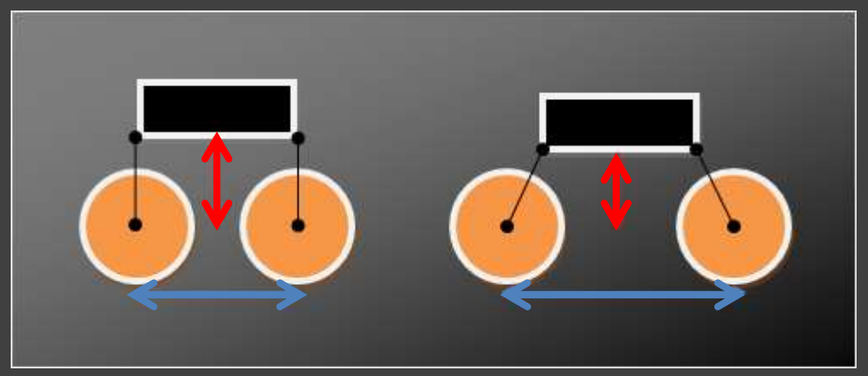

## Telescoping arm designed to:

- Maximize arm extension
- Maintain perpendicularity between wheel and ground throughout arm motion
- Use mechanism to steer vehicle

# Background

**Nissan Land Glider**

- Fixed track width
- Vehicle pivots on longitudinally pivoting suspension arms
- 17° Pivot to counter centrifugal forces



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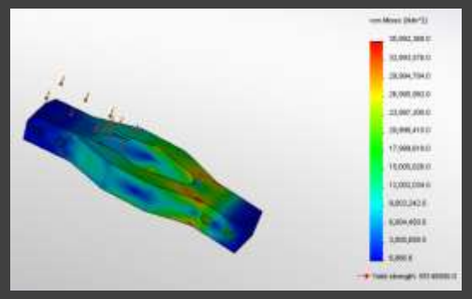
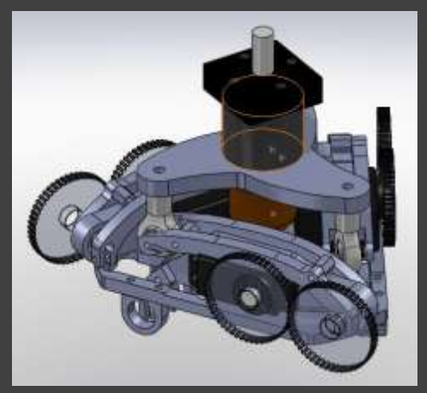
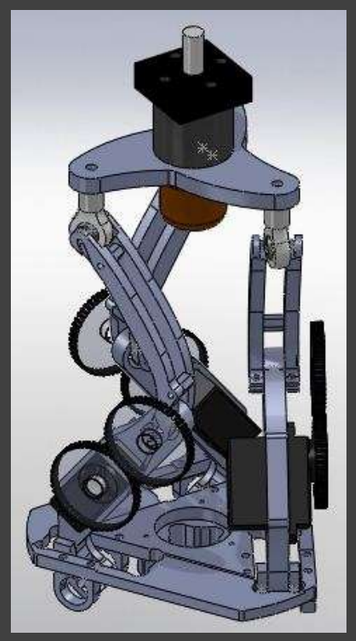
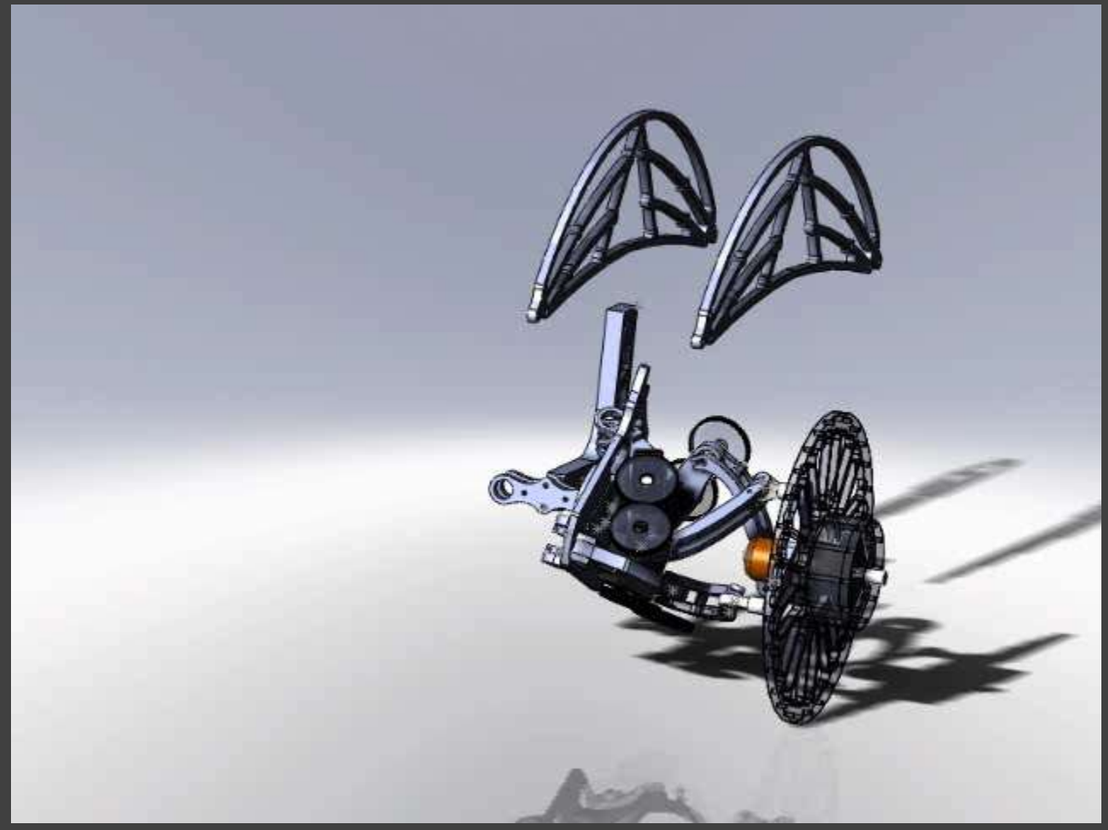
# Design

- Maximize ratio of expanded arm length over contracted (currently 3.83)
- Maximize under chassis clearance
- Complete expansion time 0.42s
- Force of 30.8N at wheel
- 3(RRS) mechanism
- Expected cornering acceleration of 3G









# Initial Modeling

$$\theta_x = \tan^{-1}\frac{\frac{D_1 + D_2}{2} - D_0}{D_y}$$

$$\theta_y = \tan^{-1}\frac{D_1 - D_2}{D_x}$$

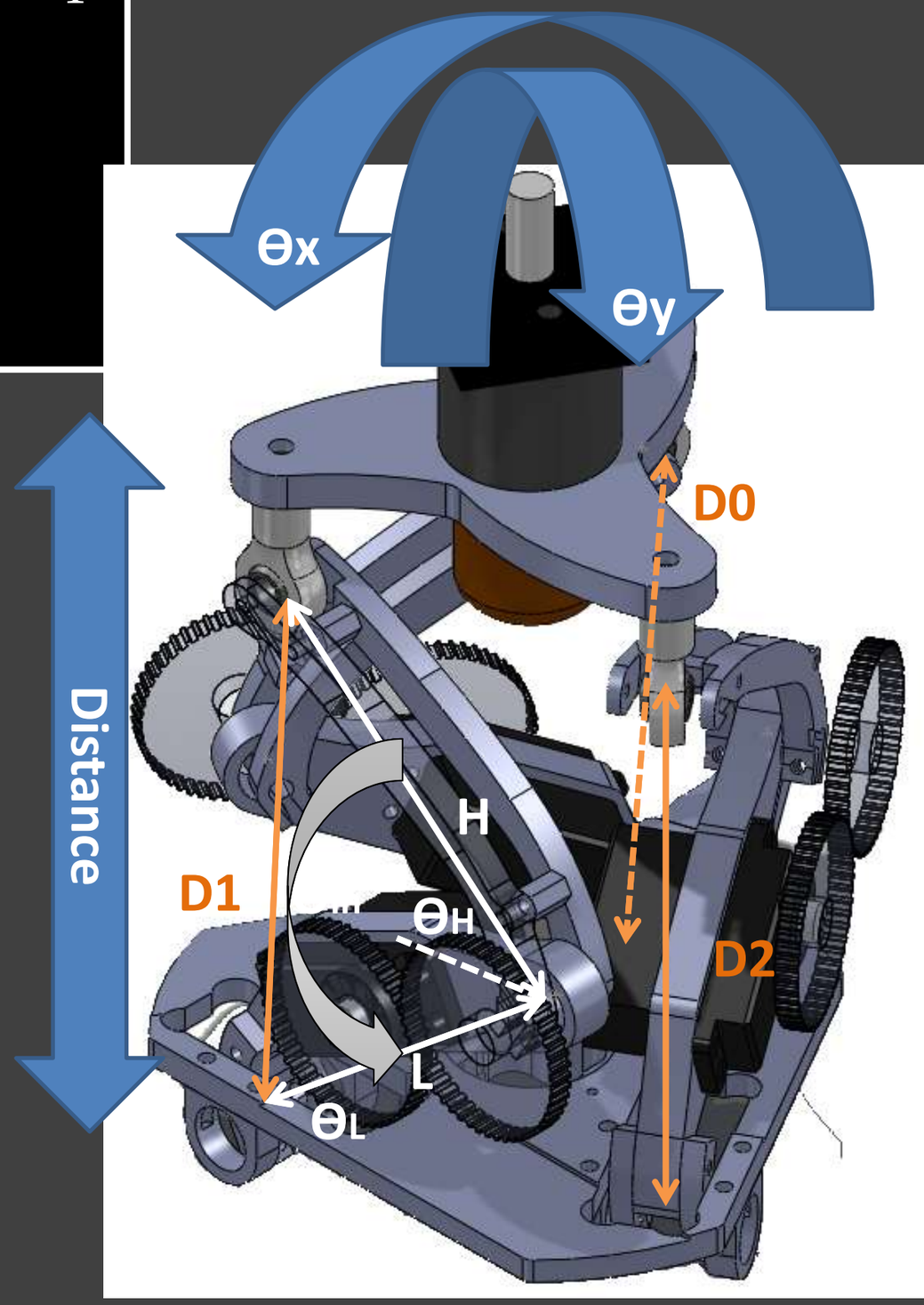
$$Distance = \frac{D_0 + D_1 + D_2}{3}$$

$$D_{\#} = L_1 \sin\theta_1 + L_1 \sin\theta_1$$

$$L_L \cos\theta_L = L_H \cos\theta_H$$

$$\theta_{in} = \theta_L + \theta_H$$

$$PWM(\theta_{servo}) = 2400\mu s - (10\mu s * \theta_{servo})$$

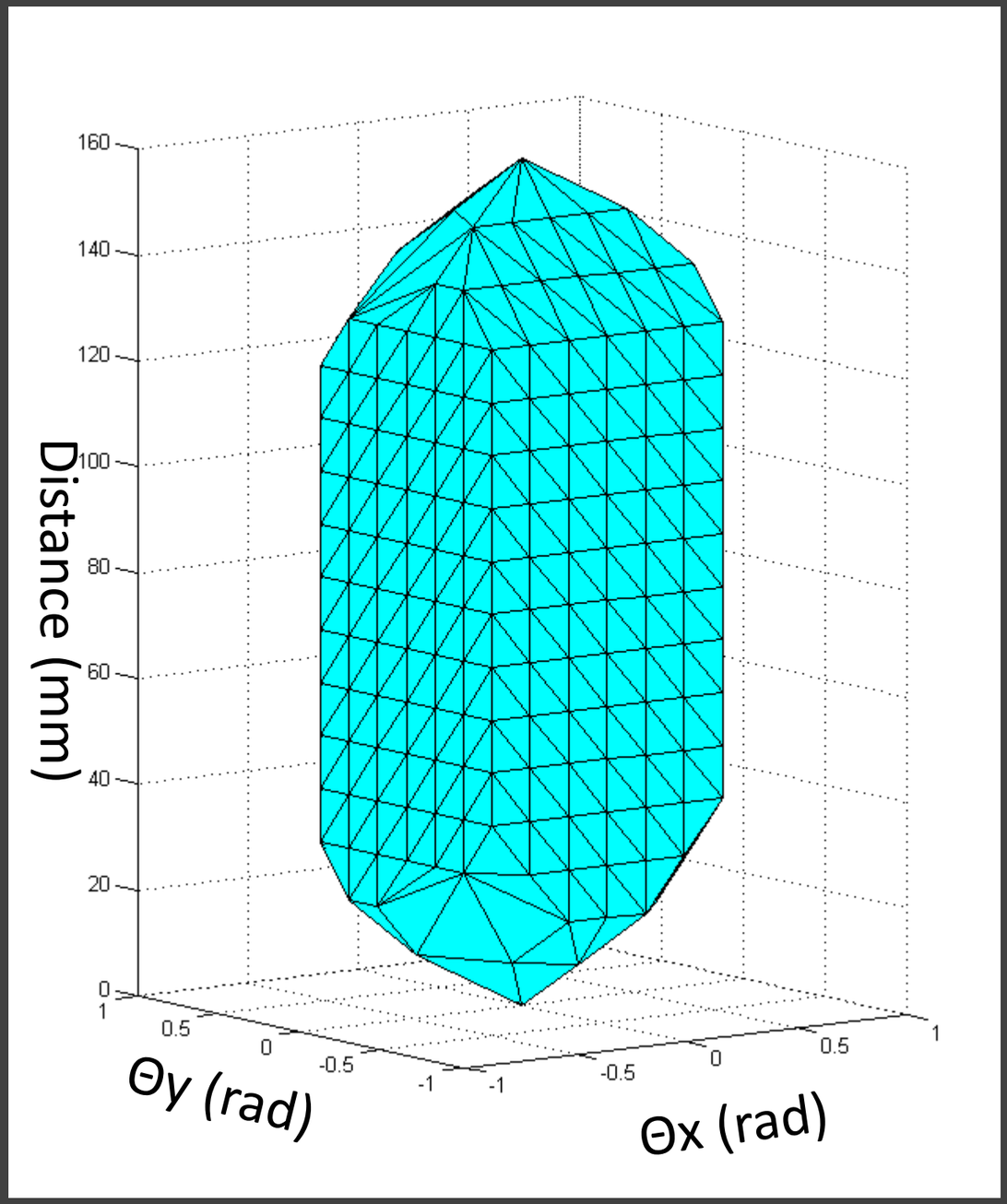



# Degrees Of Freedom

$$D.O.F. = 6\,(n-1) - 5(h) - 3(l)$$

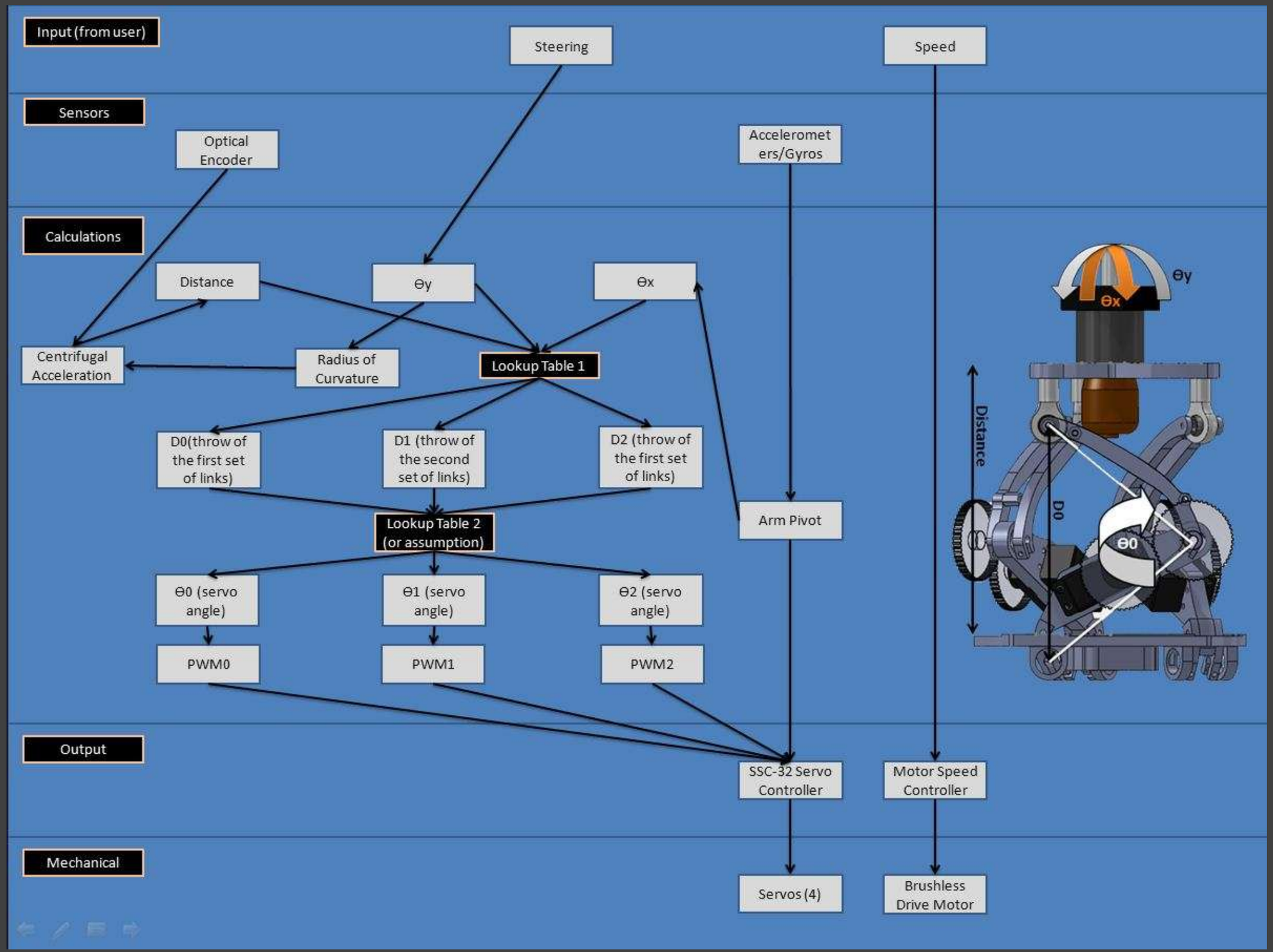
$$D.O.F. = 6\,(7) - 5(6) - 3(3) = 3$$

# Workspace


160
140
120
100
80
60
40
20
0
Distance (mm)
1
0.5
0
-0.5
-1
Θy (rad)
-1
-0.5
0
0.5
1
Θx (rad)

# Control System





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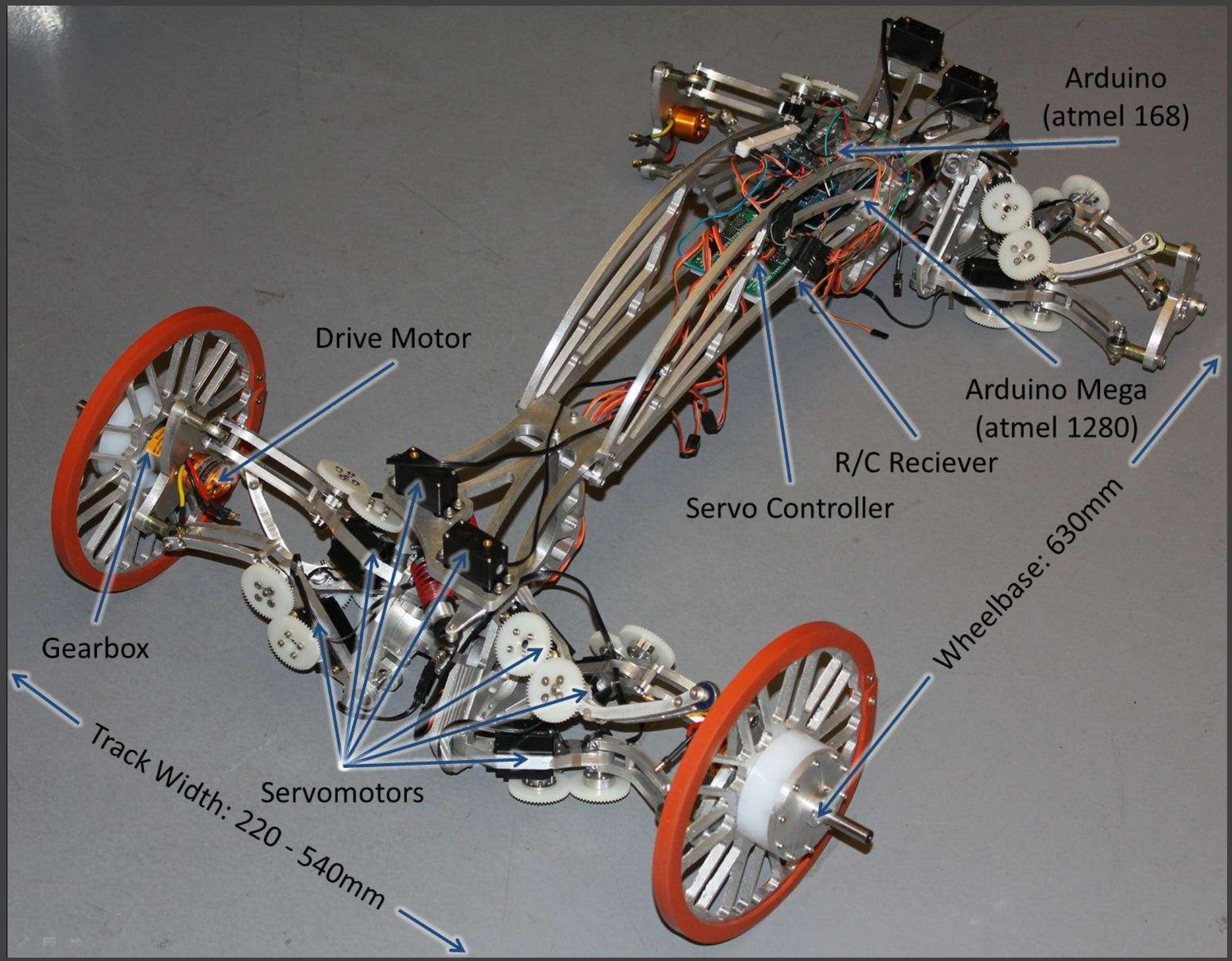
# Current Prototype



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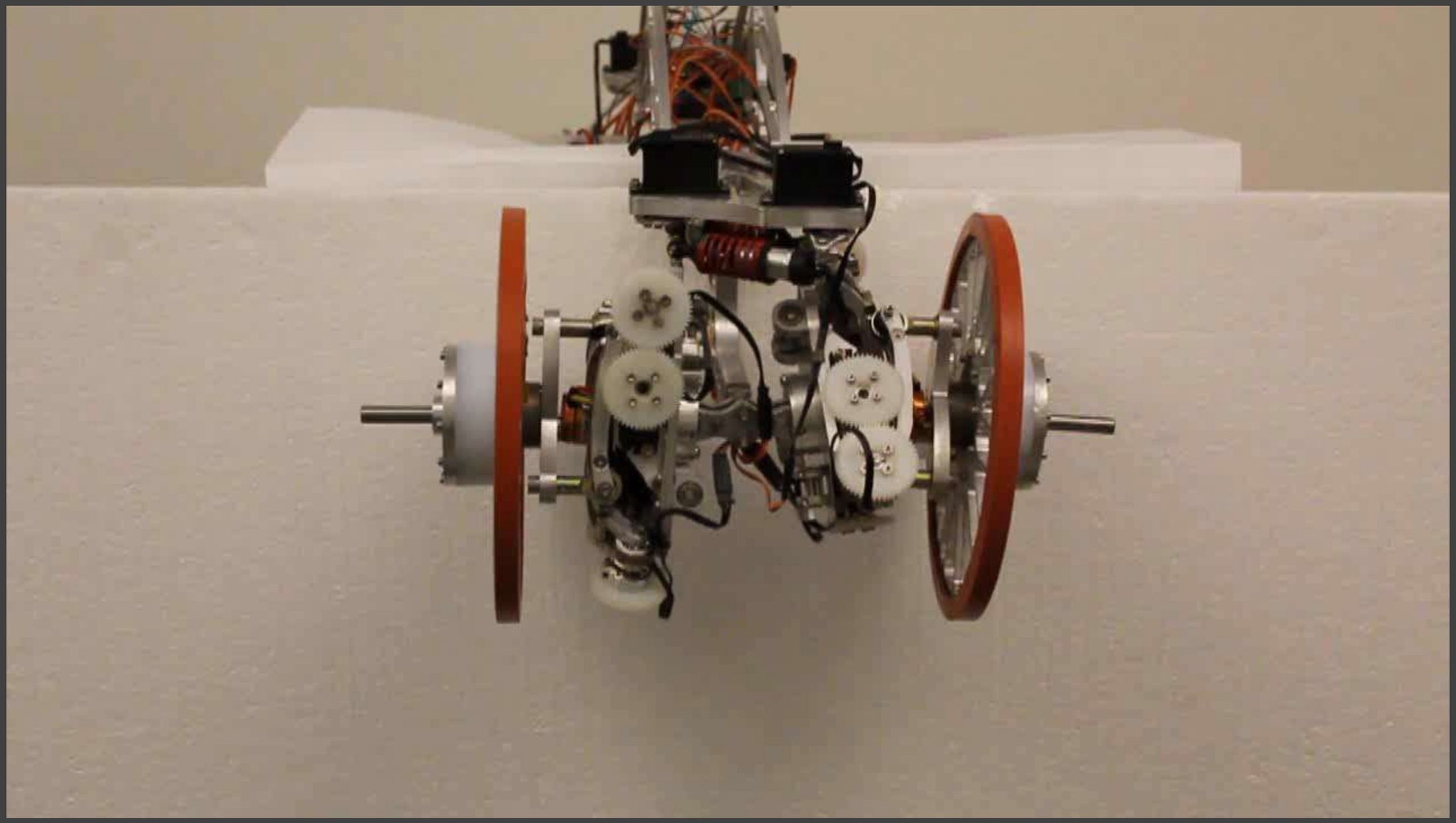
# Demonstration



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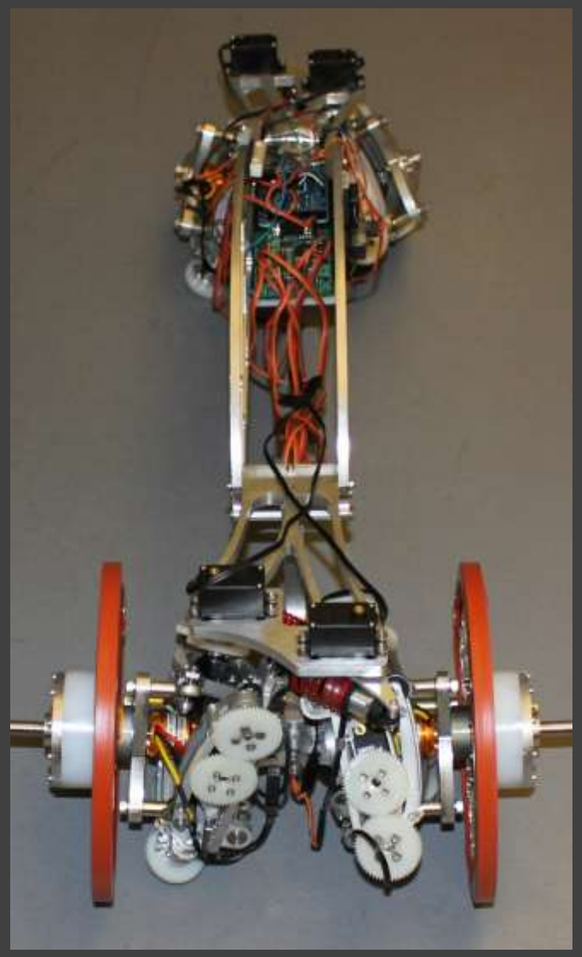
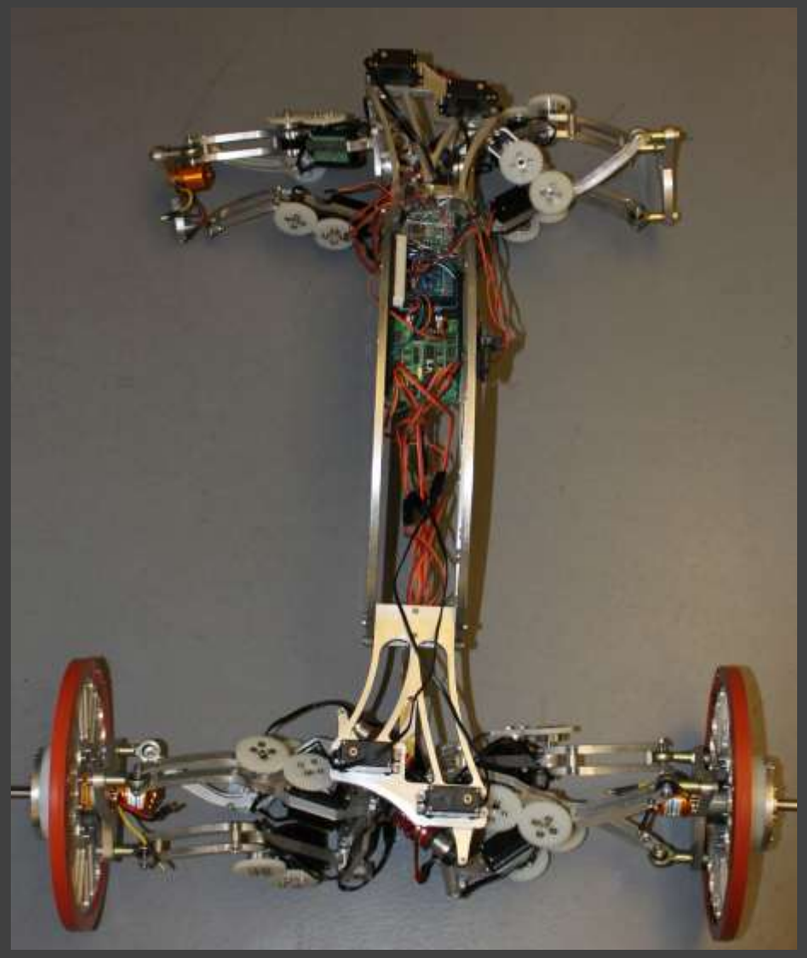
# Applications

- Extraterrestrial Exploration
- Disaster Relief
- Developing World





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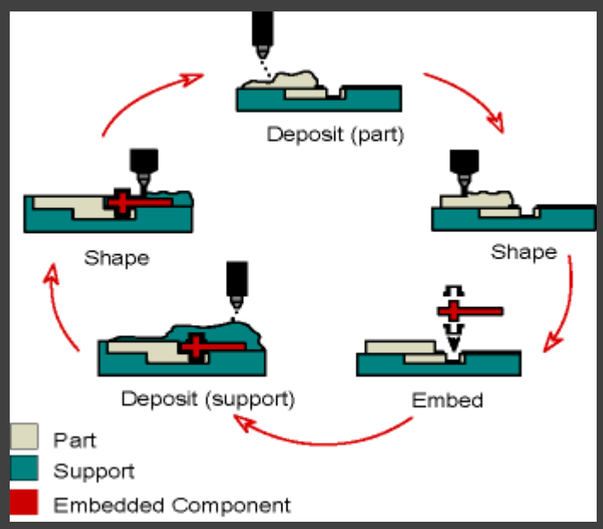
# Future Work & Conclusion

**Short Term**

- Inverse Kinematics
- Minimize Jerk
- Implement Governing Controller

**Long Term**

- Implement Non-linear Controller
- SDM Through Multi-Material 3D Printing



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# Thank You