Development of a Tree Climbing Snake Robot

Advisor:
Dr. Jonathan Clark

Team 10:
Esteban Szalay, Jorge Campa,
Michelle Maggiore, Justin Morales

Sponsor:
Mr. Jeff Phipps

Background Information

Every year, 200 people are killed in tree related incidents.
The average cost for removing a fallen tree is between $500-1000.
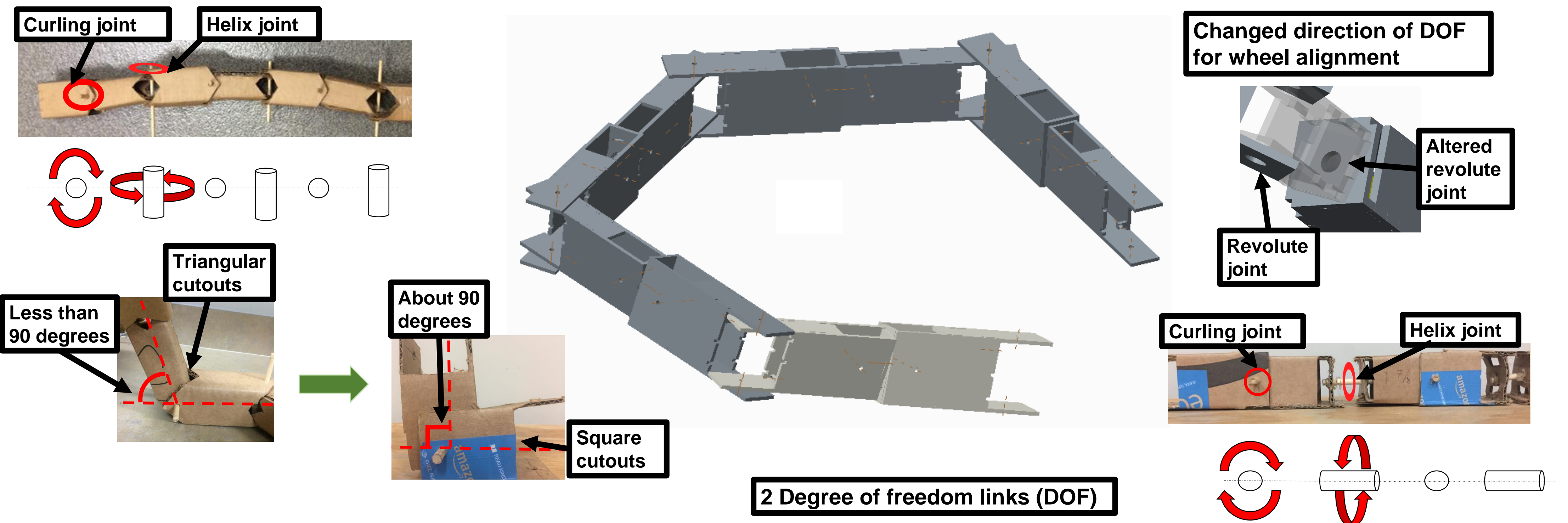The cost of cutting the tree itself is $150-1500.

Project Scope

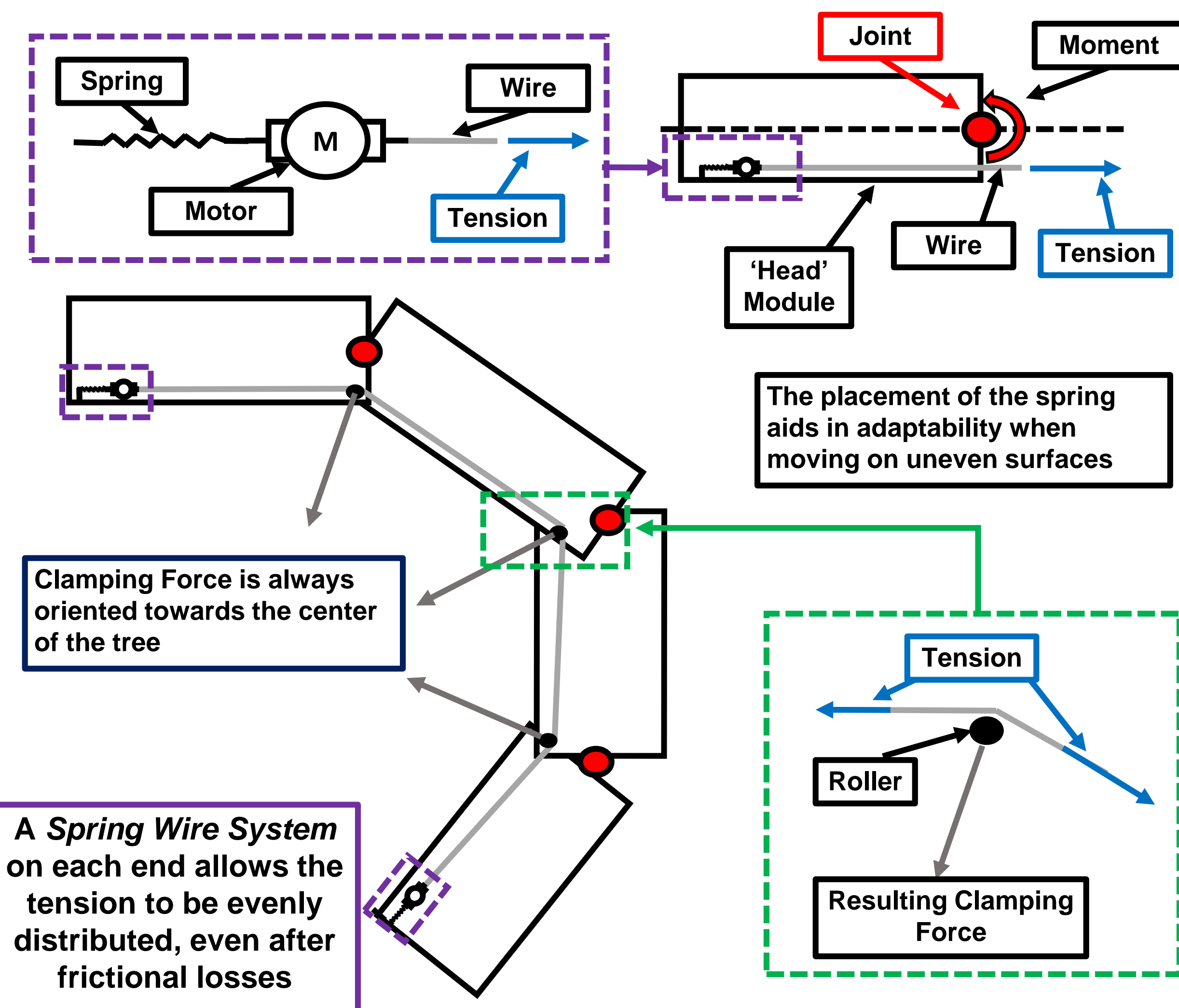The team's goal is to build a remotely operated snake robot that aids in the safe removal of trees.

Objectives:
- Length of robot has to be at least 1.5 times the length of circumference
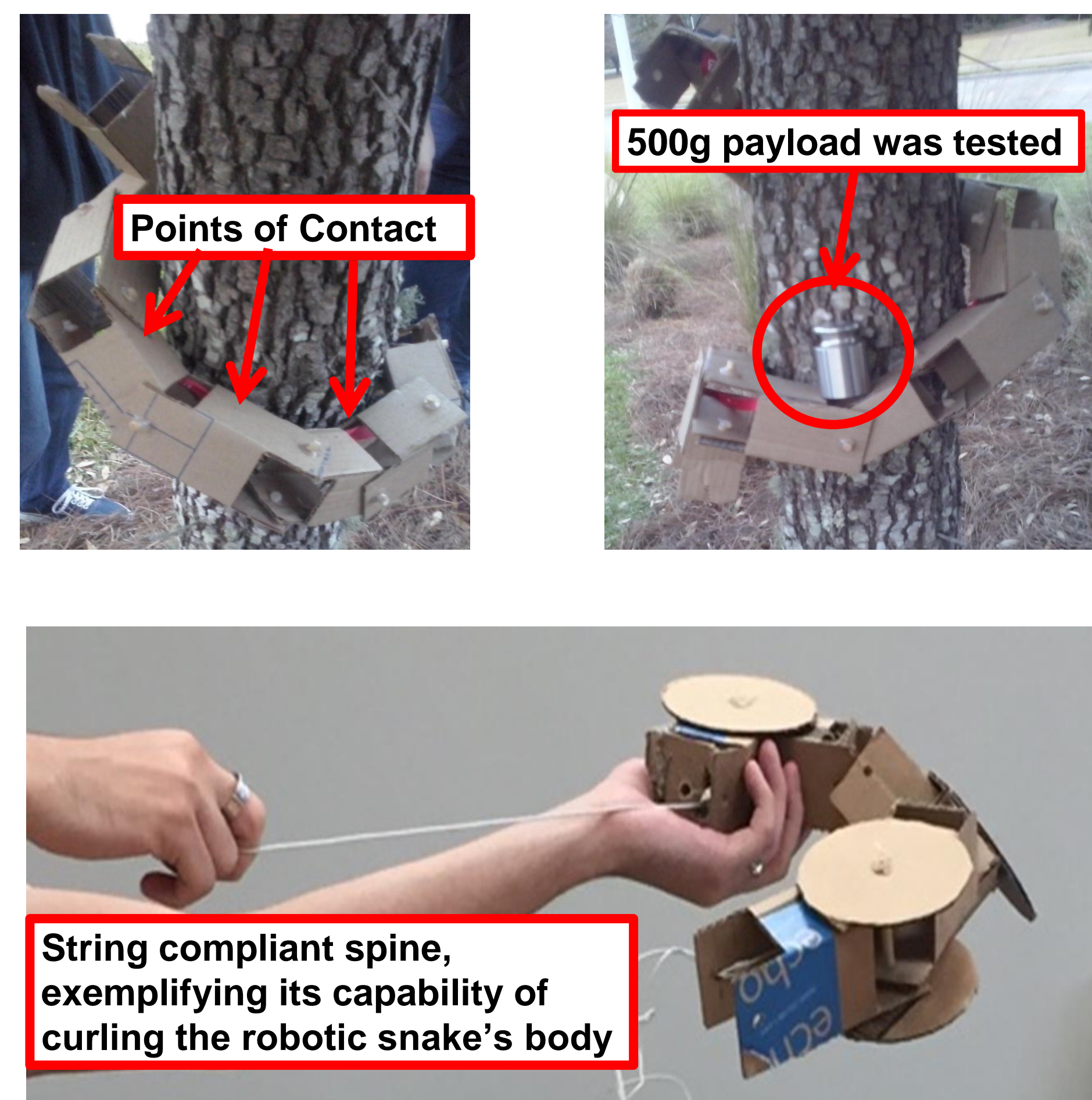- Must climb at a minimum of 60ft/hr
- Carry a 20lb payload

Design

Curling joint   Helix joint

Triangular cutouts

Less than 90 degrees

About 90 degrees

Square cutouts

Changed direction of DOF for wheel alignment

Altered revolute joint

Revolute joint

Curling joint   Helix joint

2 Degree of freedom links (DOF)

Clamping Mechanism

Spring   Motor   M   Wire   Tension

Joint   Moment

'Head' Module   Wire   Tension

The placement of the spring aids in adaptability when moving on uneven surfaces

Clamping Force is always oriented towards the center of the tree

Tension

Roller

Resulting Clamping Force

A *Spring Wire System* on each end allows the tension to be evenly distributed, even after frictional losses

Testing

Points of Contact

500g payload was tested

String compliant spine, exemplifying its capability of curling the robotic snake's body

Future Work

Motor Selection
- Spring: Calculate force needed to hold snake on tree
- Wheel: Calculate force needed to move snake at reasonable speed

Branch Avoidance
- Camera will be attached to head of snake
- Feedback will be given to user on remote
- User will have control of wheels

References

[1] US Bureau of Labor Statistics.
[2] T. L. Lam and Y. Xu, "A flexible tree climbing robot: Treebot - design and implementation," in Robotics and Automation (ICRA), 2011 IEEE International Conference on, May 2011, pp. 5849–5854.
[3] M. I. N. Faizal, W. A. F. W. Othman, and S. S. N. A. S. Hassan, "Development of pole-like tree climbing robot," in 2015 IEEE International Conference on Control System, Computing and Engineering (ICCSCE), Nov 2015, pp. 224–229.
[4] C. Wright, A. Johnson, A. Peck, Z. McCord, A. Naaktgeboren, P. Gianfortoni, M. Gonzalez-Rivero, R. Hatton, and H. Choset, "Design of a modular snake robot," in 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems, Oct 2007, pp. 2609–2614.
[5] F. Enner, D. Rollinson, and H. Choset, "Simplified motion modeling for snake robots," in Robotics and Automation (ICRA), 2012 IEEE International Conference on, May 2012, pp. 4216–4221.

Acknowledgements