Novel Wheel-Leg Model and Design for a Pipe-Navigation Robot

Tyler J. Downey, Dr. Carl A. Nelson

Department of Mechanical & Materials Engineering, University of Nebraska–Lincoln

INTRODUCTION & BACKGROUND

Pipe Navigation

In recent years, pipe robots have become more prevalent. Pipe networks are seen all over the world and require regular inspections and maintenance.

Previous Designs

- Inchworm locomotion
- Simple wheeled rover
- Track

Robot Design Criteria

- Passively adjust to small changes in diameter
- Actively adjust to large changes in diameter
- Accommodate diameter changes greater than robot length
- Complete gradual and sharp (90-degree) bends

PURPOSE

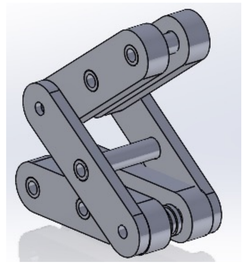
This research aims to show a new approach to a pipe robot by incorporating a novel wheel-leg design, allowing for the robot to navigate different diameters of pipe while being able to complete sharp turns. The use of pipe robots will be more cost efficient and safe to use in many different industries, making it easier to inspect pipeline networks.

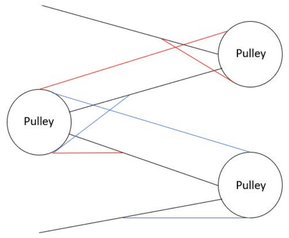
SOLID MODELING

- Designed and created multiple models using SolidWorks software
- Created individual parts of leg segment
- Assembled individual parts into a partial model

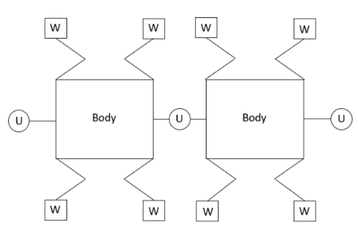
MODELS

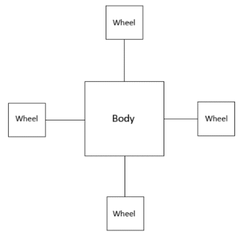
Design of Partial Leg & Pulley Constraint



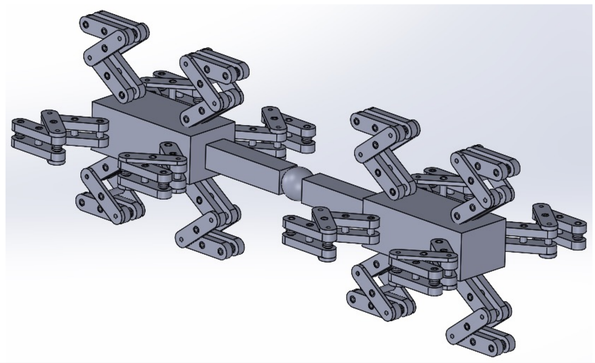


Top & Side View Schematic Showing Leg-Linkage Design and all Legs





Full Leg-Linkage Design



MCNAIR SCHOLARS PROGRAM

METHODS & TESTING

3D Printing

All parts of leg segment were 3D printed and assembled using screws to complete a leg. Each segment incorporates a pulley constraint to allow for stretching and compressing the leg mechanism.

Test Environment

Once assembled, the robot was tested in a tunnel to ensure it would move. Different diameters of tunnel were used to analyze data. The robot was also tested at various inclines to ensure it will maintain adequate contact force without slipping.

RESULTS & DISCUSSION

The robot was capable of accommodating changes in diameter with the ability to stretch and compress. It was also successful in navigating on an incline while maintaining adequate contact force.

FUTURE WORK

- Create advanced model of prototype
- Examine optimal materials
- Determine specific uses
- Field testing in a series of pipelines

ACKNOWLEDGEMENTS

- Dr. Carl A. Nelson, Research Mentor
- McNair Scholars Program