ARAtronics Research Center for
Opto-Mechatronics Engineering

ARAtronics Research Center,
Mechatronics Engineering Department,
Faculty of Engineering and Material Sciences (EMS),
The German University in Cairo (GUC)

Bachelor's Thesis, Term Project

Rolling Locomotion of Cable-Driven Soft Spherical Tensegrity Robots

Supervisor (s): (**Assist. Prof. Dr. Eng.** Amir Roushdy)

Soft spherical tensegrity robots are novel steerable mobile robotic platforms that are compliant, lightweight, and robust. The geometry of these robots is suitable for rolling locomotion, and they achieve this motion by properly deforming their structures using carefully chosen actuation strategies. The objective of this project is to consolidate and add to our research to date on methods for realizing rolling locomotion of spherical tensegrity robots. To predict the deformation of tensegrity structures when their member forces are varied, we will introduce a modified version of the dynamic relaxation technique and apply it to our tensegrity robots. In addition, we will present two techniques to find desirable deformations and actuation strategies that would result in robust rolling locomotion of the robots. The first one relies on the greedy search that can quickly find solutions, and the second one uses a multigeneration Monte Carlo method that can find suboptimal solutions with a higher quality. The methods will be validated both in simulation and with hardware robots, which show that our methods are viable means of realizing robust and steerable rolling locomotion of spherical tensegrity robots. **There is a Master's student from Mechatronics engineering Department and the Lab Engineer from ARAtronics, guiding and directing the student with Assist. Prof. Dr. Eng. Amir Roushdy.**

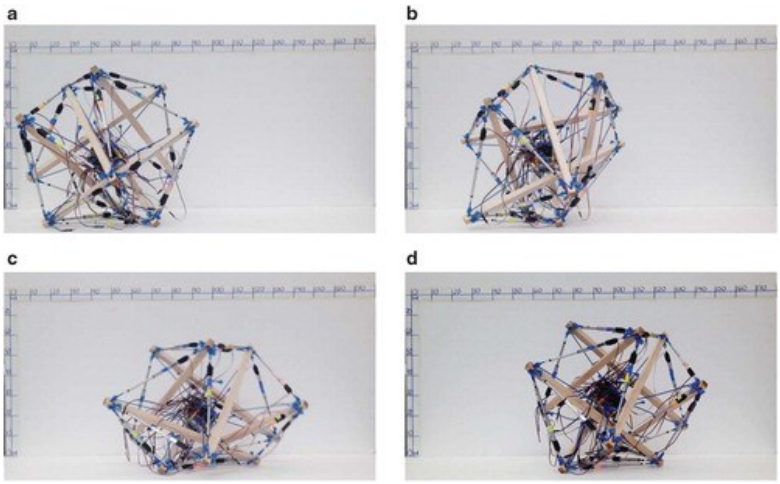

Fig.: Spherical Tensegrity Robotics Mechanisms in locomotion

Project description and objective:

The Common robotics platforms have limitations in the terrain they can cover and their robustness to unknown environments. Additionally, these heavy and typically expensive robots make certain missions impractical. In contrast, robots based on the structural concept of tensegrity ("tensile-integrity") can potentially locomote over dangerous terrain, may have less weight than comparatively equipped wheeled

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robots, and may not require external landing equipment. This high strength-to-weight ratio has prompted much research into the deployability of tensegrity structures, and their ability to fit into space-constrained

Research focus of this project:

- Literature review on the project should be studied properly.
- Not only, creating a software control system for the project but also the hardware.
- Experiments using the gadget and control system should be built properly.
- The outcomes must be documented.

Requirements:

- Passionate to learn more about 3D Printing design, Robotics and control.
- Prior mechatronic design expertise is desired like "SolidWork and Arduino".
- Enthusiasm for completing actual practical work with 3D printing staff (design fabrication and construction).
- A method of working that is both structured and self-contained.

General tasks of the project:

- The complete methodology is already available in the ARAtronics Lab, so we will discuss it from the first day to start the automation process for it
- Fabricate the machine/system using 3D printer/CNC machine (small parts).
- Assembly all parts of the Robot.
- Changing the working variables and see the effect on the locomotion of the robot.

Other notes:

- A weekly meeting with the advisors will be required for this project, as well as weekly progress updates (***The meeting could be more than once during the week based on your progress and based on your achievements***).
- You should to be in the Lab two days per week (***It could be more than two days based on your progress and based on your achievements***).
- All reports must be prepared in the style of a research paper.
- The outcome of this research will be published in one of the coming international Conferences and , or Journal

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