

Simulation of a soft robot with gazebo

Abstract

Masterthesis at IRS-VSA.

During this thesis, a simulation of a soft robot based on the piece-wise constant curvature model should be developed.

Start: 08.01

Tags: *Robotics, Soft Robotics, PCC, Simulation*



Supervisor:

Linus Witucki, M. Sc.

IRS-VSA, Raum 212

Tel.: 0721/608-42628

linus.witucki@kit.edu

Motivation

Human-robot collaboration is increasingly becoming a crucial area of research within the context of Industry 4.0. It promises to combine the repeatability and precision of robots with the flexibility and decision-making skills of humans. Therefore, robots are being developed that are small, light and have torque sensors implemented to make them safe for close physical coupling with humans. But the safety is only guaranteed through the sensors and software. In a fail-state, the robot can still harm the human. As a result, a completely new kind of robot emerged, the soft robot. These robots are developed with the safety by design concept in mind. Mostly, they consist of soft materials like cloth or silicon and are actuated pneumatically instead of with motors. Such robots are inherently safe for direct human-robot coupling. An example of a soft robot can be seen in Figure 1. To make the deployment of these robots easier simulation tools are required. One such simulation should be developed during the course of this thesis.

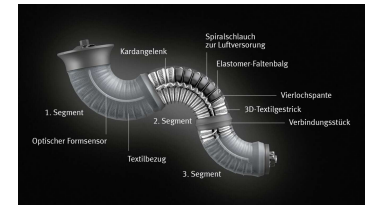


Figure 1: Soft robot @Festo

Goal

The goal of the thesis is the development of a Modular simulation for a soft robot. The robot is based on the piece-wise constant curvature model and consists of multiple segments. Each segment has the constraint of a constant curvature (see Figure 2). Gazebo in combination with ROS2 should be used as a framework for the simulation.

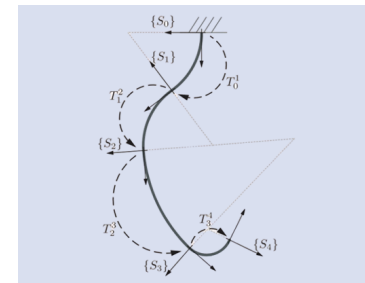


Figure 2: Piece-wise constant curvature

Helpful prior knowledge

The subsequent prior knowledge is advantageous for the completion of the final thesis:

- Soft Robotics
- Robotics
- ROS2
- Gazebo



Figure 3: Gazebo

Work packages

Work package 1: Research

- Research in soft robotics
 - Soft robot
 - Piece-wise constant curvature model
 - Control strategies for soft robots
- WP-Results:
 - Detailed summary about existing soft robot projects

Work package 2: ROS2

- At least 2 ROS2 training tutorials
- ROS2 example projects
- WP-Results:
 - List of completed ROS2 tutorials

Work package 3: Software architecture

- Design of the software architecture that will be used for the implementation
- WP-Results:
 - Detailed report explaining the software architecture
 - UML diagrams of the software architecture

Work package 4: Implementation

- Implementation of the designed software architecture
- WP-Results:
 - Simulation results
 - Comparison with state of the art research