The 9th East Asia Mechanical and Aerospace Engineering Workshop
May 30 - June 1, 2019, Korea University, Korea

A Collision-Free Approach for Multi-Segment Continuum Robots by Self-Motion Control in *SE*(2)

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Abstract

This paper demonstrates an online collision-free approach for a multi-segment continuum robot manipulator to generate its end-effector trajectory to the desired position in *SE*(2) in the presence of obstacles. Using a geometric representation, the method allows a multi-segment continuum robot with redundant degrees of freedom to avoid obstacles by reconfiguring themselves, while following the planned end-effector trajectory. The continuum robot manipulator is simplified as a virtual variant-link model under piece-wise constant curvature assumption. Obstacles, which are defined as convex polygons within the workspace of the manipulator, are further modelled as ellipses in robot frame for the analysis. Collision between the continuum manipulator and obstacles can be detected if any virtual joints are inside the boundary of ellipses. The recognition of robot-obstacle collision is computed online. In the case of collisions, the collision-free algorithm allows the manipulator to avoid obstacles with necessary self-motion adjustment. The proposed approach is based on frame transformation and inverse kinematics of continuum robots. The advantage of this method can be seen in the high computational efficiency by using a simplified model. The proposed method is evaluated and discussed through MATLAB simulation for a planar 2-segment continuum robot manipulator.

Key words: continuum robot, obstacle avoidance, trajectory planning