An Integrated Software Platform for Intelligent, Autonomous Control of Hyper-Redundant Modular Robotic Systems using Simultaneous Localization and Mapping

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The ability to be deployed through small access points and traverse through tightly-confined spaces much more efficiently than conventional mobile robots makes snake robots (a type of hyper-redundant modular robotic system) ideal tools for Search and Rescue and Minimally Invasive Surgery applications. Such systems have many internal degrees of freedom (DOFs) that allow for simplified obstacle avoidance and traversal in tightly packed volumes. Moreover, these highly articulated devices can coordinate their internal DOFs, giving them a variety of locomotion capabilities such as crawling, swimming, climbing, and rolling. However, due to these same DOFs, locomotive control of snake robots is very difficult and time consuming. Operating such a difficult-to-control system in intense, high-pressure situations such as those mentioned above makes human error very likely. The best way to eliminate human error is to make the robotic system autonomous. In this study, I propose a novel integrated software platform that implements Simultaneous Localization and Mapping (SLAM: the problem of estimating an environment map with a mobile robot while simultaneously estimating the pose of the robot in the incrementally constructed map), Point-Cloud Processing Algorithms, Inverse Kinematics, and Sinusoidal Motion Models in order to localize a Modular Snake Robot in its environment and efficiently control the actuation of each of its DOFs in an autonomous manner. The specific locomotive task targeted in this study that can later be generalized to all potential instances encountered on the field is to locate an elevated hole on a wall and locomote through it autonomously.

Awards Won:

Third Award of $1,000