Development of a Graffiti Removing and Sign Cleaning Cable Robot

By: Sean Donohoe
Advisor: Professor Steven Velinsky

This work focuses on the problem of graffiti removal from large overhead roadway signs. These signs are important to the operational efficiency of the national road network and when they are painted with graffiti they must be cleaned. Removing graffiti from these signs is often a labor intensive and dangerous proposition. As such the goal of this work is to find a safer way to clean these signs. The cable robot is selected as the particular type of robotic architecture to address this problem. In order to decrease worker exposure time, setup time is decreased by only requiring two cable actuators be mounted to the sign. Using fewer cables decreases setup time, but due to the well-known properties of such systems, it generally reduces the usable workspace. As such, a novel cable robot system is developed that uses a set of pulley arms that can rotate in the plane about their mounts over large angles while the system is operating. As the arms rotate, the orientation of the cables that they guide is modified. This gives the system redundant degrees of freedom that are not typically available with most cable robots. To take advantage of these extra degrees of freedom while also reducing the redundancy, the net force that the end-effector can generate in an instantaneous anisotropic desired direction is maximized. Through simulation, it is shown that maximizing the net force in a desired direction improves the system’s performance. This work develops a workspace methodology that allows the effect of moving the arms to be included. A proof of concept prototype is built to ascertain the suitability of the system. This includes force generation ability, comparison to the theoretical results, and path following ability.