GRADUATE STUDENT RESEARCH SEMINAR SERIES (2019)

EXACT OPTIMIZATION ALGORITHMS FOR THE DESIGN OF CABLE HARNESS LAYOUTS AND LOCATIONS OF JUNCTIONS

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The configuration of cable harness assemblies is currently performed in a manual process at the final stages of design, which relies heavily on the experience of the designers and engineers. In addition to being costly and time-consuming, this process lacks automation and the final solution is often far from optimal. The focus of this research is to set up a mathematical framework for the optimization of the design process to achieve maximum compactness and minimum weight in the assembly. This research is twofold. On one side, the problem of finding the shortest route connecting two components of the system in a 3D cluttered environment is considered and addressed through an exact geometric based algorithm. On the other side, the problem of path branching is considered and modeled as an optimal location problem. The point(s) where the path of a connector starts branching to reach different components is called the breakout(s). The goal is to find the optimal location of the path breakouts with the aim of minimizing the overall length of the connectors while maximizing the common length between any two consecutive breakouts. The optimization problem is formulated as a bi-objective integer program. Two solution methods are proposed: (1) to solve for the optimal locations of a known number of breakouts and (2) to find the minimum length tree that spans all the components of the system and generates the optimal harness layout. This tree is known as a Steiner tree. The two methods are compared based on their final optimal solutions and computational efficiency.

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