

Exact and heuristic approaches for the optimal welding location problem on the vehicle wiring harness

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Abstract

Nowadays vehicles are highly customizable products which can be equipped with a great number of options. This provides several harness design problems to automotive companies, where by harness we mean the set of *cables*, positioned within the vehicle *chassis*, which transmit information and electrical power to the options to make them operative. In this context, we focus on an optimization problem arising in the construction/assembly phase of the harness within a vehicle. The options selected by customers have to be connected through a harness shaped in a tree structure within the vehicle chassis. In particular, the wiring has to connect subsets composed of two or more options. The total length of the connecting cables could be very large if a dedicated cable would be used for each couple of options in each subset. This length can be significantly reduced by realizing the connection through the usage of cable weldings. This work introduces for the first time the problem of the optimal placement of the weldings on the wiring harness tree of a vehicle *OWLP*, aimed at minimizing the total length and/or the cost of the cables, weighted by their gauge. The problem can be schematized as a *p*-median problem (*PMP*) on a tree with additional technological constraints related to the welding positions and mutual distance. This work presents an ILP formulation and gives some hints about a matheuristic approach for the *OWLP*. The efficiency and the effectiveness of the proposed methodologies is discussed together with several findings.

Keywords : *harness design, p-median problem, ILP formulation, matheuristic*