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Use of geometry optimization to rationalize layout optimized trusses

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Abstract

Layout optimization provides a computationally efficient means of identifying the optimal arrangement of bars in a truss. The plastic layout optimization formulation permits a wide variety of problem types to be solved rapidly using linear programming, including problems involving self-weight and multiple load cases. However, the solutions obtained are often quite complex, particularly when fine numerical discretizations are employed. To address this geometry optimization is here employed as a post-processing step. As well as adjusting the locations of the nodes in the layout optimized solution this has the effect of filtering out numerous bars carrying small forces, thereby rationalizing the solution. The non-linear optimization problem involved is solved using an efficient interior point solver. To demonstrate its efficacy the technique is applied to a wide range of example problems, involving point and distributed loads, self-weight and multiple load cases. It is shown that the geometry optimization rationalization step is very effective in reducing structural complexity, and also reduces the computed volume, sometimes markedly. Finally, it is shown that the computational cost associated with the proposed rationalization technique is often relatively modest.