

## A comparative study on the optimisation-based form-finding of tensile membrane structures

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### Abstract

Form-finding of tensile membrane structures (TMS) is an inverse problem in mechanics, wherein the (primary) form/shape of a structure needs to be found based on the applied loads and boundary conditions. Several numerical methods have been developed and employed for the form-finding of TMS. However, some important characteristics of such algorithms, such as robustness and computation cost, – needs to be investigated further for arriving at an efficient form-finding solution.

In this study, the form-finding of TMS is formulated as an area minimisation problem. Two nature-based heuristic algorithms, (i) particle swarm optimisation (PSO) and (ii) ant colony optimisation (ACO), are used to solve this optimisation problem. Form-finding solutions obtained using these heuristic algorithms are compared with the results from the well-known dynamic relaxation (DR) algorithm, in terms of the important algorithm efficiency characteristics mentioned earlier. The proposed methods are tested on two common TMS types. Both the heuristic methods proposed are found to be similarly efficient as DR.

**Keywords:** tensile membrane, form-finding, heuristic algorithm, dynamic relaxation, optimisation