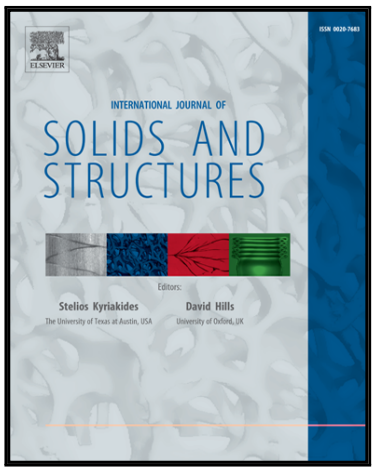

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Non-parametric shape optimization method for designing cable net structures in form finding and stiffness maximization problems

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ABSTRACT

Cable net structures, belonging to the tension structures, have been widely utilized in structural engineering. In this study, we develop a non-parametric shape optimization method based on the H^1 gradient method for designing cable net structures in form finding and stiffness maximization problems. We divide the design velocity field of cable net structures into the off-axis and the in-axis components for deriving and applying the shape gradient function in each design problem conveniently. In the form finding problem, we use the total length of cables as the objective functional and minimize it without or with considering the constraint condition of perimeter. In the stiffness maximization problem, the compliance is used as the objective functional and minimized under the constraint condition of perimeter and total length of cables considering large deformation and small strain. Moreover, two-step shape optimization of cable net structures from the form finding problem to the stiffness maximization problem is also implemented. The validity of the developed shape optimization method is confirmed by design examples.

Keywords: Cable net; Compliance; Form finding; Non-parametric; Shape optimization; Stiffness maximization.