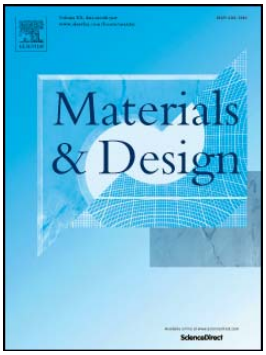

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Crushing analysis and multi-objective optimization design for bionic thin-walled structure

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Abstract: Thin-walled structure has gained increasing attention and been widely used in the field of mechanical engineering due to their extraordinary energy absorption capacity and light weight. In this paper, we introduced a new energy absorbed structure named as bionic thin-walled structure (BTS) based on the structural characteristics of horsetails. In this study, six kinds of BTSs with different cross-sectional configurations under lateral loading conditions were investigated using nonlinear finite element method through LS-DYNA. According to the numerical results, it can be found that the cell number, inner wall diameter and wall thickness of the BTS had significant effect on the crashworthiness of the structure. In order to obtain the optimal design among the six kinds of BTSs, the six BTSs were optimized using a metamodel-based multi-objective optimization method which was developed by employing polynomial regression (PR) metamodel and multi-objective particle swarm optimization (MOPSO) algorithm. In the optimization process, we aimed to achieve maximum value of specific energy absorption (SEA) and minimum value of maximum impact force (MIF). Meanwhile, we also optimized the traditional thin-walled structures, i.e., the circular and square tubes. Based on the comparison of the Pareto fronts obtained by the multi-objective optimizations, we found that the crashworthiness of the BTSs was better than that of the circular and square tubes and the best BTS among the six kinds of BTSs was different