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Multiobjective Optimization of Multi-Cell Tubes With Functional Graded Thickness

Jianguang Fang[1,3], Yunkai Gao[1], Guangyong Sun[2], Qing Li[3]

[1] School of Automotive Studies, Tongji University, Shanghai, 201804, China
[2] State Key Laboratory of Advanced Design and Manufacture for Vehicle Body, Hunan University, Changsha, 410082, China
[3] School of Aerospace, Mechanical and Mechatronic Engineering, The University of Sydney, Sydney, NSW 2006, Australia

Abstract

Multi-cell structures have been extensively studied as potential energy absorbers for their outstanding performance. Unlike existing multi-cell tubes with uniform thickness (UT), this paper introduces functionally graded thickness (FGT) to multi-cell tubes under dynamic impact, which can be fabricated by an extrusion process. Numerical model is established using nonlinear finite element analysis code LS-DYNA, and experimental tests are also conducted to validate the numerical model. The multiobjective optimizations of UT and FGT multi-cell tubes are conducted to seek the optimal gradient parameters to improve the specific energy absorption (SEA) and reduce the maximum impact force (Fmax) simultaneously, in which the multiobjective particle optimization (MOPSO) algorithm and response surface (RS) surrogate modeling technique are adopted. The optimization results demonstrate that the FGT multi-cell tubes produce more competent Pareto solutions than the conventional UT counterparts; and similar gradients in different regions of FGT multi-cell tubes are recommended attributable to their better interactions.