Numerical simulation of magnetic pulse welding process using an edge-based smoothed finite element method

†Xiangyang Cui[1], *Yongjie Pei[1], and She Li[1]

[1] State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, Hunan University, Changsha, 410082, PR China

*Presenting author: yjpei@hnu.edu.cn
†Corresponding author: cuixy@hnu.edu.cn

Abstract

In this paper, numerical simulations of the magnetic pulse welding (MPW) process of similar and dissimilar metals are carried out by establishing a coupled modelling of electromagnetic field and mechanical field. MPW is a high-speed, high strain rate, and solid-state welding technology, which including the transient eddy current and large deformation in the process. In the present work, an explicit scheme is given for the simulation of MPW process, and the edge-based smoothed finite element method is used in both electromagnetic and mechanical field. The multi-body contact is considered for the contacts of fly plate, parent plate and spacer, and the defence node algorithm is used to calculate the contact forces. Moreover, an adaptive remeshing technique is also introduced to solve the problem of severe mesh deformation caused by the high-speed impact in MPW process. The MPW process of aluminum-to-aluminum and aluminum-to-HC420LA steel are simulated separately, and the numerical results of flyer kinetics, such as impact velocity, collision velocity, showing good agreement with the experimental data. The welding interface characteristics, jet phenomenon, and temperature distribution are well reproduced, and discussed the relationship to the welding mechanism.

Keywords: magnetic pulse welding, the multi-body contact, adaptive remeshing technique, flyer kinetics, welding interface characteristics, welding mechanism.