Comparison of forming, welding and heat treatment simulations in LS-DYNA and MSC Marc

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Abstract

The manufacturing of components for aero engine structures from a flat sheet to the final shape usually requires several steps that may introduce residual stresses and shape distortions in the part. Depending on the magnitude, sign and distribution with respect to the stresses induced by the service load, the remaining stresses may affect the service life of a component, especially when submitted to cyclic loading. Nowadays, several types of software that have the ability to predict the residual stresses and the final shape of a component subjected to various process steps are available. However, literature shows a lack of comparison studies among different software tools for multi-step simulations of a manufacturing process. In this study, the manufacturing process chain of an aerospace component including forming, welding and heat treatment in the nickel-based superalloy 718 is modelled and simulated using the two finite element software codes LS-DYNA and MSC.Marc. The results from the displacement of the blank in the punch stroke direction, the equivalent plastic strain and the von Mises stress are compared between both FE codes. The displacement of the blank after forming is slightly higher in LS-DYNA compared to MSC.Marc, as well as the equivalent plastic strain and the von Mises stress values. This tendency is also observed after trimming and welding. It can also be noted that the distribution of both strains and stresses on the trimmed and welded parts varies between the two compared codes, presumably due to the choice of different solver options, explicit and implicit.