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Springback Prediction for Sheet Metal Cold Stamping Using Convolutional Neural Networks

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Abstract : Cold stamping has been widely applied in the automotive industry for the mass production of a great range of automotive panels. Predicting the springback to ensure the dimensional accuracy of the cold-stamped components is a critical step. The main approaches for the prediction and compensation of springback in cold stamping include running Finite Element (FE) simulations and conducting experiments, which require forming process expertise and can be time-consuming and expensive for the design of cold stamping tools. Machine learning technologies have been proven and successfully applied in learning complex system behaviours using presentative samples. These technologies exhibit the promising potential to be used as supporting design tools for metal forming technologies. This study, for the first time, presents a novel application of a Convolutional Neural Network (CNN) based surrogate model to predict the springback fields for variable U-shape cold bending geometries. A dataset is created based on the U-shape cold bending geometries and the corresponding FE simulations results. The dataset is then applied to train the CNN surrogate model. The result shows that the surrogate model can achieve near indistinguishable full-field predictions in real-time when compared with the FE simulation results. The application of CNN in efficient springback prediction can be adopted in industrial settings to aid both conceptual and final component designs for designers without having manufacturing knowledge.

Keywords : springback, cold stamping, convolutional neural networks, machine learning
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