Mathematical modelling of wire flat-rolling

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Abstract

This study introduces a mathematical model for wire flat-rolling, building on the framework established in the sheet rolling model reported in the Arxiv preprint (https://doi.org/10.48550/arXiv.2408.013
By assuming a small rate of change in both thickness and width relative to the length, the continuum mechanics and plasticity equations, along with boundary conditions, are simplified to represent plane-stress deformation. Notably, this model is the first to predict lateral spread without requiring any fitting parameters. The predictions demonstrated good agreement with experimental data across various rolling conditions and wire diameters, achieving an average absolute error of 0.2 mm for 27 data points. While the model accurately captured the order of magnitude for roll pressure distribution along the rolling direction, finite element (FE) results fell between the predictions for plane-stress and plane-strain deformation.

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