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Development of a flexible tooling system for sheet metal bending

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ABSTRACT

This article presents the design and development of a flexible tooling system for sheet metal bending. The flexible tooling system aims to reduce manufacturing disturbances and increase the efficiency of the forming process. First and foremost, the structural behaviour of the sheet metal is investigated using the finite element method for the numerical simulation of the three-point bending process. The analysis' findings enabled the prediction of component reaction to loads, which are essential for the further optimization and enhancement of the tooling system's flexibility. At the initial stage of the development phase, SolidWorks, the computer-aided design software, is utilized to visualise the flexible tooling system and improve the tooling connectivity design. Furthermore, the prototype is developed by integrating mechanical and electrical components, such as the Arduino Mega microcontroller, stepper motors, and digital stepper drivers. Automation is achieved by programming the Arduino microcontroller board and controlling the stepper motors' movement to ensure precise displacement and speed control of the forming tools. The tooling system's major qualities are its high flexibility, achieved through the implementation of two moveable support cylinders and the possibility of being further upgraded to a closed-loop forming system. The higher level of automation and optimization of the sheet metal bending process can lead to improved processing efficiency and help achieve the desired formed products with higher quality and the required geometric tolerance. It is expected that the development of a flexible tooling system will find widespread application in sheet metal bending processes, resulting in reduced material costs, rapid equipment set-up and higher processing repeatability.

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