Smart Roll Forming

Intelligent roll forming based on monitoring of drive torques

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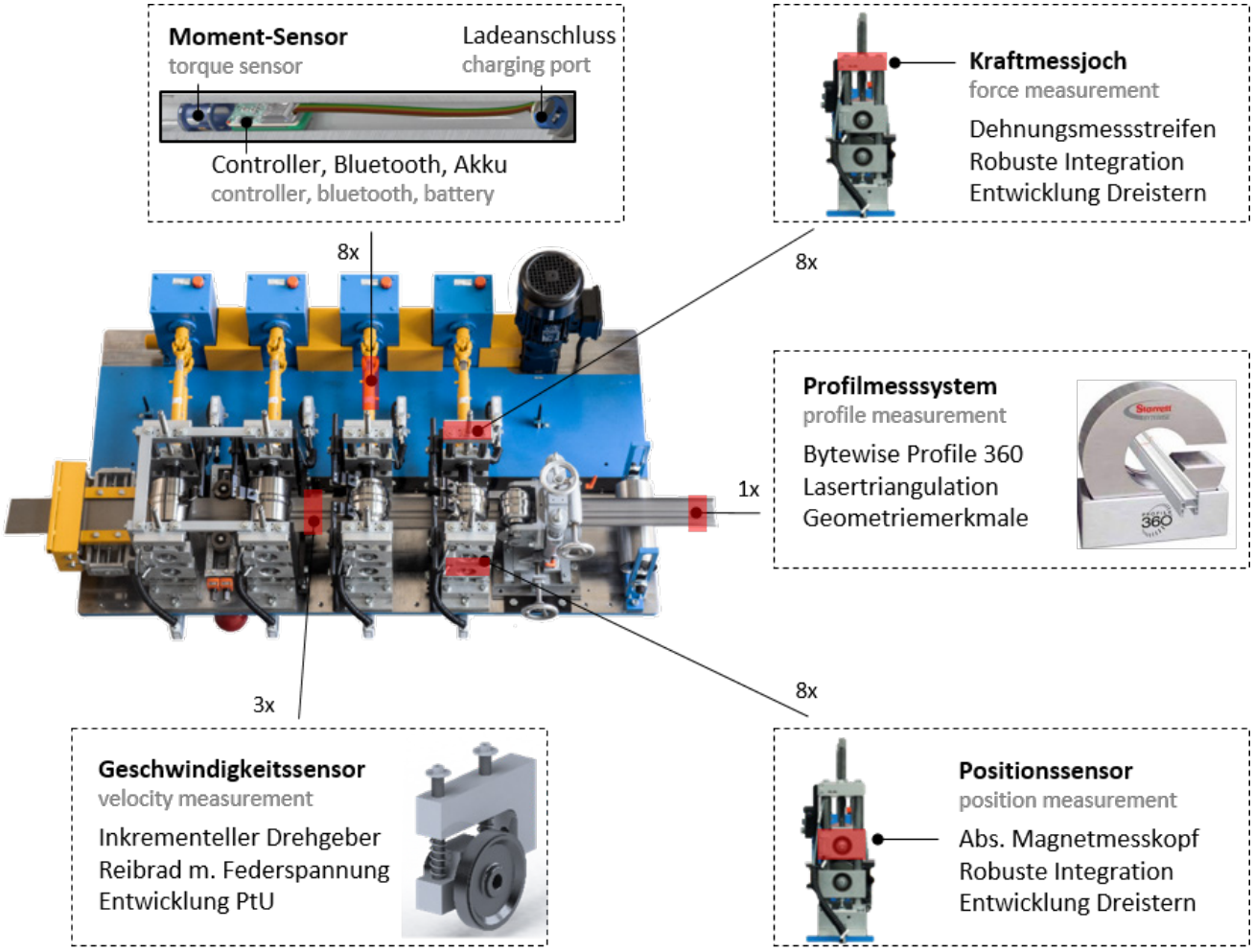
Abstract

The main objective of the research project was to increase energy efficiency by monitoring and optimizing drive torques in roll forming processes. This requires the elimination of disproportion-ately high accelerating torques as well as decelerating torques. For this application, a sensor-based monitoring of the forming process was implemented on a demonstrator plant. Decelerating rolls or segments were detected using torque sensors in the drive shafts in order to investigate optimiza-tion measures systematically. The measured data were implemented in the programmable logic controller of the roll forming line to display current process conditions in real time and to show the potential for optimization. Several influencing factors and optimization measures were identified in the FEM as well as in the real forming process, and were finally validated in an industrial test series.

Project description

In times of climate change, the efficient use of energy is a global objective. The industrial sector accounts for more than 50 % of energy consumption, with steel processing alone causing about 25 % of industrial CO2 emissions. As an industrially well-established manufacturing process, roll forming is used to manufacture open and closed profiles. In this process, the sheet metal is trans-ported through several forming stages by means of rotating roller tools and formed according to the roller contour. As



[1] Intelligent roll forming line and integrated sensor technology

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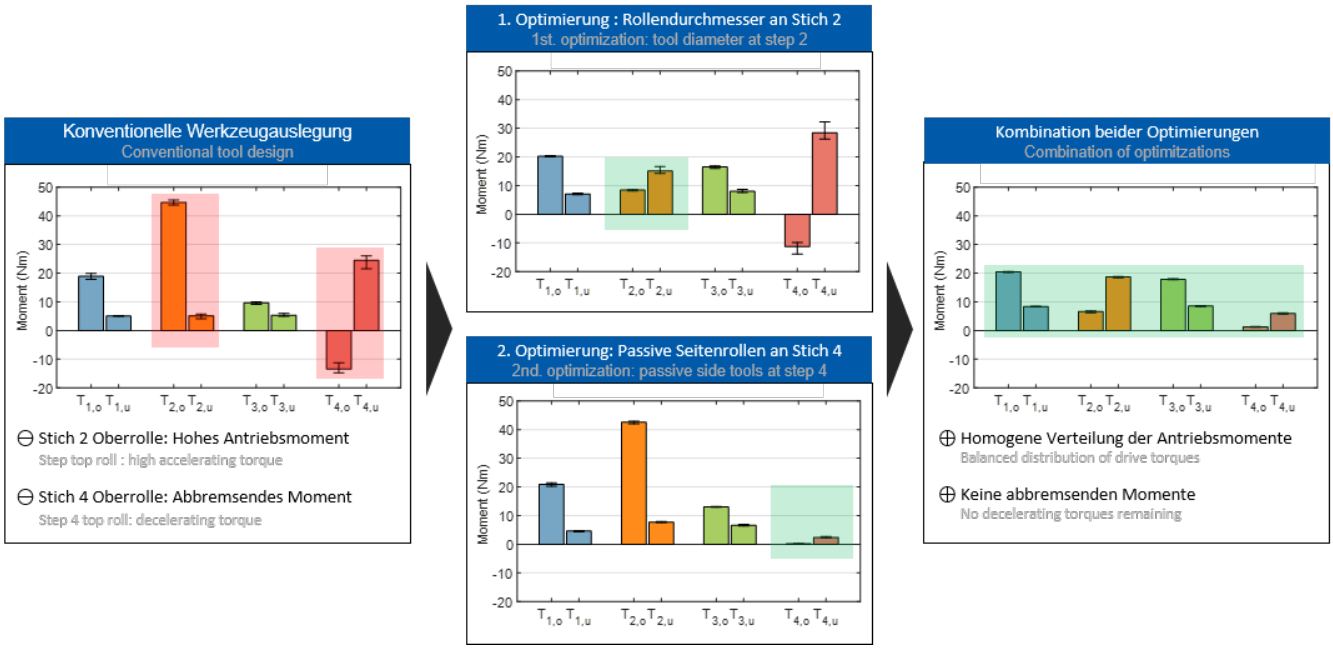

[2] Process optimization and energy savings using the intelligent roll forming line

the diameters of the upper and lower rolls vary in the contact zone with the sheet metal, the peripheral speed deviates locally from the speed of the sheet metal. The resulting non-uniform slippage conditions cause imbalances of the roller tools with partially decelerating tor-ques leading to a low energy conversion efficiency.

The main goal of the research project was to increase the energy efficiency by eliminating deceler-ating torques. While our project partner DREISTERN GmbH has developed a sensor-equipped roll forming line (Fig. 1), a comprehensive FEM model has been derived at PtU. Using sensory cardan shafts, existing disbalances between upper and lower rollers became detectable and decelerating rolls were able to be identified. Based on the analyzed data, the process was virtually optimized in order to test promising measures in practical application. In addition to a decoupling of entire rolls, local measures such as rotatable roll segments and adjustments of the forming gap proved to be suitable optimizations. After initial validation in the test field (Fig. 2), the findings were successfully applied in industrial production. As a result, the desired technology transfer could be achieved promisingly from both the manufacturer‘s and the user‘s point of view.

Results

The identified optimization measures were initially tested on the demonstrator plant developed in the project and were quantified in systematic series of measurements (Fig. 2). In the process, strongly heterogeneous accelerating torques were balanced at one stage and decelerating torques were eliminated at another stage. In contrast to the initial process condition, the resulting homo-geneous driving torque distribution shows a reduction in process power of more than 15 %. The optimization methodology developed in the project was successfully applied in industrial produc-tion during a one-week series of measurements. Thus, the technology transfer aimed at within the project was realized in a successful way both in the production of the equipment and in the applica-tion of the process. In addition, challenges that arise in data acquisition, data analysis and the appli-cation of measures in daily production conditions could be identified and already partially solved. The PtU is aiming to extend the knowledge gained during the project and to apply it in cooperation with partners from industry in future cooperations.

Acknowledgement

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