Laser cut quality estimation with deep learning

Degree programme: BSc in Electrical Engineering and Information Technology
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Industrial partner: Bystronic Laser AG, Niederönz

In today's manufacturing industry, the demand for fully autonomous and cost-effective production facilities is constantly rising. To ensure that quality can be maintained without human intervention, AI-based solutions are increasingly being deployed. In this bachelor thesis, an independent AI-based solution to estimate the laser cut quality was further developed together with the project partner Bystronic Laser AG.

Initial situation

The foundation for this project was developed in previous studies by electrical and mechanical engineering students. The idea is to use a simple 2-D camera to capture images of laser cut surfaces in order to estimate the burr and roughness quality using a neural network model. Initially, models were trained with datasets of high-resolution images and measurements of cut surfaces created with an optical measuring device. For a more cost-effective approach, a standalone device was developed to create new image datasets of the same cut surfaces to train the models. The most recent efforts have focused on fine-tuning parameters to optimize image acquisition and model training.

Goal and Realisation

The aim is to integrate everything from before into an independent system. In the end, it should be possible to insert a test piece into the device and obtain an estimation of the roughness and burr quality at once. In order to obtain an estimate from the stand-alone device, a modular interface was developed with which an image can be captured, processed and evaluated directly by the neural network. At the same time an user interface (HMI) was developed, by a previous student as rework, for easier operation and demonstration. To improve the robustness of the system, further image and measurement data of different materials and laser cutting machines were created.

Results and outlook

The final system offers the possibility of quality estimates of roughness and burr at the touch of a button. In addition, the process for creating further image datasets has been optimised to minimise the steps between data acquisition and training models, which can be updated via drag and drop.
The results contribute to the project partners' plans to integrate such a system into their sheet metal processing chain to create a fully autonomous processing solution.

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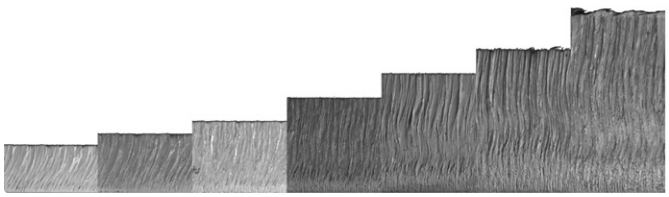

Train image samples from the Stand-alone device developed by former students