Innovative Tagging and Tracking Solutions to Improve Traceability in the Rolling Mill

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INTRODUCTION

Robotics and Automation already play a prominent role in all parts of Industry 4.0, coming together with learning algorithms that allow both both bots and humans to optimize production and improve quality, as well as operators' safety and health. To be successful, an Industry 4.0 approach must be concrete. How can we upgrade existing rolling mills? How can we ensure operators' safety and improve productivity and quality? Through the integration of different digital technologies connected simultaneously to computer systems equipped with artificial intelligence and learning algorithms, robots can automatically perfect their operations and operators are able to quickly intervene on the production efficiency, making decisions based on objective data, in a path of continuous improvement.

The following document offers an overview on instruments that turn a rolling mill into a "smart" one.

Keywords: rolling mill, automation, robotics, machine vision, ai, lean production, digital mill

DISCUSSION

A rolling mill plant basically consists of reheating furnaces, rolling mill and accessory devices. The economic efficiency of metal rolling processes is strongly correlated to the quality level of the end-rolled products. Rolling of flat steel products is a complex process where the quality of the product is influenced by a range of factors such as incoming material, mechanical and electrical equipment, operating parameters and automation and control strategies etc.

The significant quality parameters are:

- Material thickness
- Material shape and surface
- Homogeneity of stress distribution

Following the process stream, the first applications that we meet are a billet-yard inventory management system for the Physical tracking of the cranes position to prevent errors in the warehouse and the billet tag reader, a system to read the billet tag and compare with the production program before the reheating furnace.

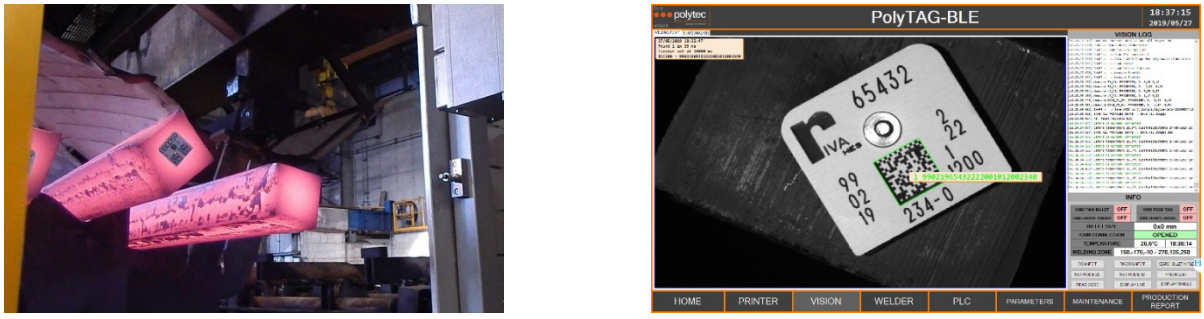

Figure 1: Billet tag application and reading

Existing rolling mills can be upgraded by implementing L1 and L2 digitalization without a full equipment replacement expense. Highlights of long products rolling mill control and automation system are: Fast set-up in management of different production profiles; innovative Double Cascade rolling stands Speed reference. calculus; Rolling Minimum Tension and Looper and material continuity control; Precision in process regulations and stands speed stability; Optimization of RHF discharge Cadence & Pacing time and of head/tail cutting and positioning.

Steel rolling involves the plastic deformation and elongation by crushing, between two or more rolling cylinders of a semi-finished product, normally called a billet, bloom or previously heated slab. Normally the rolling stands, which can have different construction shapes, are placed in line in the process and each one provides for a partial reduction of the section of the rolled material and the consequent elongation, also involving an increase in the output speed.

The new smart solution provides the use of an autonomous vehicle, able to move freely near the rolling stands. On it is installed a robotic arm which mounts a measuring device and a 3D vision system to guide both the vehicle and the arm. The vehicle has the peculiarity to move autonomously approaching the measurement point; at the second instance the robotic arm will be activated by locating the point to be scanned and moving the measurement system into position to verify the plastic deformation in exit from the rolling rolls, the section and/or carrying out a surface defect analysis.

The cooling bed sampling robot allows you to cut, pick up and analyze samples on long rolling mill's cooling bed. The system can identify the bar to be analyzed, cut a sample, and move it to the analysis station to check dimensions, chemistry, and other quality factors. The adoption of this system dramatically reduces the operator's risk and positively impact productivity, and the overall quality of the rolling mill output with an estimated time saving of +- 2minutes for each sample compared to manual operations.

Based on the products type, there is a wide range of smart robotics applications that allow to improve productivity automatically managing operations like: tagging, marking, pieces counting, tags/codes reading, bundling, debanding.

Thanks to advanced machine vision systems and AI, each smart machine becomes a point of collecting and processing of data relating to the product and process. Automation systems running industrial robots are very efficient and their designs cover a very large spectrum of manufacturing parts or production applicability. Not just production cycle time, even the time to place the product on the market is drastically reduced. For that case, the time to respond to customer demand is very short. These benefits of automation systems implementing industrial robots encourage industry to implement robots interconnected by a uniform communication infrastructure. The fundamental interconnection concept has therefore be focused on scalability regarding rising robot counts in the network and having in mind the use of it within a manufacturing execution system environment.

Figure 2: Bundle bars tagging robot and scan with point identification, piece counting and tag reading after welding

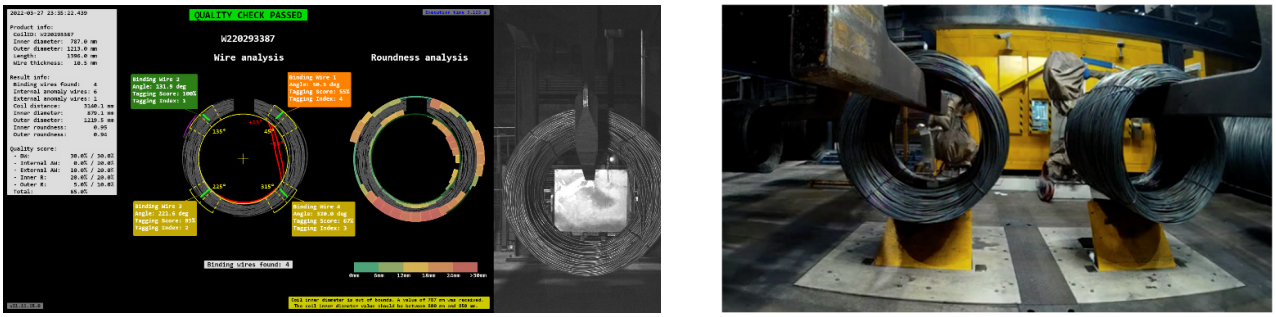

Figure 3: Wire coil strap identification and conformity check

Machine Vision and Neural Network Technology can finally solve the common issues of the current tracking systems, the visual recognition of dimension, color, shape, and other factors during the movements of the product dramatically increase the reliability and reduce potential mismatch and claims, benefiting quality and productivity.

CONCLUSION

Nowadays a superior product quality is a matter of course for the customer. For that reason and to differentiate against competing companies added value must be offered. Short delivery times, high flexibility, a broad proliferation of variants, adherence to delivery dates, shorter product life cycles and so forth. These are properties which can only be created by improving processes and not by the production itself.

Today's customers want products tailored to their demands. Digital Transformation is the way to move towards Lean steel manufacturing, focusing on minimizing waste within manufacturing systems while simultaneously maximizing productivity.

