

VIVALDI – Steel Billet Tracking with Advanced Computer Vision

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Our groundbreaking computer vision system allows for the precise tracking of serial numbers on steel billets in challenging industrial settings. It combines cutting-edge hardware and machine learning, excelling in character recognition and localization while adapting to dynamic ambient lighting conditions. Moreover, it accurately measures crucial geometric parameters such as side sizes, bulging, and skewness. This multifaceted technology promises to elevate material tracking, quality assessment, and production optimization in the steel industry to unprecedented levels.

For many heavy industries, specifically steel production, the ability to monitor and trace materials throughout the production process is essential. In response to this need, CSEM has developed a cutting-edge computer vision system specifically designed to read and track the serial numbers engraved on steel billets. This system is optimized on both hardware and software domain to deliver the high accuracy and robustness required for a harsh industrial environment, including retraining for continuous optimization, assessment of geometric characteristics for better management of the production and smooth interaction through a user-friendly Web interface.

To achieve the level of accuracy and robustness necessary for industrial use, our computer vision system incorporates a multiple camera with active illumination. In addition, the optical layout is strategically positioned to capture the serial numbers engraved on steel billets from various angles and lighting conditions. This approach ensures that even in challenging environments with dust, debris, or low ambient lighting, the system can reliably capture the required information.

The associated software integrates data from all the cameras and illuminations, efficiently fusing and processing the information in real-time.

Due to high variability in the data specifically due to the quality of casting in this harsh environment and the need for high recognition accuracy (99.8%), at the heart of our software solution lies a neural network algorithm specifically designed to tackle the unique challenges posed by steel billet tracking. This neural network performs a dual role, simultaneously localizing and recognizing characters engraved on the billets. The uniqueness of the algorithm is its ability to leverage additional information about the structure of serial numbers. For example, it understands that the first two characters represent the year, the last character is always a letter, and so on. As in our method the localization and recognition happen jointly, this contextual awareness not only enhances character recognition but also improves the accuracy of character localization, making it an indispensable tool in a challenging industrial setting.

To cope with the dynamic nature of industrial processes, our system incorporates a retraining module. This feature allows for fine-tuning the neural network to adapt to the specific characteristics of their plant or production line. By providing a mechanism for constant optimization, our system ensures that it remains adaptable to changing conditions and requirements.

Beyond its novel serial number recognition capabilities, the proposed system accurately determines critical factors such as side sizes, bulging, skewness, and more, by measuring various geometric parameters of the steel billets, hence contributing to a deeper understanding of the billets' physical characteristics, enabling precise quality assessments and facilitating production optimization. This multifaceted functionality underscores our commitment to delivering a solution tailored to the specific complex demands of the steel industry.

To make our cutting-edge technology accessible and user-friendly, we also have developed a web-based interface. This interface serves as the gateway for users to interact with the underlying algorithm. It enhances the user experience in several ways:

1. Visualization of Inference Performance: Users can easily monitor and visualize the performance of the inference process in real-time. This transparency allows for quick identification of any issues and helps maintain optimal system performance.
2. Retraining and Fine-Tuning: Through the web interface, users can initiate the retraining process, fine-tuning the neural network to suit their specific needs. This flexibility ensures that the system continuously evolves to meet changing demands.
3. API Integration: The web interface seamlessly integrates with the underlying algorithm through APIs. This not only simplifies the interaction but also opens the door for further customization and integration into existing industrial systems.

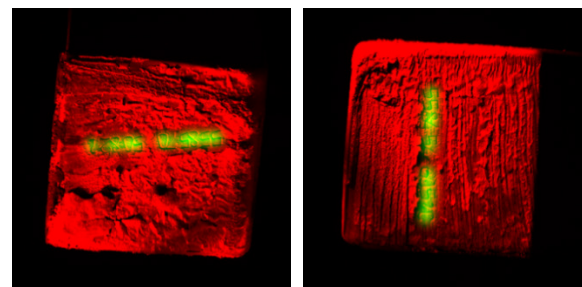


Figure 1: Illustrating the visible section of the steel billet (red), overlaid by the output of the character recognition (green).

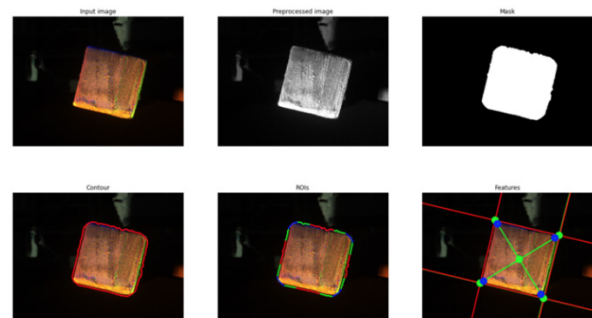


Figure 2: Segmenting the billet in the presence of background artifacts and measuring its geometrical characteristics.

Finally, since the system is flexible and modular, it can be customized for other inspection and quality control applications to have an end-to-end (from hardware to software and processing) optimized system for the application at hand. Automatization to reduce the need for human intervention for changes in the main building blocks of the system are expected to be implemented in the future versions.