



Sensors and Automation

SQA™: Surface Quality Assured Steel Bar Program

This project is intended to alleviate surface quality problems faced by the U.S. special quality steel bars and rods industry, and their



customers, the U.S. forging industry. During steel production, surface defects in the steel formed in the hot rolling process account for 50% of material rejects, or 2.5% of the total steel shipments, factors that affect efficiency and operation costs. Because most surface defects are sporadic and unpredictable, conventional statistical sampling techniques, which only enable a small portion of the material to be inspected, are not practical options for monitoring the steel product's quality.

OG Technologies, Inc., will lead research that seeks to address this issue through the development of a Surface Quality Assurance (SQA)™ program to enable efficient rolling process control and automatic and accurate marking of the residual

surface defects for downstream removal. The program will use several new innovations to create and demonstrate an SQA™ prototype, including HotEye™, a technology developed by OG Technologies that can deliver high-definition images of workpieces at or exceeding 1,450° C.

The basic concept behind this project is to minimize surface defects in hot rolled steel products by developing the capability of online automatic root cause identification using HotEye™ to detect surface defects, combining the findings with information from other process sensors, and applying advanced diagnostic methodologies to analyze the data.

Besides HotEye™, other project capabilities include: in-line, real-time imaging based visual inspection for surface defects on hot rolled steel bars; in-line, real-time imaging based speed measurement for high-speed hot rolled bars; modal-based vibration reduction for enhanced instrumentation performance in hot rolling lines; advanced data analysis for process signatures and root cause identification; predictive process control to prevent surface defects; and a new business paradigm between steel and forging based on defect detection, marking, and removal.

Applications and Benefits

This technology will help create a new steel rolling mill operation paradigm. Benefits of this technology include:

- Rapid detection and response to surface defect problems
- Improved surface quality control of deliverables
- Minimization of defect-related costs
- Improved product quality

Project Participants

- OG Technologies, Inc. (Lead organization)
- University of Michigan
- University of Wisconsin
- Charter Steel
- Metaldyne
- U.S. Department of Energy

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For the special quality bar rolling and forging industry, applying the findings from this program could potentially reduce operational costs by 2.5% or over \$200 million per year and save 6 trillion Btu per year.

The technologies developed in this project can also be applied to other industries, such as steel sheet rolling and paper rolling.

Project Plans and Progress

Project History: This project was awarded under the Sensors, Controls and Automation Crosscutting Technologies solicitation. The award was signed in the spring of 2004.

Project Tasks

The goal of this project is to develop and demonstrate an SQA™ that enables efficient steel rolling process control and is capable of automatically and accurately marking material surface defects for downstream removal. Major research efforts are organized into five tasks:

- Development of an imaging-based sensor.
- Performance of sensor-based process pattern analysis.
- Creation of an approach to improve process monitoring and identify root causes of surface defects.
- Creation of a method to prevent and/or eliminate surface defects.
- Integration of project systems.



Sensors and Automation

The Sensors and Automation Activity (S&A), part of the Industrial Technologies Program, develops and deploys integrated measurement systems for operator-independent control of manufacturing processes with broad applicability across multiple industry sectors.

The industry sectors served by S&A are those that have established partnerships with the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy to collaborate in joint technology development for the competitiveness and vitality of the industry.

Work done under S&A will lead in providing the advanced measurement and control technology solutions to meet the needs of all industry sectors supported by the IOF strategy.

To learn more about S&A activities, visit the program web site at:

www.oit.doe.gov/sens_cont/

A Strong Energy Portfolio for a Strong America

Energy Efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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The CPS number for this project is 14228.

