

FOREWORD

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In recent years, large changes have occurred in the environment surrounding the iron and steel industry and in the business models of steel makers, and introduction of innovative technologies is progressing in response to various challenges, including carbon neutrality, geopolitical risk and labor shortages. In particular, since instrumentation, control and system technologies contribute to decarbonization and energy conservation, the development of manufacturing processes for high-value-added products, safe, stable, high efficiency, high quality production activities, and improved labor productivity, we recognize that the continuing evolution of these technologies as one core part of manufacturing is necessary.

In manufacturing industries, Industrie 4.0 was announced in Germany in 2011, and in Japan, similar initiatives to create new value are underway through exploratory activities under the name of Society 5.0. As part of these efforts, deployment of AI, IoT and robotics technologies and improvement of data processing capabilities have been astonishing, and the creation of smart factories is being driven by the collection of qualitatively and quantitatively huge volumes of real-time data from manufacturing processes, big-data analysis, and utilization of AI which is incorporated in production processes. Cyber-physical systems (CPS) are also being used, enabling optimal process design and facility operation, as well as prediction of anomalies by a simulation technology that integrates physical space and cyberspace, expressed by numerical models and statistical models. These are also technologies that have attracted considerable attention as approaches for problem-solving.

The JFE Group carries out big-data analysis of information specific to sensing, images and operation, and applies the results to high-precision control models, quality assurance instruments represented by defect inspection equipment, abnormal sign monitoring, operational support (guidance), remote operation and automation. This Special Issue introduces a number of recently-developed instrumentation, control and system technologies and products. Although the following are only some examples, as an example of CPS utilization in the control field, a model for estimation of the hot metal composition and temperature in the converter in real time was constructed and is contributing to improved productivity. As an example of smart factories and AI utilization, machine learning was used to apply operator know-

how to rolling load schedule calculations at the tandem mill, leading to the development and adoption of a “shared control” system. Other examples include the development of a technology that detects product chattering marks in the cold rolling process by vibration measurement using a combination of sensors, image processing and the smart factory concept, and utilization of AI in image processing for steel bar count measurement and its application in an actual production line. In the field of measurement, a device for measuring the oval part of bars by photography with a self-illuminating camera was developed by a member company of the JFE Steel Group, and a robot that performs acoustic (tapping) inspections of the stators of AC motors for rolling mills, enabling non-disassemble inspection, was also developed. In the systems field, this Special Issue introduces an example of analysis and diagnosis of abnormal signs in welders from operational condition data. At the same time, as product technologies, this Special Issue also introduces airflow visualization utilizing an infrared camera, foreign object detection, material identification, piping leak location detection, an on-line condition monitoring system in which vibration sensors are arranged in a wireless system, and a rolling mill load cell. JFE Steel is also devoting great effort to these solution businesses.

In the future, JFE Steel will continue to proactively develop instrumentation, control and system technologies so as to always respond to the advanced needs of customers and society with the world’s most advanced technologies. We look forward to receiving guidance and opinions regarding this Special Issue from all those concerned.