TNChE Asia 2025 Conference

" Accelerating Industrial Decarbonization: Digital-AI and Energy Transformation "

Presenter's Biodata & Abstract

Full Name : **Jonas Berge**

Organization : **Emerson**

Current Position : **Senior Director, Applied Technology**

Title of Presentation : **The four types of industrial AI and how to use them correctly**

Presentation Abstract:

Industrial AI part of advanced automation supports plants along the chemicals value chain from refining and petrochemicals to bulk chemicals and speciality chemicals. It supports plant personnel in production operations, maintenance, and in automation modernization projects.

Four Types of Industrial AI

Industrial AI tools use either machine learning, deep learning, causal AI, generative AI (GenAI), or a combination of these technologies. Each AI technology has specific strengths and suitable applications:

- *Machine learning* is a statistical algorithm which in the training phase uncovers correlation in 'big data' sets. In operation the correlation infers values or state like failure, process upset, or quality issue.
- *Deep learning* is a subset of machine learning based on neural networks used for image recognition or some cases of inferential sensing.
- *Causal AI* in readymade apps embed known first principles physics and chemistry as well cause and effect relationships for processes and equipment. There is no training required. In operations, apps determine a value or a status like failure, process upset, or quality issue.
- *Generative AI* uses large language model (LLM)-type artificial neural networks, like generative pre-trained transformers (GPT), which are statistical algorithms. GenAI tools are pre-trained on images, natural language text, and code examples. In the generative phase it generates natural language text such as condensed responses to searches across thousands of text documents or new code based on prompts. But caution: GenAI is known to 'hallucinate'.

Improving Production Operations

The operator can enter a question like "*How do I, set, feed target, to 25000 barrels per day*" in a 'co-pilot' on top of Advanced Process Control and the co-pilot does the simulation work and responds with a few options for the operator to choose from.

Or the 'co-pilot' on top of the planning and scheduling software can explain the rationale of marginal values and constraints given by the software model in natural language text.

Improving Maintenance

Causal AI is used to predict equipment failure for predictive maintenance, pinpointing equipment fouling and losses to optimize cleaning and replacement schedules, pinpoint and control emissions, and quantify corrosion rates to better manage corrosion inhibitor injection and pipe section replacement.

Causal AI can even run in intelligent field instruments like smart valve positioners to predict the failure and quantify valve issues including friction and deadbands affecting control loop performance.

Similarly, causal AI in asset monitoring devices enable predictive maintenance rotating equipment like fans, motors, gearboxes, and pumps.

Automation Modernization Projects

A combination of rule-based AI, machine learning, and generative AI trained on several legacy DCS and PLC systems is used in plant modernization projects to help explain the old DCS or PLC system's configuration and generate an equivalent configuration for the new DCS, achieving automatic conversion of up to 70% of the old configuration.

Data Foundation

Industrial AI in operations runs on real-time data – a lot of which is not available today due to manual data collection. Plants must therefore lay a foundation of wireless sensor network infrastructure, to automate manual data collection like vibration, ultrasonic thickness, temperature, pressure, fluid level, and acoustic noise.

Conclusion

Experience has shown you need both sensors and AI software. Because before you can 'connect the dots' you must 'collect the dots'.