2019 EU-US Frontiers of Engineering Symposia

Smart Manufacturing

Organizers: Corie L. Cobb, University of Washington, and Tobias Meisen, University of Wuppertal

Abstract

Manufacturing broadly refers to the engineering process of creating industrial products from raw materials using a variety of subtractive and additive methods such as machining, forming, extrusion, and printing. In recent years, the concept of manufacturing has drastically shifted. New and modernized technologies that integrate sensors, advanced robotics, information technology and artificial intelligence, form what is known as Smart Manufacturing where production tools are connected to constantly gather data, monitor production processes and perform real-time optimization. Smart Manufacturing includes not only data collection and processing, but also inferring from and reasoning about data by means of cognitive computing to improve the end product. The ultimate goal is to realize self-monitoring and self-optimization of the entire end-to-end manufacturing process.

The key elements of Smart Manufacturing that we are focusing are:

- the integration of sensors or automated robotics in production machines and products (allowing for better data acquisition), gathering the data (linking, structuring and representing) as well as storing it (industrial data lakes);
- employing data science approaches to automate or optimize manufacturing to remove 'trial-and-error' approaches;
- developing new robotics and closed loop control feedback at the hardware level;
- sustainably transferring and deploying solutions into the world while addressing broader clean energy challenges and reducing material waste for the environment.

In this session, we address the aforementioned elements with individual presentations at the leading edge of Smart Manufacturing, starting with a talk from Alicia Dröge from Saint Gobain. She will talk about the associated challenges and obstacles to enabling Smart Manufacturing in the glass industry and the need for smart products. She will also address product deployment challenges, including new services, privacy and sustainability.

Thereafter, Hadas Kress-Gazit from Cornell University, will dive into the factory and take a closer look at manufacturing lines and material handling facilities. With the availability of sensors as well as actuators, new readily available data facilitates new methods for smart processing. In her talk, she will discuss "synthesis for robotics" which encompasses new approaches for automating robot design and programming from high-level specifications.

Focusing on an exemplar modern manufacturing technology, Ibo Matthews from Lawrence Livermore National Laboratory, will talk about the future of Metal Additive Manufacturing (AM). Metal AM has broad applicability and offers substantial benefits in design versatility and customization. However, global adoption of Metal AM is currently hindered by a lack of process control, process repeatability, and part quality verification. Presenting new "intelligent" methods for feed forward control, models and hardware, Dr. Matthews will discuss how Metal AM can transform into a Smart Manufacturing technology and accelerate future product development.

Finally, Melanie Zeilinger from ETH Zurich, will drill down into the control level and present advanced control techniques that can be employed in the field of Smart Manufacturing. In particular, she will focus on safety requirements and how safety requirements can be addressed when optimizing controls. Moreover, she will talk about the importance of human factors, focusing on how user information can be integrated into automatic controllers.