Pr Nabil Anwer, Université Paris-Sud

Geometric Variations Management: New challenges and opportunities for Product Digital Twin

Geometric variability is unavoidable in the realization of mechanical products. New manufacturing processes and design methodologies have experienced important changes during the last years in terms of impact on product design and production. With the advent of smart manufacturing, new avenues of research are emerging and supported by the evolution of standards and digital tools. In this context, shape representation, processing and mining at a conceptual, geometric and computational level envision a more global geometric-centric process with a life cycle perspective.

Lying at the interface of mechanical engineering, modern geometry, computer science, and statistics, Shape Engineering is concerned with the study of geometric properties of mechanical products. Its goal is to establish a theoretical foundation for the modelling and processing of product's shape and variability, and to develop methods for geometric reasoning to infer knowledge and enable decision making in the product in the context of smart manufacturing.

The modeling of product shapes and dimensions is now largely supported by geometric modeling tools. However, the underlying geometrical variations cannot be addressed efficiently when covering the overall product life cycle. To support geometric quality assurance and information flow throughout the product lifecycle, digital-driven technologies are currently in use and rely on Computer-Aided Design systems which has not been developed for smart manufacturing purposes. Moreover, a comprehensive geometric model for that considers the intricate link between Shape, Material and Process is not mature yet.

This presentation will discuss some of the shortcomings with the current specification and verification approaches and standards as well as digital technologies to support geometric variations management and illustrate the current challenges and future prospects for smart manufacturing. This talk will also investigates the fundamentals of shape engineering at a conceptual, geometric and computational level. New developed concepts such as Skin Model Shapes and Digital Twin and their applications for product engineering, additive manufacturing, digital manufacturing and computational metrology will be presented, and challenges and future researches will be highlighted.