

Available Projects Description for FFIRE Program

Hongyue Sun, Mechanical Engineering, College of Engineering

Data Analytics for Smart Manufacturing

A manufactured product is the end of a long chain of interwoven manufacturing steps that may span geography, industries, and manufacturing processes. Each step may be optimized, yet for a step there may be uncertainty about the larger context of its contribution that if known during production would allow for greater efficiencies, better quality, and improved productivity. If a global system analysis and optimization could, in addition, be conducted cooperatively with each step during production, the end product and overall production would greatly benefit. Advances in hybrid distributed control and optimization, in highly networked cyber-physical systems, and in artificial intelligence and machine learning have opened new opportunities in cyber-enabled manufacturing. This project is an interdisciplinary research project with the primary goal of building data analytical models to address the high-dimensional functional dependencies over manufacturing machines and corresponding controllers to achieve an accurate and efficient manufacturing process quality control. The team will collaborate with experts in architecture design and implementation, additive manufacturing, and simulation from University at Buffalo and Arizona State University.

Ethical Manufacturing

In the era of Industry 4.0, manufacturing systems are enhanced with advanced technologies and interconnectivity. While this evolution significantly expands the functionalities and accessibility of manufacturing machinery, it also introduces unprecedented ethical challenges in manufacturing regulation, such as malicious use of customizable fabrication (e.g., counterfeit goods and 3D printed weapons). This project pioneers the exploration of ethical Industry 4.0 and anchors principles of legality, integrity, and accountability as fundamental components in the digital manufacturing ecosystem.

This project is centered around the creation and validation of an innovative digital framework to foster an ethical manufacturing ecosystem where machine ethics, including legality, integrity, and accountability, is mandated throughout the product design-fabrication-service life cycle. This research project explores principles of ethics as new functional components and constructs a digital framework that tackles technical obstacles in ethical Industry 4.0, including intellectual property (IP) protection, data security and privacy, regulation, and compliance. Collaborative with experts from University at Buffalo, the team will investigate and develop an ethical cyber layer, incorporating a set of computational algorithms, architecture, and software, to enhance the legality, integrity, and accountability of the digital manufacturing system.