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RESEARCH REPORT

Unsettled Technology Domains in Robotics for Automation in Aerospace Manufacturing

Dr. Jody E. Muelaner

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About the Author

Dr. Jody E. Muelaner is a chartered mechanical engineer with a background in metrology, aerospace manufacturing, and machine design. He now specializes in writing about technical topics in a way that the target audience can easily understand.

His writing has included technical reports for Rolls-Royce and Airbus, peer-reviewed journals, and UK government reports, as well as magazines and websites. He has published several hundred articles and was awarded the Sage Best Paper Award in 2010.

Starting out in machine design, Dr. Muelaner initially worked on sawmills, waste-processing machinery, domestic appliances, and medical devices. After moving into metrology, his research focused on modeling and optimizing uncertainty in manufacturing systems, enabling right-first-time assembly, and the design of innovative laser instruments. He founded Muelaner Engineering Ltd in 2018 to provide consultancy and technical writing within advanced manufacturing and machine design.

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Unsettled Technology Domains in Robotics for Automation in Aerospace Manufacturing

Abstract

Cost reduction and increasing production rates are driving automation of aerospace manufacturing. Articulated serial robots may replace bespoke gantry automation or human operations. Improved accuracy is key to enabling operations such as machining, additive manufacturing (AM), composite fabrication, drilling, automated program development, and inspection. New accuracy standards are needed to enable process-relevant comparisons between robotic systems.

Accuracy can be improved through calibration of kinematic and joint stiffness parameters, joint output encoders, adaptive control that compensates for thermal expansion, and feedforward control that compensates for hysteresis and external loads. The impact of datuming could also be significantly reduced through modeling and optimization. Highly dynamic end effectors compensate high-frequency disturbances using inertial sensors and reaction masses. Global measurement feedback is a high-accuracy turnkey solution, but it is costly and has limited capability to compensate dynamic errors. Local measurement feedback is a mature, affordable, and highly accurate technology where the robot is required to position or align relative to some local feature. Locally clamped machine tools are an alternative approach that can utilize the flexibility of industrial robots while also enabling high-quality machined surfaces. Hybrid high-accuracy control strategies will be required for many processes.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. SAE EDGE™ Research Reports are not intended to resolve the issues they identify or close any topic to further scrutiny.

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