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RESEARCH REPORT

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Thorsten Roye, Dipl.-Ing., MSc

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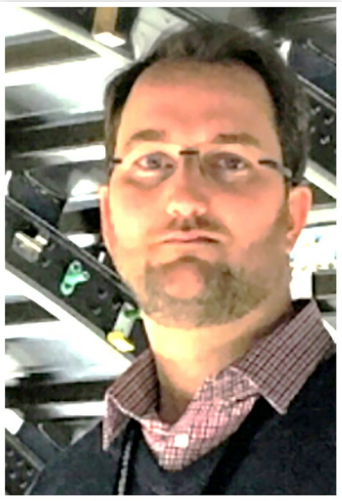

Thorsten Roye is the Manufacturing Engineering Expert for Fastening Systems at Airbus. In this role, he serves as an advisor to management and all production plants across Airbus for final and temporary fasteners, fastening tools, and fastening processes for commercial aircraft, defense and space, and helicopters.

He has a diploma in mechanical engineering-aircraft systems (Technical University in Hamburg, Germany) and a Master of Science in Composites (Private University Hannover, Germany).

Mr. Roye has worked for Airbus for the past 15 years, having been responsible for automation, robotics, and mechatronics. Currently, he leads Airbus collaboration with multifunctional teams in procurement, engineering, quality, and research and development. He represents Airbus in several workshops, training programs, and conferences worldwide.

Named on more than five issued patents, Mr. Roye is highly interested in assembly and manufacturing topics touching a broad range of industries, including automotive.

He is an assistant professor at two German universities and focuses on assembly technologies. He is also an instructor for SAE International teaching "Introduction to Airframe Engineering—Design for Manufacturing, Assembly, and Automation."

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Unsettled Technology Areas in Deterministic Assembly Approaches for Industry 4.0

Abstract

Increased production rates and cost reduction are affecting manufacturing in all sectors of the mobility industry. One enabling methodology that could achieve these goals in the burgeoning "Industry 4.0" environment is the deterministic assembly (DA) approach. The DA approach is defined as an optimized assembly process; it always forms the same final structure and has a strong link to design-for-assembly and design-for-automation methodologies. It also looks at the whole supply chain, enabling drastic savings at the original equipment manufacturer (OEM) level by reducing tooling costs and lead time. Within Industry 4.0, DA will be required mainly for the aerospace and defense industry, but serves as an interesting approach for other industries assembling large and/or complex components. In its entirety, the DA approach connects an entire supply chain—from part manufacturing on an elementary level to an OEM's final assembly line level.

Addressing the whole process of aircraft design and manufacturing is necessary to develop further collaboration models between OEMs and the supply chain, including addressing the most pressing technology challenges. Since all parts aggregate at the OEM level, the OEM—as an integrator of all these single parts—needs special end-to-end methodologies to drastically decrease cost and lead time. This holistic approach can be considered in part design as well in the design-for-automation and design-for-assembly philosophy). This allows for quicker assembly at the OEM level, such as "part-to-part" or "hole-to-hole" approaches, versus traditional, classical assembly methods like manual measurement or measurement-assisted assembly. In addition, it can increase flexibility regarding rate changes in production (such as those due to pandemic- or climate-related environmental challenges).

The standardization and harmonization of these areas would help all industries and designers to have a deterministic approach with an end-to-end concept. Simulations can easily compare possible production and assembly steps with different impacts on local and global tolerances. Global measurement feedback needs high-accuracy turnkey solutions, which are very costly and inflexible. The goal of standardization would be to use Industry 4.0 feedback and features, as well as to define several building blocks of the DA approach as a one-way assembly (also known as one-up assembly, or "OUA"), false one-way assembly, "Jig-as-Master," etc., up to the hole-to-hole assembly approach.

The evolution of these assembly principles and the link to simulation approaches are undefined and unsolved domains; they are discussed in this report. They must be discussed in greater depth with aims of (first) clarifying the scope of the industry-wide alignment needs and (second) prioritizing the issues requiring standardization.

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 challenges they identify or close any topic to further scrutiny.

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