Flexible Robotics to Inspect Aerospace Components

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Ultrasound inspection often viewed as one of the main bottlenecks of the manufacturing process, is a regulatory requirement to inspect aerospace components. To reduce non-value-added inspection times, industries opt for heavily customised automation technologies. Despite the recent progress made by ultrasound inspection systems, they still lack the fundamental technology to perform fully autonomous Nondestructive Testing and Evaluation (NDT&E) without human intervention. Therefore, this research presents and discusses the feasibility and advantages of using flexible robotics in NDT&E to exploit human skills such as dexterity, know-how, analysis and advanced decision-making abilities (in collaboration) with robotic capabilities such as strength, accuracy and repeatability to inspect high-integrity components. The body of work presented here uses KUKA KR6 and KUKA KR90 robotic manipulators and Phased Array Ultrasound Testing (PAUT) roller probe technology to inspect additively manufactured metallic components.

The flexible robotic programming technique discussed in this research provides in-situ robotic programming capabilities enabling human inspectors to program these systems by task demonstration. This technique is advantageous when there is little or no prior knowledge of advanced robotics or part geometries. The proposed flexible inspection technology provides real-time trajectory optimisation for better inspection results while accommodating as-built part tolerances. In contrast to conventional automated inspection cells, the proposed flexible inspection technology will enable easily reconfigurable workcells to inspect high-value aerospace structures. These systems will increase accuracy and throughput by combining unique human skills and robotic capabilities. Also, this technology will enable compact-agile robotic systems without requiring groundwork for monolithic facility infrastructure, reducing non-recurring charges. Initial experiments using additively manufactured components in a laboratory setting revealed approximately 20 folds reduction in robot programming times to inspect complex geometries.