Automated Jet Engine Fan Blade Inspection Using a Robotic Eddy Current Array (ECA) System

Nicolas Badeau[1], Louis-Philippe Blanchet[2], Étienne Grondin[3]

[1]R&D , Evident Scientific, Canada, [1]R&D, Evident Scientific, Canada, [1]Systems and Integration, Evident Scientific, USA

Jet engine fan blades are critical parts that need periodic inspection for safety reasons. Prevailing inspection methods include penetrant testing (PT), magnetic particle inspection (MPI), and manual eddy current testing (ECT). These methods have several drawbacks, including operator fatigue, lack of data archiving capabilities, and unproven measurement repeatability. To resolve these issues, this paper proposes an innovative robotic inspection system for jet engine fan blades that uses eddy current array (ECA) technology to achieve over 90% coverage of the total surface, detecting submillimeter size notches. The system consists of a six-degrees-of-freedom (DOF) robot along with two external axes, a rotary axis that is fixed on a linear rail. The fan blades are mounted in a clamp that is fixed on the rotary axis at its root. The clamp's mounting position maximizes the available inspection area of the fan blade. The two external axes are used to increase the robot's reach and enable the operator to manually adjust the clamp's position, facilitating the blade loading and unloading. Tooling was also developed to accommodate different inspection strategies as well as various fan blade models. The path plan is computed using off-line programming (OLP) software. It also includes an encoding solution that converts the data acquired of complex three-dimensional surfaces into two-dimensional X-Y maps with proportional scaling, which is critical for indication sizing. This solution provides effortless, precise, and repeatable inspections of complex-shaped blades, with data archiving capabilities. Results from a typical fan blade are presented, demonstrating the encoding and data acquisition abilities.