PRESS RELEASE

Innovative artificial intelligence (AI) algorithms to shorten aircraft development times

Aircraft downtime reduced by 80 percent

Good things come to those who wait, as the saying goes. But wait no more! Shorter product development timeframes not only save time and money, but also improve competitiveness. This can be achieved with faster and more efficient testing processes. Fatigue tests [Ermüdungsversuche (EF)] on completed aircraft take up a significant portion of the time spent on aircraft development and certification. The aim is to reduce the time between the start of the project and certification from around eight years down to five. The **"F-REE"** (Fraunhofer-Gesellschaft RapidEF Enablers) project is working to develop and optimize innovative AI processes for use in industrial environments. Its main focus is on accelerating and significantly improving the reliability of testing processes. Doing so will also circumvent the time-intensive process of manually interpreting recorded data.

Industry is currently undergoing a structural change referred to as "Industrie 4.0", or "I4.0" for short. I4.0 involves modern, digital, non-destructive testing that incorporates robot-aided inspection and product integrity assessment. The collaborative research project funded by the German Federal Ministry for Economic Affairs and Climate Action is developing innovative AI algorithms that will enable defect detection via multimodal NDT data. It will collate and interpret optical, thermal and deformation measurements, thus reducing or even entirely replacing the time-consuming process of manually interpreting NDT data. "By minimizing human input, testing processes can be made quicker and more efficient, resulting in improved competitiveness," explains Prof. Ahmad Osman, the acting Project Manager at Fraunhofer Institute for Nondestructive Testing IZFP.

These innovative approaches form the project's two-pronged approach to shortening the testing phase: "explainable AI models" for comprehensible

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multimodal NDT data processing, and continuous automated monitoring and inspection processes. To this end, data will be continuously collected and analyzed in real time. Artificial intelligence can be used as such to identify and assess damage to the fuselage at an even earlier stage. In recent years, AI algorithms, most notably Deep Learning, have emerged as key technologies for carrying out complex data analyses. Their use in automated quality assurance in conjunction with NDT processes, in particular in aviation, has not yet taken hold.

The downtime of aircraft prototypes should be reduced by 80 percent when AI is used. © pixabay

In this project, Fraunhofer IZFP looked into how downtime could be reduced. For this purpose, the test was operated without any disruptions for inspections and repairs. Ongoing knowledge of the test object's current condition is necessary for this: This so-called "digital twin" is made possible using data collection systems which operate on a continuous basis. Virtual sensors — multi-camera based 3D deformation measuring systems — are combined with optical, thermographic and acoustic processes and integrated into a complete system. This measurement data is superimposed onto the material and process parameters in order to generate the digital twin.

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Modern technologies, new concepts, novel designs

"The downtime resulting from fatigue testing in an aircraft's initial service life should be reduced by 80 percent. This is appealing because automated processes are applied, thus allowing operations to continue uninterrupted," says Prof. Ahmad Osman.

In doing so, the fatigue testing of the entire aircraft can be significantly sped up with the help of a "RapidEF Process". This involves simulating the initial aircraft service life without interruption at the highest possible test speed. Additionally, test results are already available prior to the first flight. This project is laying the foundations for achieving clear reductions in all test phases.

It also improves the precision of data in terms of timings. Large volumes of data can be processed in real time using a cross-system data management system. An additional damage reconstruction, a direct transfer to the digital twin and an automated numerical analysis allow the assessment to be carried out in real time.

Project Profile
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