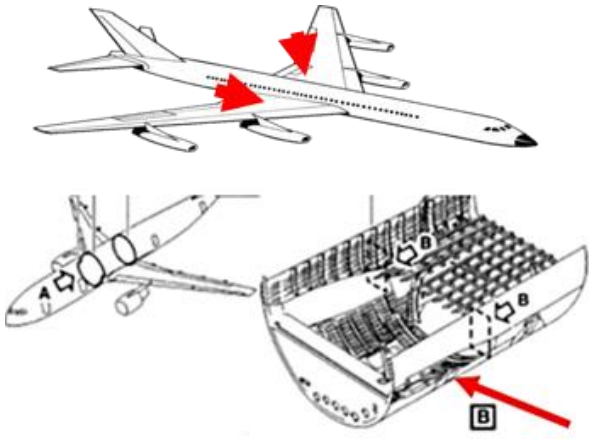
SELFSCAN - Neural net based defect detection system using Long Range Ultrasonic Testing (LRUT) technology for aircraft structure health monitoring

The periodic maintenance and inspection of an aircraft is both costly and time-consuming. The critical structural components of an aircraft need careful examination as small cracks can appear in large and complex structures. In some cases, the defects are hidden beneath layers of other attachments, so accessing these components involves dismantling the assembly and long downtime hours for airline operators.



Guided wave technology is a promising technique for structural monitoring. It provides large area coverage from a limited number of sensors, combined with potentially high defect detection sensitivity. However, due to the complex nature of ultrasonic guided waves, the often complex geometry of the components requiring monitoring and the variable environmental conditions they exist in, the interpretation of the captured signals can be very challenging.

Project objective

The main aim of the SELFSCAN project was to develop Guided Wave (GW) and Neural Networks (NN) based integrated structural health monitoring (SHM) for critical aircraft components using permanently installed sensors to allow the testing of critical and inaccessible areas without the need to dismantle during every inspection.

The approach used in SELFSCAN was to gather data that is used to train a Neural Network, which can then be used to evaluate the health of the component throughout its lifespan. The detectability of defects is increased when historical data is used to identify changes over time.

Such condition monitoring has great potential to increase understanding of the structural integrity of aircraft components, increasing their service life and greatly reducing the risk of catastrophic failures. Within SELFSCAN, it has been shown that such complex signals can be used as input for a neural network system to facilitate in-situ defect detection.

The aim for the legacy of the project was to enable a fundamental realignment of inspection/maintenance strategies, which could then be based on the actual momentary condition of the aircraft structure. SELFSCAN has been very successful and achieved all intended objectives. It has been shown that the developed neural network system was able to differentiate between data from defective and non-defective cases with high accuracy. It was shown that the most optimal neural network developed was able to distinguish between data from non-defective cases and those with a fatigue crack of surface length equal to or greater than 2.5mm with high accuracy in laboratory conditions. This was achieved despite the defective region being more than a few hundred millimetres from the sensor location and in a location considered inaccessible to other means of inspection.

SELFSCAN was a collaboration between the following organisations: TWI LIMITED, Przedsiebiorstwo Badawczo-Produkcyjne Optel sp.Z o.o., Phillips Consultants, Isotest Engineering s.r.l, Smart Material GmbH, Cereteth, NDT Expert.

For further information, please visit the project website at **www.selfscanproject.eu**.

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