CORROSION QUANTIFICATION THROUGH EXTENDED USE OF LAMB WAVES

OBJECTIVES

The aim of COQTEL project is to develop a solution for corrosion monitoring on airplane structures, by using Lamb waves and by combining both passive and active interrogations.

WHY COQTEL

In 2016, the combined commercial aircraft fleet operated by European airlines was around 7900 airplanes. The annual corrosion cost for this number of aircraft was estimated by the US National Association of Corrosion Engineers to 2.2 B$, which includes corrosion maintenance at 1.7 B$ and downtime due to corrosion to 0.3 B$. Anticipating corrosive conditions ahead of time can lead to significant cost savings and less aircraft downtime. It is estimated that savings between 15% and 35% of the cost of corrosion could be realized.

The aim of COQTEL project is to develop an in-situ continuous monitoring solution, that will help the industry moving from planned maintenance to condition-based maintenance.

TECHNICAL PRINCIPLE

The solution is based on Lamb waves monitoring. Lamb waves are a special type of acoustic waves that propagate in solid plates.

When a corrosion damage is present in a structure, it can be detected by using such waves.

In the active method, a piezoelectric (PZT) actuator is used for creating a Lamb wave in the plate. PZT sensors are placed in different areas on the plate and receive the Lamb wave generated by the actuator. A damage inside the plate will modify the propagation of the waves by adding an extra echo caused by the damage. By observing the signal from the different sensors, it is possible to retrieve this echo and thus to get information on the damage.

In the passive method, PZT sensors are used to monitor Lamb waves that are generated by the expansion of the corrosion damages. While active method provides information on large existing damages, passive method can be used to monitor the corrosion at earlier stages.
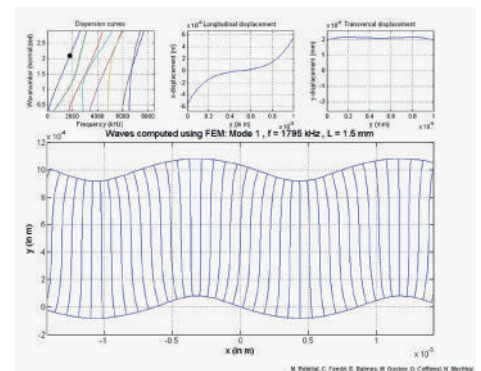

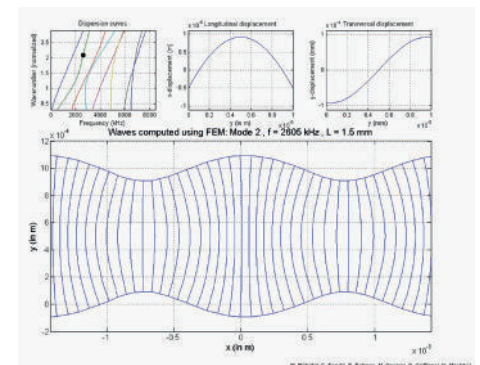Fig. 1: Antisymmetric Lamb wave
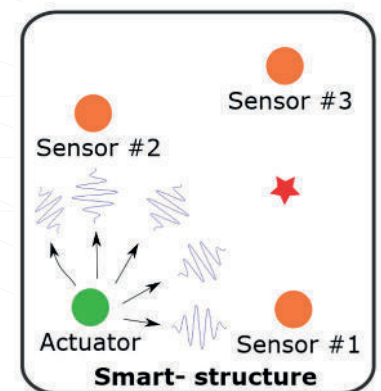

Fig. 2: Symmetric Lamb wave
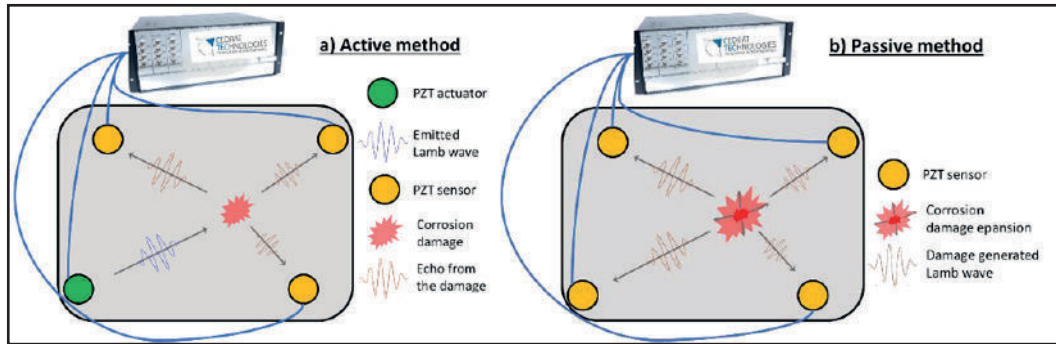

Fig. 3: Lamb wave based damage detection setup

Fig. 5: Active and passive methods

The project aims at developing a complete solution, which can ultimately provide a "fly / not fly" signal to the aircraft maintenance operators. This will require a good understanding of the corrosion mechanisms, by running acceleration corrosion tests on specially developed coupons (WP2 & WP3), and the development of data treatment algorithms (WP5).
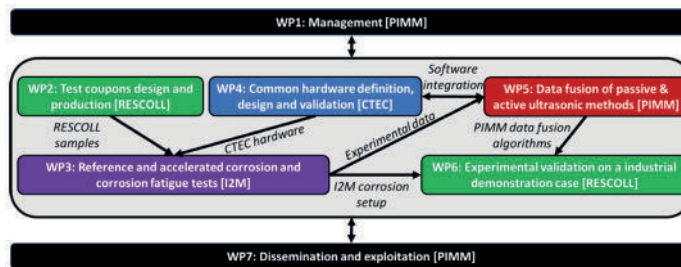

Fig. 4: Project work package breakdown structure

PARTNERS

COQTEL is an ANR project, which consortium is made of 4 partners: CTEC, I2M, PIMM and RESCOLL.

CTEC will be leader on WP4, which target is:

- To provide specifications for the PZT actuators and sensors, and for their integration.
- To provide the electronics prototype for driving the actuator and the sensors in passive and acoustic modes.