Integrating electromagnetic functions into Fiber Metal Laminates – the structural challenge

– EMuS 2019 -

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ABSTRACT

This paper will outline aspects, outcome and prospects of full integration of antennas into structural elements of aircraft, from a structural design perspective. The paper will also briefly discuss (structural-) certification aspects.

Full integration in this context means making the antenna function an integral part of the structural component. Structural components in this regard are meant to be structural aircraft elements that fulfil a load-bearing function.

Fiber Metal Laminates is a composite aircraft construction material, consisting of fiber layers that are bonded with metal layers to form a cohesive laminate. This construction material has been developed especially to improve metal fatigue properties of aircraft construction material. As it turns out, this material lends itself to be morphed into an antenna.

Antennas produce radio waves by making use of the electromagnetic phenomenon, that: changing electrical fields induce changing magnetic fields, and vice versa. Antennas are, in essence, two electrical conductors between which is created an alternating electric field, by exciting them with electrical charge. The conductors will be electrically isolated from each other.

Since the core fiber layer within the laminate is electrically insulating, exciting the metal layers with electrical charges could create electric fields and act as antennas.

Two types of antenna, which enable integration within an aircraft fuselage skin, have been chosen for this research; each antenna for a different application in terms of operating frequency and direction of radio wave propagation. The focus in the paper will be on the larger of the two, a VHF antenna, which possess more structural challenges.

The paper will not so much describe the design, but discuss the characteristics thereof that led to the ultimate design; such as limitations and constraints found, and compromises and mitigations taken.