A new efficient production method of mm-wave components used in Enhanced Flight Vision Systems

A.Vorobyov[1], S. Unterhofer[1], I. Montesinos[3], M. Dadras[1], M. Sierra[4], F. Kroll[2], O. Sereda[1]

[1]CSEM: Centre Suisse d'Electronique et de Microtechnique SA ; [2]SAAB ; [3]TTI ;
[4]Universidad Politécnica de Madrid

Flight delays result in considerable losses for the air transportation industry. Since the problem is due mainly to low visibility, enhanced flight visibility systems are progressively being installed in civil aircraft to assist pilots to land under any visibility circumstances. The EU-funded 3DGUIDE project aims to demonstrate a cost-effective production method for high-precision mm-wave waveguide antennas with 3D printing. This is a promising process for the production of antennas with complex 3D shapes used in Enhanced Flight Vision Systems (EFVS) to considerably reduce their production cost with the potential to also decrease radar weight. A Laser Powder Bed Fusion (L-PBF) technology opens new horizons allowing the fabrication of parts, that are limited or cannot be produced in any conventional way. Production of the mm-wave components based on L-PBF additive manufacturing, optimized for high resolution (<0.5% down to less than 10µm), with freedom of shaping allowing for an increased level of integration, with a large variety of materials including aeronautics-proven materials. A method has been defined to optimize material development to achieve such a small scale and has been applied for Aluminium alloy allowing dimensions of respectively 80µm±3 and 150µm±3 with a surface roughness of ~6 µm after shot peening and below 1µm after advanced surface treatment (combination of posttreatment). The AM obtained part's properties are approaching those of bulk material.

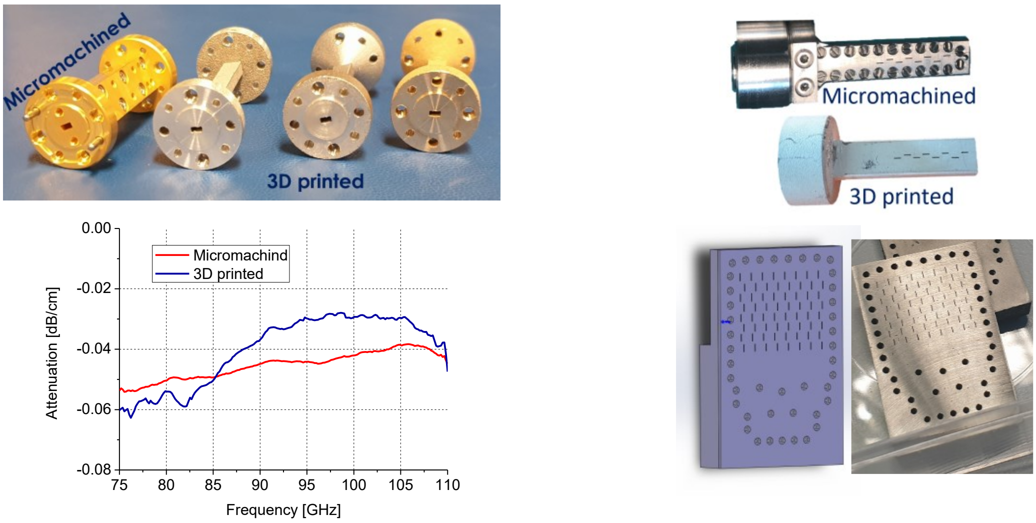

Figure 1. Example of 3D printed mm-wave waveguide sections and radar antennas.

Figure 1 shows manufactured mm-wave components. The WG sections are operated at 75GHz-110GHz (W-band). And antenna array optimized for 94GHz. The attenuation loss of the 3D printed WG is close to or better in comparison with the traditional micromachined one (see Fig.1).

Conclusion

L-PBF technology has already shown many advantages in micro-wave components manufacturing, such as weight reduction, assembly reduction and simplification or even embedding cooling channels thanks to its design freedom. 3D printing is a good technology choice to produce antennas with complex 3D shapes (e.g. waveguide), assembly steps reduction and costs.

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