RESEARCH OF INNOVATIVE AND BREAKTHROUGH ADDITIVE MANUFACTURED LEADING-EDGE CONCEPT (RIB-AM)

This project is part of the Clean Sky 2 funding program and is carried out in cooperation with other research institutes. Clean Sky 2 is a joint venture through a public-private partnership between the European Commission and the European aviation industry to achieve defined environmental objectives. Environmental goals are, for example, the reduction of CO2, gas emissions and noise level produced by oder of aircrafts. This project aims to develop a novel leading edge concept based on advanced manufacturing and integration techniques.

PROJECT OVERVIEW

DURATION

11/2018 – 09/2021

PARTNER

- AIRBUS
- AMRC
- TWI
- FADA-CATEC

FUNDED BY

Clean Sky 2

RESEACHER

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Project aim

The aim of the project is to develop novel manufacturing technologies applied to large size components belonging to the primary structure of aircrafts. To achieve this goal, the focus will be on the following three areas: The automated placement of fibers with thermoplastic resins, the use of the FDM process with short fiber reinforced thermoplastics and the development of a new method for joining components on the basis of rivet-free applications.

Role in the project

Within the project, the Paderborn University respectively the Institute of Polymer Technology "Kunststofftechnik Paderborn" (KTP) is working on the additive manufacturing of rib structures. The focus is on the development and optimization of the Fused Deposition Modeling (FDM) process for short fiber reinforced thermoplastics. As a first step, a review of the current state of the art is necessary and requirements have to be defined. Subsequently, materials that are relevant for the project are selected and determined. Once the material selection is finished, filaments are developed and produced which can be processed in the FDM process.

The aim is to select the material and the used machine in such a way that a good processability and a sufficient quality of the resulting parts are achieved. This is followed by the determination of a complete parameter set for the manufacturing of test specimens with the selected material. The test specimens are used to define the FDM specific mechanical properties which can be achieved with the selected material. These mechanical properties are then used for the topology optimized rib concept. The aim of the topology optimization is to create a new and lighter design for the ribs that improves the mechanical performance and meets the requirements of FDM manufacturing. The topology optimization is performed at the Center for Advanced Aerospace Technologies (CATEC) with the support of the Paderborn University (KTP) by contributing AM manufacturing rules and FDM specific constraints.

Further procedure

The selection of materials has been completed and the first processing tests have been carried out. To determine a complete set of parameters for processing the material in the FDM process, optimized process parameters must be determined. Process parameters which have to be optimized are the build chamber temperature and the nozzle temperature. These parameters are varied and examined with regard to the achievable weld seam strengths. Differences due to the selected process parameters can be identified with the help of manufactured test components and the following determination of the weld seam strength. For this purpose, test specimens are produced out of the components, and the strengths of these test specimens are determined with the help of tensile tests. This procedure is illustrated in Figure 2. The real weld area between the individual strands is then determined to calculate the weld seam strength of the individual test points by using microsections to measure the weld seam width (see Figure 3).

After these investigations, the occurring warpage behavior is analysed, as the warpage during the FDM process should be kept as low as possible. Then, in a further step, material-specific adjustments and investigations are carried out to generate a parameter set for the material and to manufacture test specimens. The selection of the test specimens and the definition of the mechanical properties which have to be determined will be done in close cooperation with the project partners.

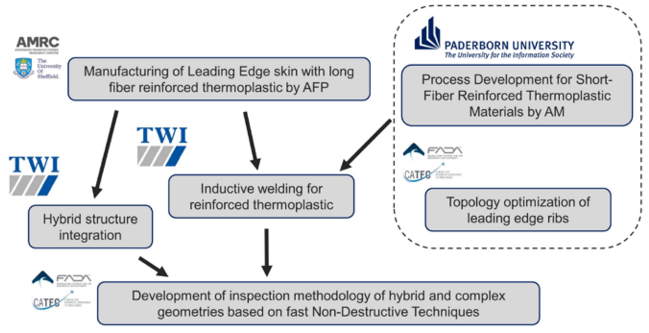

FIGURE 1 Workflow RIB-AM

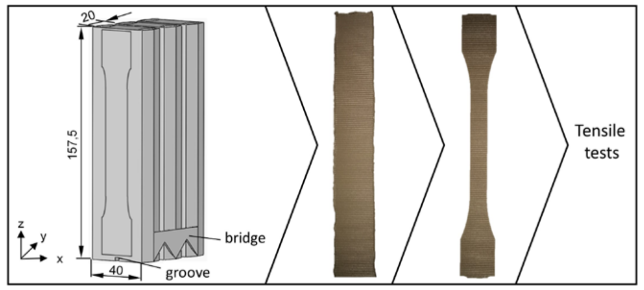

FIGURE 2 Process chain for determining the weld seam strength

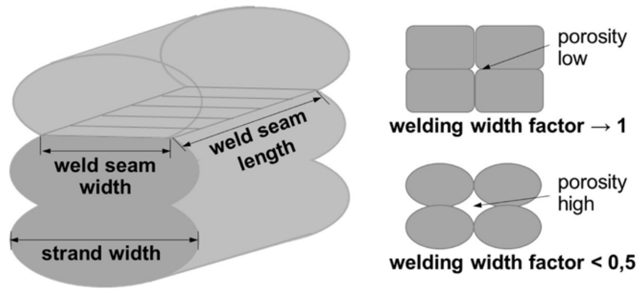

FIGURE 3 Structure of the welding surface and influence of porosity of a component