domminio

Digital method for improved manufacturing of next-generation multifunctional airframe parts

Newsletter

Issue #6, March 2024

Pablo Romero Rodríguez

DOMMINIO Project coordinator

R&D Program Manager Advanced Materials & Manufacturing

aimen

Discover the Future of Aviation with DOMMINIO - Newsletter **Edition #6**

Step aboard as we glide into the 6th edition of the DOMMINIO Newsletter, your portal to the **latest advancements in aviation**. Come along for an exciting exploration of the DOMMINIO project, where we're revolutionizing aviation systems through a cutting-edge **Digital method for imprOved Manufacturing of next-generation MultIfuNctIOnal airframe parts**.

At DOMMINIO, our devoted researchers are focused on developing an innovative data-driven methodology encompassing the design, manufacturing, maintenance, and pre-certification of multifunctional and intelligent airframe parts. Our vision is clear: to achieve **cost-effective, efficient, and sustainable manufacturing of high-quality aircraft components**, leveraging the following technologies:

- Robotic Technologies (ATL, FFF) for precision manufacturing
- Advanced Simulation Tools for optimized performance
- Online Process & Quality Monitoring for real-time insights
- Structural Health Monitoring (SHM) with data-driven fault detection capabilities

As we forge this transformative path, our newsletter proudly presents the findings from our latest milestone - **"Laboratory integration and data pipeline realization - WP6."** Delve into the articles, insights, and discoveries shared here, and witness how DOMMINIO is shaping the future of aviation.

Stay connected via our website and join our lively social media community to stay informed about the newest advancements in the DOMMINIO project. Let's explore the limitless opportunities that await us in aviation systems together.

Enjoy your reading, and let's set off on this exciting adventure to redefine the future of aviation!!!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007022

Funded by the European Union

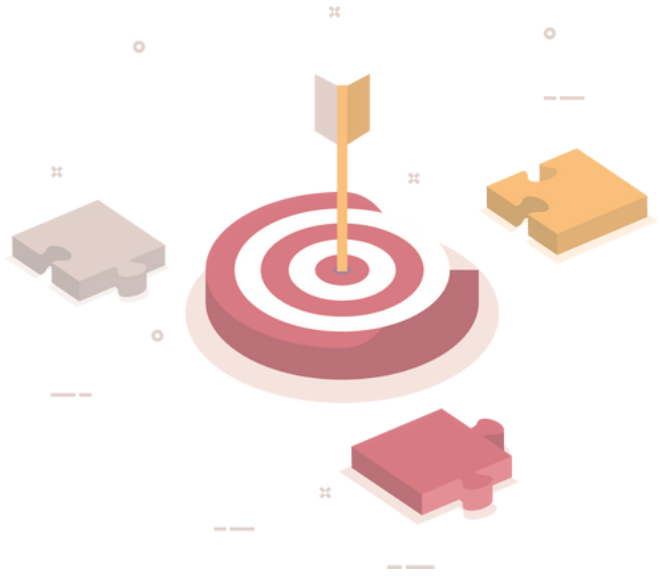
Let's connect

WP6 In a nutshell

Work Package 6 aims to validate DOMMINIO multi-stage manufacturing system technologies, enabling the realization of the DOMMINIO data-driven pipeline in a laboratory environment through the elaboration of two representative prototypes representing DOMMINIO´s target application cases.

This general objective can be subdivided into the following sub-objectives:

- Combining Automated Tape Laying (ATL) and Fused Filament Fabrication (FFF) processes for multifunctional composite airframe parts manufacturing.
- Evaluating the advanced combination of Automated Tape Laying and Fused Filament Fabrication processes.
- Defining communication protocols and exchanging data formats between modeling software, process control, quality monitoring, and sensors.
- Developing DOMMINIO, a data-analytics and knowledge-based system with self- adaptive control capabilities, to support the multidisciplinary design optimization of new multifunctional composite airframe parts.



domminio
Digital method for improved manufacturing of next-generation multifunctional airframe parts

Issue #6, March 2024

WP6

Multi-stage manufacturing laboratory integration

Regarding the ATL/Automated Fiber Placement (AFP) process, the laser-based heating system was integrated into the existing commercial ATL/AFP system.

Also, the Non-contact Ultrasound NDT system developed by DASEL was integrated.

At a communication level, Python-based software executed on a central PC synchronously gathers data from all the different devices, including the robot positions.

Several monitored nozzles were tried and attached to the robot for the FFF process.

Following the same communication layout of the ATL/AFP cell, a central PC records the data from all the systems, including temperature measurements and the robot positions.

Integrating Innovation, Transforming Manufacturing: Advancing ATL/AFP with Laser Heating, Non-contact Ultrasound NDT, and Python-powered Communication

WP6

Multi-stage data interoperability and extension

The manufacturing data was gathered in a synchronous way and stored using a specific file format (HDF5) for both ATL/AFP and FFF processes.

The output HDF5 file is obtained with all the data interpolated that can be displayed. The next two images show the result of post-processing for AFP and FFF as it is shown in Figures 1 & 2.

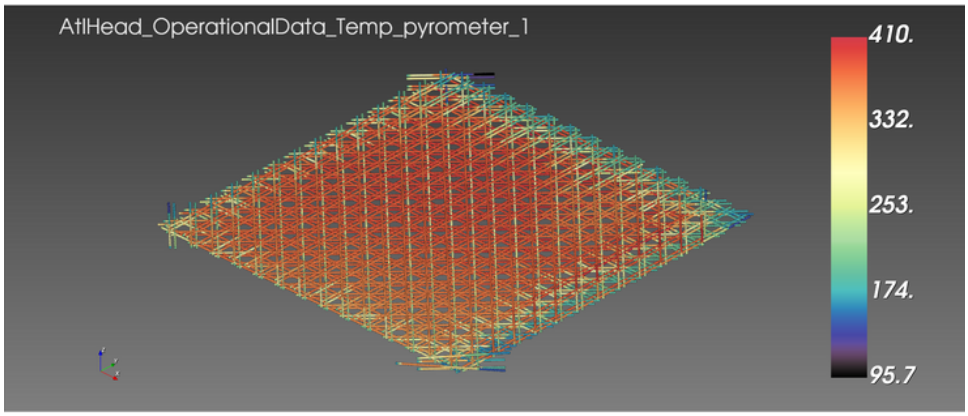


***Figure 1**: Temperature mapping of AFP laminate manufacturing*

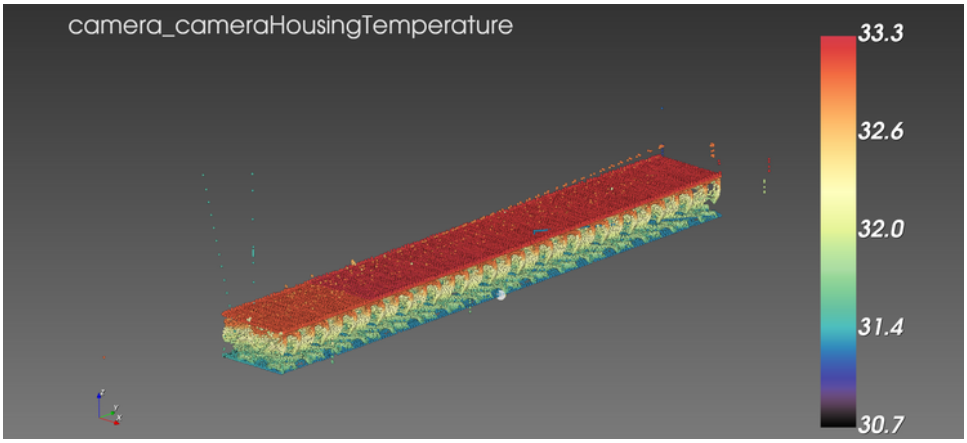


***Figure 2**: FFF gyroid manufacturing*

domminio
Digital method for improved manufacturing of next-generation multifunctional airframe parts

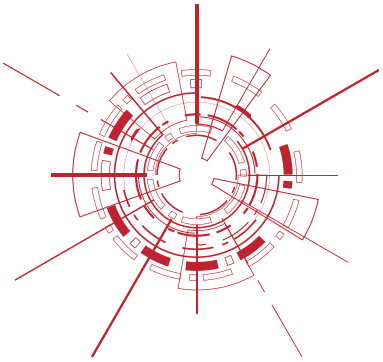
Issue #6, March 2024

WP6

Data analytics and Knowledge-based system

A digital thread based on AutomationML technology (AML) was built to provide a consistent structure to heterogeneous data.

This technology provides a structure that enables the storage or linking of data from different sources and can be complemented with metadata or relevant ontologies and semantics.



Representative prototypes realization

WP6

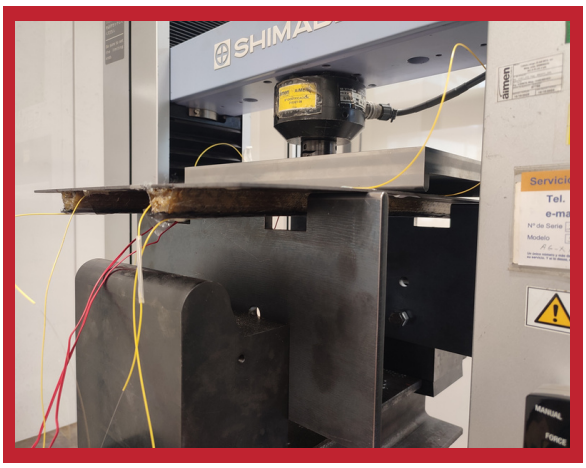


***Figure 3**: DOMMINIO stiffened panel tested according to Four Point Bending based on ASTM D6272*

The main recent achievement related to this WP was the manufacturing and testing of two concepts of stiffened panels by four-point bending.

These stiffened panel prototypes were defined by ACITURRI and BAE and tested based on the ASTM D5272 standard, as shown in Figure 3.

It was observed that the tangent modulus of elasticity was markedly increased if the system in compared to unstiffened panel in both prototypes configurations, proving the potential of this multi-stage manufacturing systems.

Figure 2: FFF gyroid manufacturing

Issue #6, March 2024

WP6 Functional and Digital Twin validation

Regarding Digital Twin validation, the finite element model for generating synthetic data was modified to represent this prototype, and once the Digital Twin is set up, its performance on the prototype will be evaluated.

WP6 WP6 contribution to DOMMINIO and next steps

The following actions developed in this WP aim to continue manufacturing and characterization of prototypes. The Digital Twin developed is being adapted to the Structural Health Monitoring prototype.

The next actions comprise generating a dataset with this finite element model and training the Artificial Neural Network to predict damage in the final prototype. Once the Digital Twin is set up, its performance on the prototype will be evaluated.

WP6 will provide the relevant tools for integrating DOMMINIO multi-stage manufacturing systems and the data-driven pipeline, including testing and evaluating them in a laboratory environment through the elaboration of selected multifunctional composite component prototypes.

domminio
Digital method for improved manufacturing of next-generation multifunctional airframe parts

Issue #6, March 2024

Digital method for improved Manufacturing of next-generation MultIfuNctIOnal airframe parts

Our Team

aimen TECHNOLOGY CENTRE

R-NANO

Arts et Métiers Institute of Technology

IPC

institute IMDEA materials

INCAS

DASEL sistemas

IRES Innovation in Research & Engineering Solutions

EASN TIS

BAE SYSTEMS

esi www.esi-group.com

ACITURRI

Connect with us: