Thesis project

Creation of digital twins to design for accessibility in aeroengine components

This thesis work is connected to the EU funded research project **DIAS - Development of Interdisciplinary Assessment for manufacturing and design.** DIAS has the goal to develop multidisciplinary design tools and methods necessary to speed up development of aeroengine components, such as Open Rotor Engine structures (see figure below). In particular, DIAS will introduce the ability to include accessibility of manufacturing tools already as objectives in the decision-making process during conceptual design.
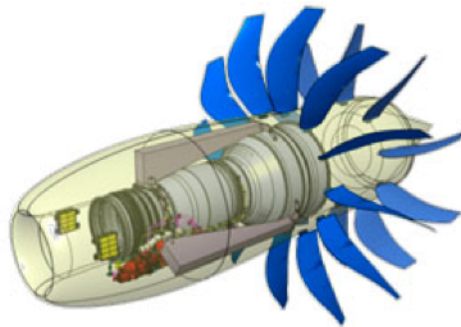

Figure 1. Open Rotor concept by SAFRAN.

The thesis project will be focused on the following objectives:

a) Create physical models (through plastic 3D printing) of a wide range of alternative concepts for Open Rotor technologies (called *variants*)
b) Create digital replicas (through parametrized CAD) from the physical models created
c) Perform digital simulations investigating the accessibility of manufacturing equipment (e.g. welding robots, non-destructive inspection robots) for the different *variants*
d) Perform physical measurements of the accessibility of manufacturing equipment
e) Update the simulated data with the real physical data
f) Link the data obtained from the simulations to the parametrized CAD models created
g) Investigate the accessibility of new variants through parametric variation (e.g. 1000 design cases)

Overall approach:

The following figure gives a high-level idea of the approach:

Train design model and explore new variants (1000 design cases)
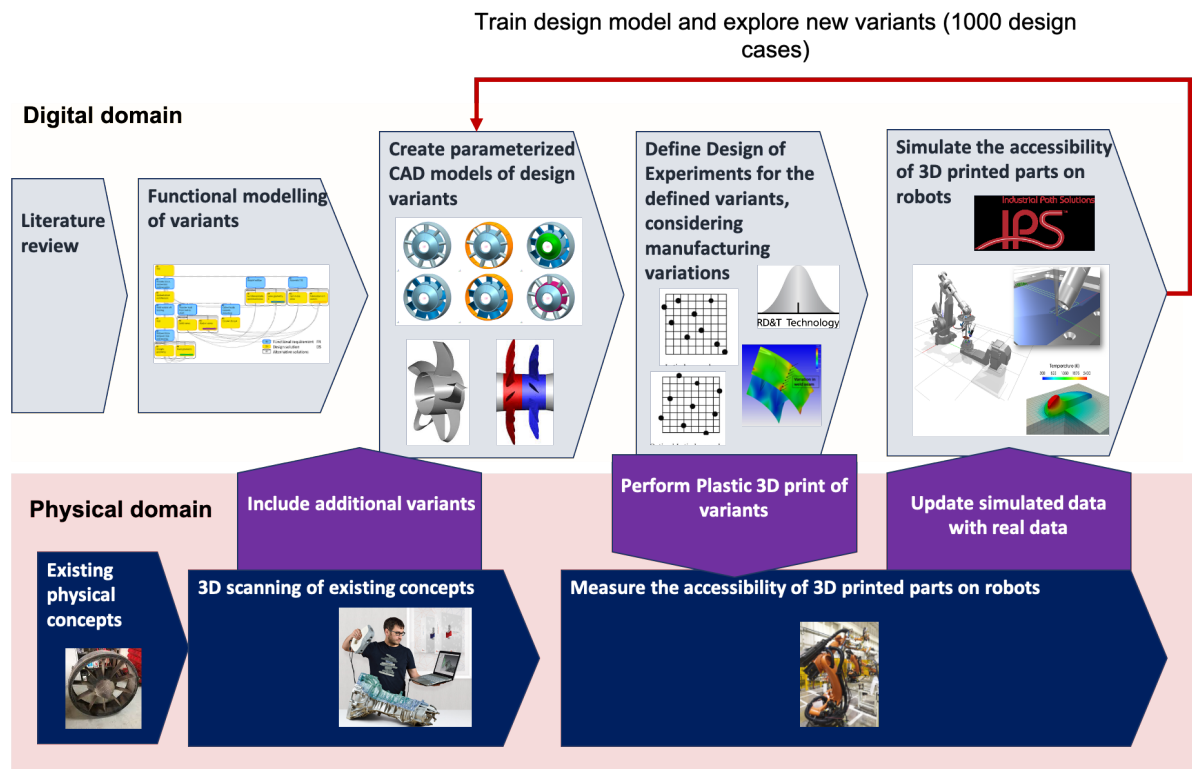
You will work on two domains, the **digital domain** and the **physical domain**. In these two domains, you will:

- Perform a literature review of existing and emerging concepts of aeroengine components
- Perform 3D scanning of existing physical concepts available at Chalmers
- Create parametrized CAD model of the identified concepts
- Perform plastic 3D printing of variants, after performing a design of experiments[1] of the dataset, and considering manufacturing variations for the variant (using the RD&T software[2])
- Perform physical measurements for the 3D printed variants on robots, analyzing the accessibility of manufacturing equipment
- Perform simulation of the accessibility of the variants (using the IPS software[3])
- Update simulated data with measured data
- Link simulated data with the parametrized CAD model
- Exercise the parametrized CAD models and analyze the accessibility of new design variants (e.g. 1000 design cases).

Contact reference

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[1] https://en.wikipedia.org/wiki/Design_of_experiments

[2] http://rdnt.se/

[3] https://industrialpathsolutions.se/