Defeaturing of 3D CAD models using Deep Learning

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Project Abstract

Today, there are many methods and tools used to perform the existing operations, following such a preparation process strongly relies on the knowledge of the experts that is not fully formalized. This lack of formalization and the associated lack of knowledge on the performance of a given preparation process induces numerous iterations between the original model and the model prepared for an activity. Thus, being able to estimate a priori the cost and quality of a given preparation process will help optimizing the transfer between Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE) models. As a consequence, the product development process will be shortened and the over-quality avoided.

The CAD model simplification makes the meshing and simulation steps easier by removing items and modifying the geometry. In this project how the quality of CAD model preparation process effect on the simulation results will be estimated using machine learning techniques. In this way, the analysts can test different adaptation strategies and thus identify the best one with respect to a given simulation objective.

The idea is to make use of Machine Learning techniques to configure a set of classifiers from a set of known examples. Once configured, the classifiers can be used to estimate a priori what would be the impact of a new unknown preparation process on the simulation results. Thus, it is possible to evaluate the preparation process without doing it. Engineers can thus save a lot of time and test several preparation processes before focusing on a particular one that they will anyhow have to do. Five output variables are used to evaluate a preparation process: the preparation cost, the meshing cost, the simulation cost, the simplification impact on sub-assembly and the overall

analysis result in an error [1]. Data can be extracted from the preparation processes description and CAD models.

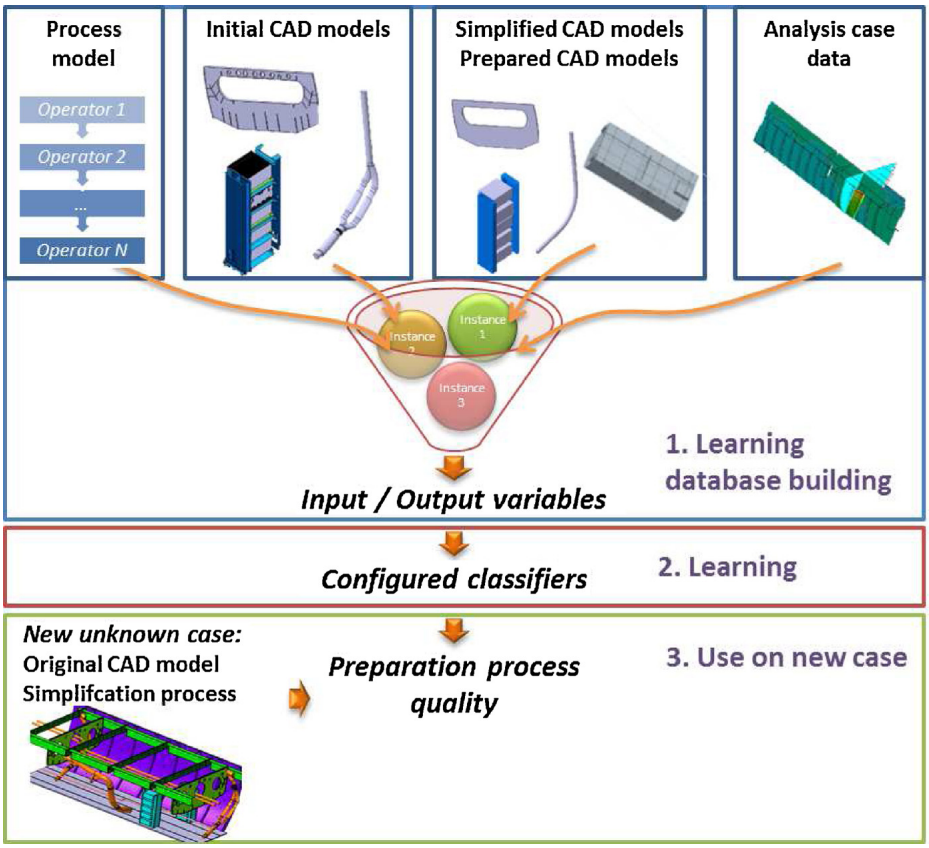

Figure 1: General approach for preparation process evaluation by using machine learning techniques [1].

Modular Diagram

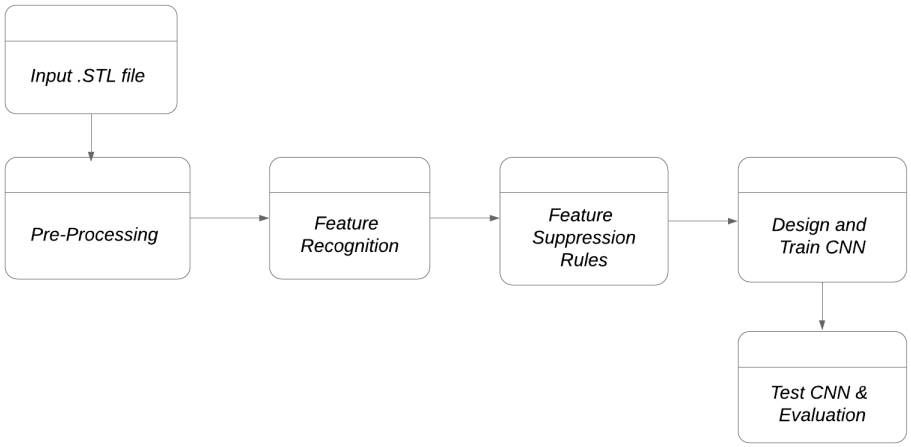

Figure 2: Modular diagram denoting the workflow of the project

Sheet metal parts are considered for this project. First 3 modules from modular diagram has been implemented in the 1st stage of project. To start with holes, bump and dent features are taken into consideration for implementation. The concept based 3D CNN will be designed that will train the model with less data.

Applications

- The same model can be used to predict the finite element results by training on the application dataset
- Topology optimization is another application where this model will help to reduce the number of iterations

Reference

1. Danglade, Florence, et al. "A priori evaluation of simulation models preparation processes using artificial intelligence techniques." Computers in Industry 91 (2017): 45-61.