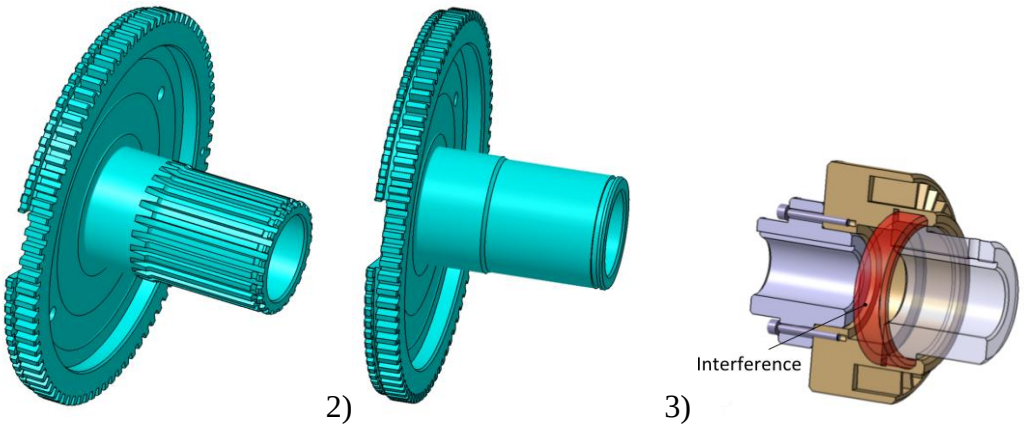
From shape symmetry analysis to shape simplification



1) 2) 3)

Shape simplification based on symmetry analysis to simplify geometric interactions between assembly components: 1) initial component, 2) targeted local simplification of the previous component, 3) example of geometric interaction between assembly components influenced by a shape simplification.

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Context

Recently, symmetry analysis has found many applications in computer graphics [1, 3]. This observation applies to CAD models as well [2]. Symmetry properties play an important role in man-made objects and partial symmetries can be used to simplify their shape as needed in many applications, among which the processing of large assemblies (from hundreds to tens of thousands of components).

Pre-requisites include interest and skills in applied geometry (for instance, MoSIG's second year course "Computer Graphics II" or/and “Computational geometry”).

Objectives

Components of industrial products often exhibit multiple local symmetries as well as some global ones [1, 2]. There, objects are described as B-Rep NURBS models. Here, the objective is to identify local symmetries that relates to rotational or translational repetitions of primitives. Then, the subset of a component shape that benefits some of these symmetry properties will be the location of shape simplifications while preserving the consistency of the object, i.e. a volume stays a volume, ... Areas subjected to these simplifications must be identified and are characterized by either linear or rotational repetitions of elementary shapes [4]. Then, the simplification operators performing these transformations will have to be formalized to ensure the robustness of the shape changes operated. The simplification operators to be designed will be particularly targeted on the simplifications of geometric interfaces appearing in an assembly of components.

Also, simplifying geometric interfaces speeds up large assembly processing when characterizing the geometric interactions between its components.

Development will be carried out in C++; will use a pre-existing software devoted to the analysis of symmetry properties and the OpenCascade open source library.

Keywords: symmetry, shape simplification, geometric interfaces, assemblies.

References

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