GUIDELINES FOR AN EFFICIENT INTEGRATION OF COMPUTER AIDED INNOVATION WITH OPTIMIZATION AND PLM SYSTEMS.

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ABSTRACT:

- In order to improve and optimize the innovation and product development process it is possible to use new technologies or new approaches:
  1. computer aided innovation system;
  2. structural optimization tools;
  3. knowledge-based tools.

- These tools increase extremely the effectiveness of the design activities where they are used; however they are not still integrated and therefore not used optimally.

- We propose a methodology that defines the guidelines to improve the efficiency in the use of the topological optimizers inside the PLM. This methodology is described referring to a specific case study which concerns the design of a plastic moped wheel.
The PROSIT project (www.kaemart.it/prosit) aims at the improvement of the product development cycle through the integration of Computer-Aided Innovation (CAI) with Optimization and PLM systems.
One of the main limits to a wider diffusion of topological optimization tools regards the poor integration with the PLM systems.

The designer has to model again the geometry interpreting the results obtained by the optimization process, and considering norms and manufacturing constraints. A solution to this problem can be found defining a best practice to integrate the topological optimization tools with modern PLM system.
Having carefully analyzed the various case studies carried out during the “PROSIT” project, we have reached the following conclusions:

1. it is possible to subdivide the geometric model into a set of “characteristic” volumes that can be considered invariant volumes or volumes to be optimized;

2. the invariant geometries cannot be modified during the optimization process;

3. STL files describing optimized models, are usually not manageable by CAD systems because they contain a high number of triangles, and many of these have errors;

4. it is impossible to use current feature recognition modules for the reconstruction of feature based models;

5. it is possible to extract –from voxel models - useful information on sections and/or profiles, which may be used during the feature based reconstruction phase.
Our main purpose was to develop a design methodology. So we can summerize our strategy in five steps.
1st step: Modelling

Modelling through joining of standardized geometries, realized according to the case study or taken from custom libraries.

A custom interface allows to select invariant geometries. This knowledge allows the designer to limit the reconstruction phase of the geometrical model only to the optimized volumes.
At the end of optimization process it is necessary to execute the OssMooth module, present in Hyper Works, in order to translate the topological optimization results into an STL format file.
The STL model of the optimized wheel:

- holds a high number of triangles (~30000 triangles);
- presents errors on triangles as non-manifold face, redundant face, crossing face and unstable face.

Implementation of KB custom user interfaces in order to:

- facilitate the checking of the geometry and the individuation of profiles and guidelines;
- select reference geometries realized in RapidForm and export them interactively to SolidWorks.
4\textsuperscript{th} step: Geometry data extraction

In order to increase our level of knowledge and extract further information from the optimized geometry, a geometrical analysis of the model may be particularly useful.
The final phase of our methodology consists in using all data and information gathered during the previous phases, in order to realize a feature-based 3D model. The user may use:

- invariant geometries defined during the initial phases of the process;
- profiles and guidelines extracted from the optimized model;
- geometrical analysis results.
CONCLUSIONS:

✓ A methodology which defines the guidelines to implement an efficient use of topological optimization tools (Altair OptiStruct) in the PLM was developed.

✓ The guidelines are translated into some knowledge based user interface that are able to support and simplify the designer’s job during the redesigning model phase.

✓ Through these interfaces the user works interactively both in Solidworks and Rapidform environment in order to extract profiles, reference curves and geometrical analysis that reduce decision-making in the redesign phase.
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Thank you for attention.