Automated Architecture DSM Generation from CAD-Models regarding physical and functional relations

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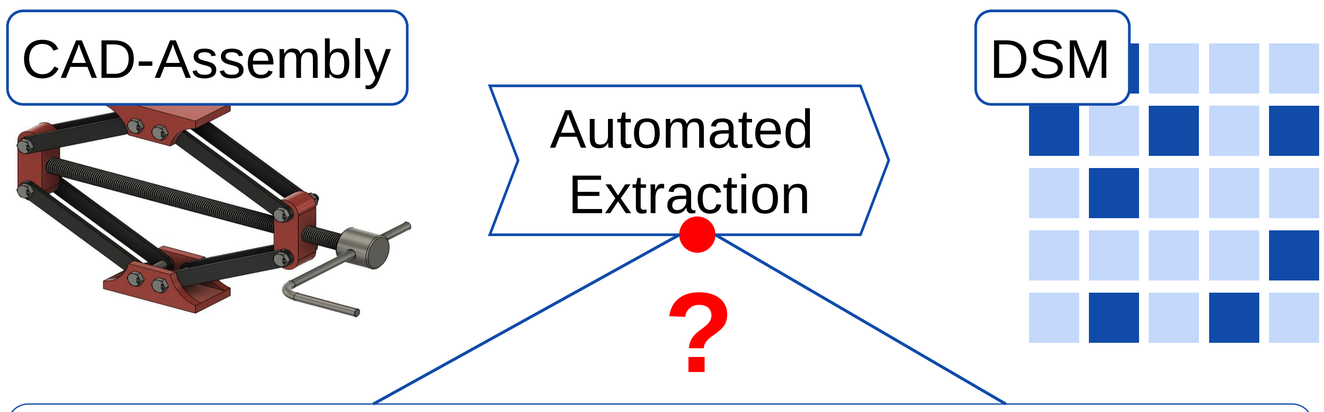
Motivation and Research Scope

Motivation

- The product architecture DSM is a framework to deal with complexity in product development
- The potential of the DSM cannot be fully exploited, due to the effort for a manual DSM generation
- There is a need for automated DSM generation



Research Scope

- This approach uses CAD-Assemblies as basis for the automated product architecture DSM generation
- API-Interfaces provide a framework for a customized information retrieval from CAD-Models
- Physical relations in terms of component contacts can be derived explicitly from the CAD-model and functional relations can be retrieved implicitly by interpreting the component contacts

Physical Relations

- Extract contact surfaces as locations of a physical relation
- Save this as DSM

Functional Relations

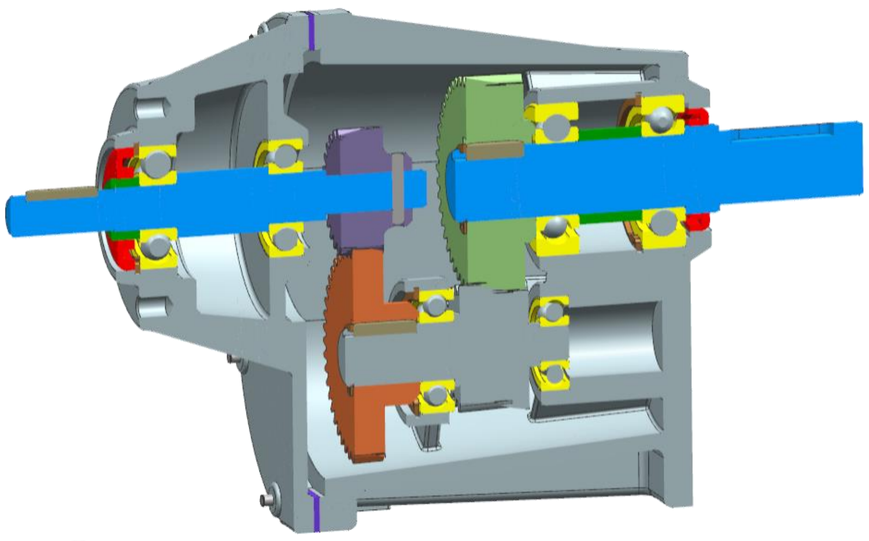
- Extract force flows between components as locations of functional relations
- Based on the physical DSM

Research Methodology

Use Case

- CAD model with sufficient number of relations and sufficiently low complexity for manual evaluation of DSM generation
- Programming with the Siemens NX API

Gear with 27 components



Physical Relations Retrieval

- Pairwise extraction of component collisions for each combination and a numerical value “1” for component collisions
- Saving results as DSM in Excel

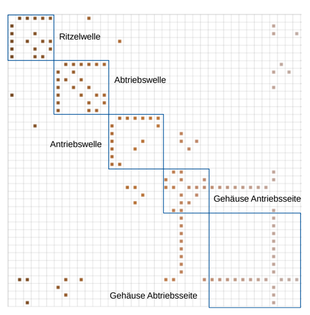
Functional Relations Retrieval

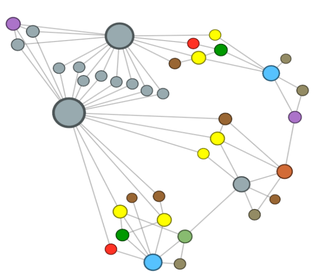
- Focus on mechanical force and mechanical energy transmission
- **Hypothesis:** The shortest paths in the DSM graph between an input and an output component represent the main functional flow of mechanical force or energy
- Identification of the shortest path with the powers of the DSM matrix and for-loops

Results and Discussion

Physical Relations Retrieval

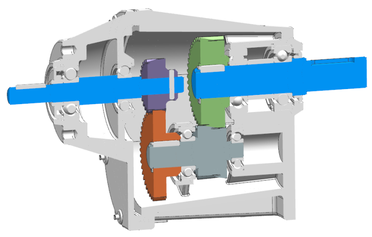
- An architecture DSM with physical component relations was build
- Modules such as housing, drive shaft, etc. could be identified properly
- The result can be displayed as matrix or as graph

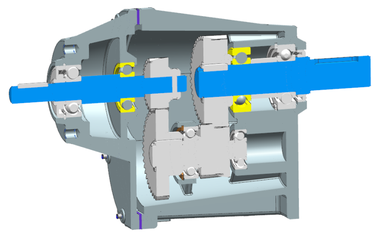




Functional Relations Retrieval

- With the drive shaft and the output shaft identified as start and endpoint of the algorithm, the shortest path between these components was identified
- The shortest path leads over the gear wheels and the pinion shaft and describes the main functional flow of the gearbox. Other paths describe the force flow to the housing.





Discussion

- The extraction of component collisions worked as proposed and no error was detected during the manual evaluation
- For the given example, the shortest path between input and output component represents the flow of the mechanical energy. This cannot be assumed for all possible use cases, so further research is needed to define the validity of the hypothesis.

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