Graph-Based Interactive Visualization of Operation Dependencies in Parametric Computer-Aided Design

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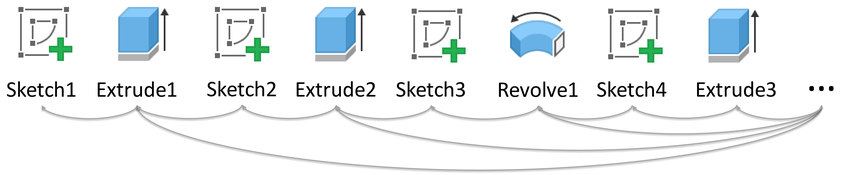
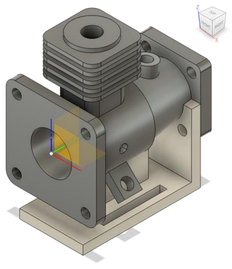
Background

- Parametric computer-aided design (CAD) is a fundamental software tool in modern mechanical product design.
- Users construct solid part geometries by defining a procedural *sequence* of **modelling operations**.
- The definition of each operation *depends on* the geometries generated by one or more earlier operations in the sequence.

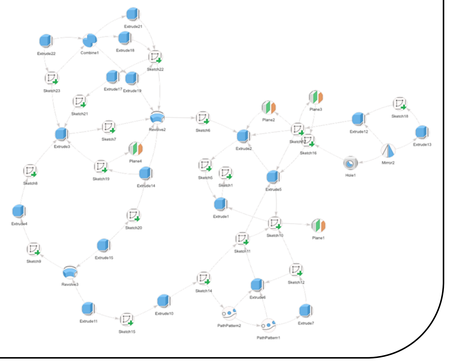


The CAD geometries that the user builds:

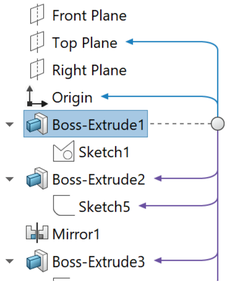


VS.

The underlying network of operation dependencies:



Challenge: existing visualization techniques do not scale as the model complexity grows



SolidWorks

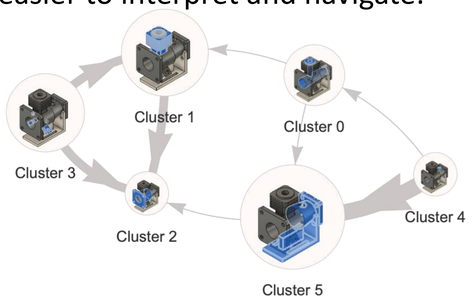
CATIA V5

Operation Modularization

A general-purpose *community detection* algorithm is deployed to group closely interdependent graph nodes into **clusters of operations**.

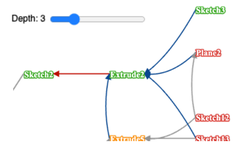
⇒ Segmenting the model into a few semantically meaningful components.

⇒ Reducing the complexity of the complete dependency network to a much smaller graph that is easier to interpret and navigate.

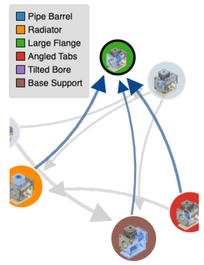


Design Implications

Operation Overview
Raise user awareness of the underlying model representations with explicit visualization



Local Dependency View
Juxtapose related information by operation dependencies



Modular View
Reduce data complexity through clustering to support information foraging

Implementation