

# ***CADModelScope*: Revealing the Dependency Structure Behind Parametric Computer-Aided Design Models**

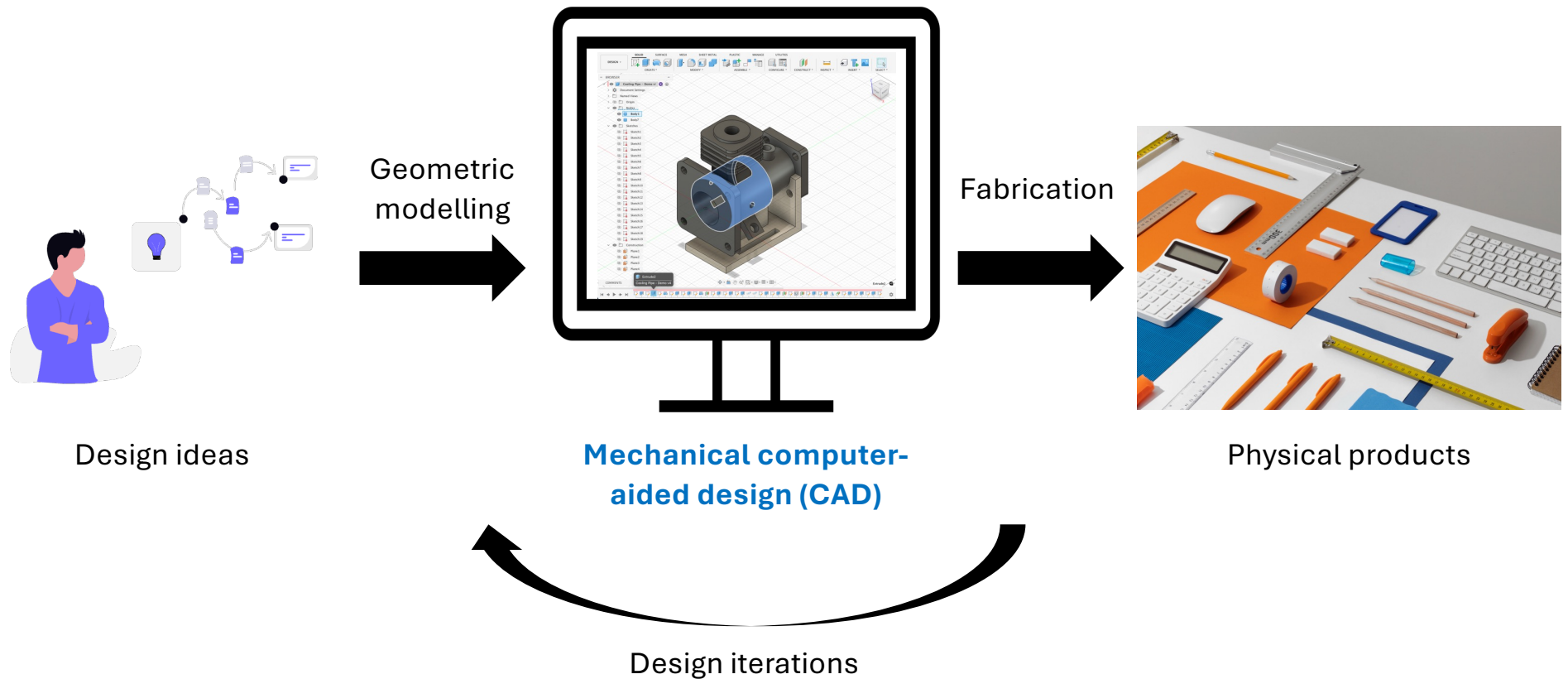
**Yuanzhe Deng, Zhijing Zhang, Dr. Shurui Zhou & Dr. Alison Olechowski**



**UNIVERSITY OF  
TORONTO**



# Modern product development



# Dependencies in parametric CAD

Operation Sequence



Sketch



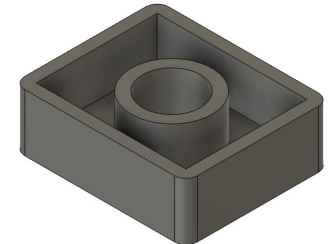
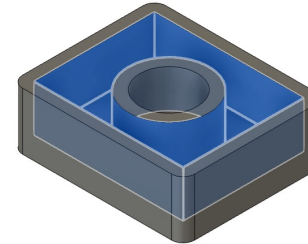
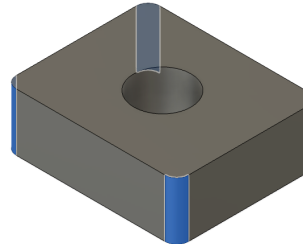
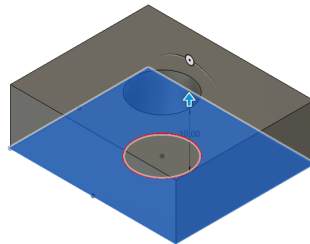
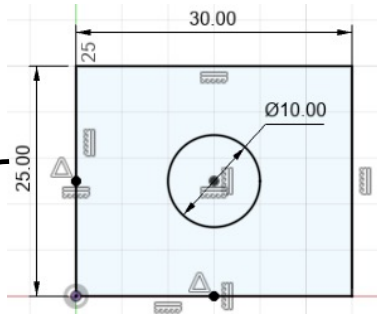
Extrude



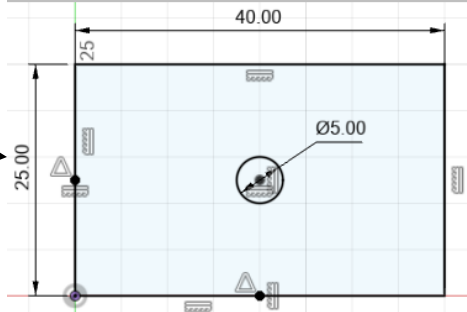
Fillet



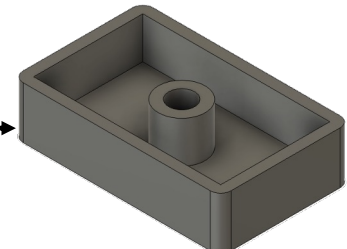
Shell



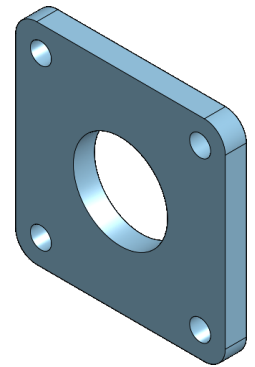
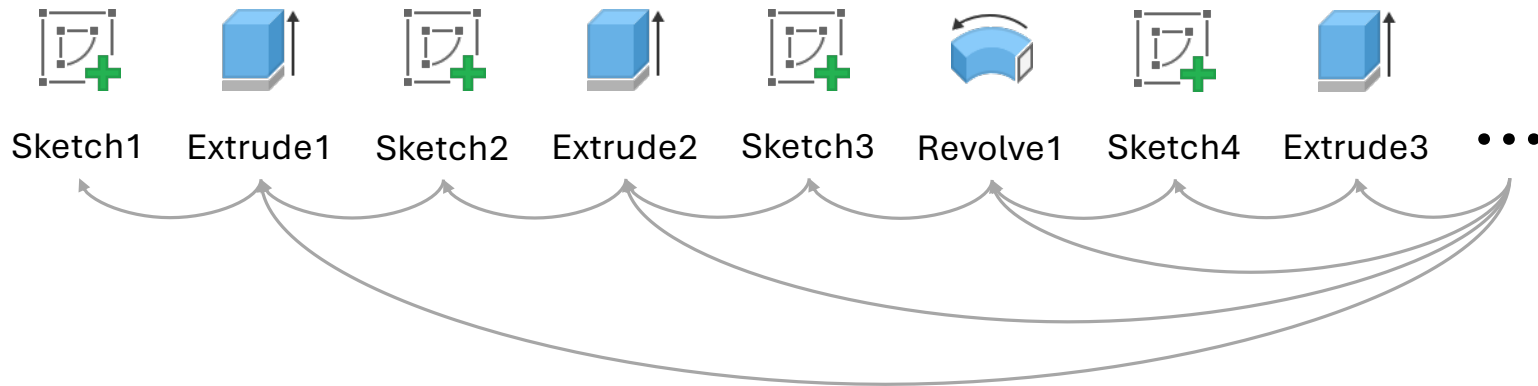
Edit

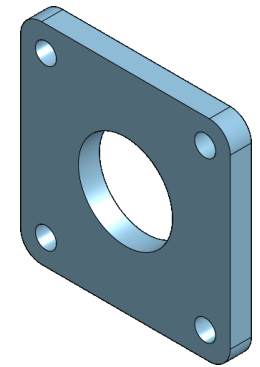
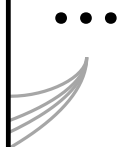
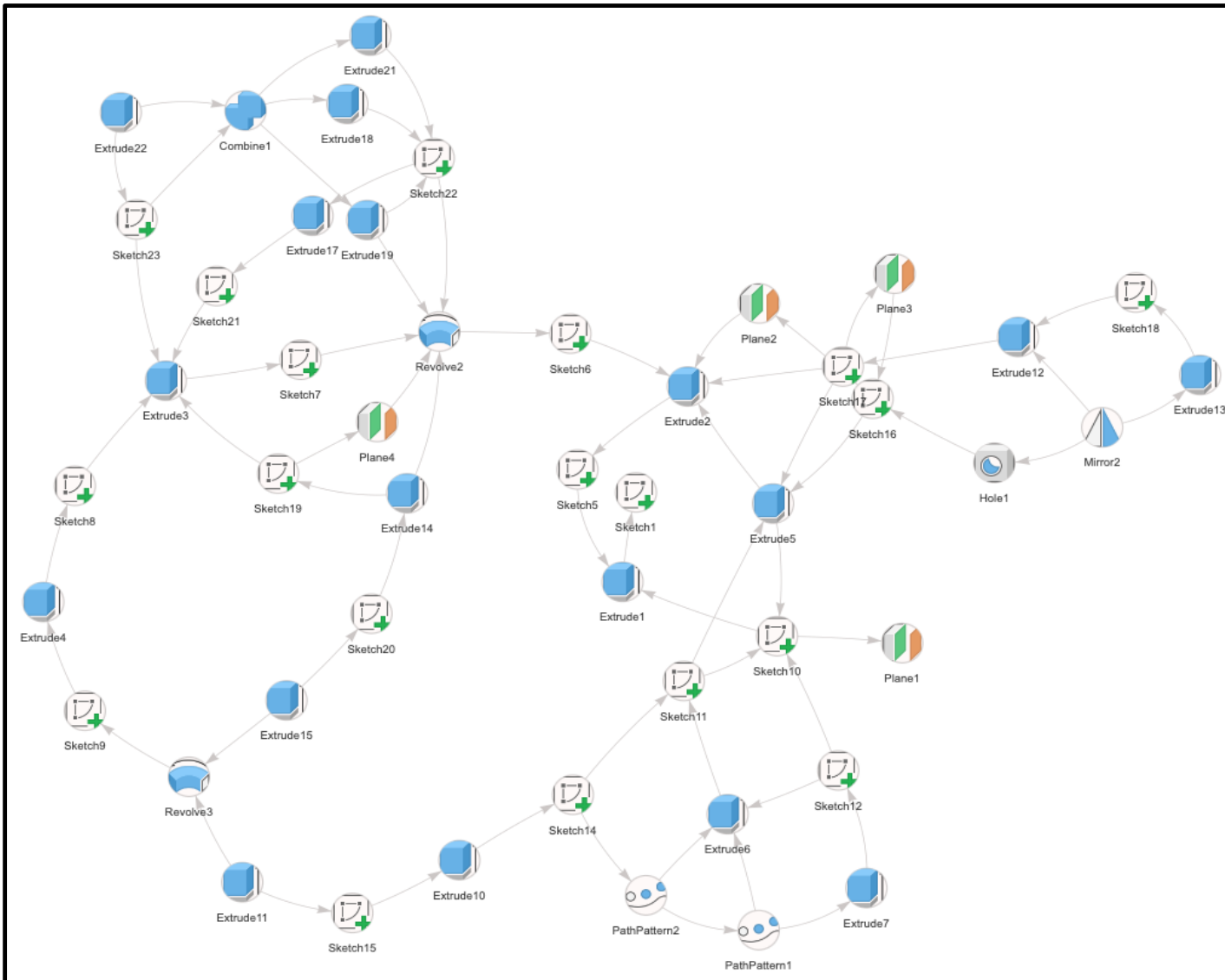


Automatic propagation



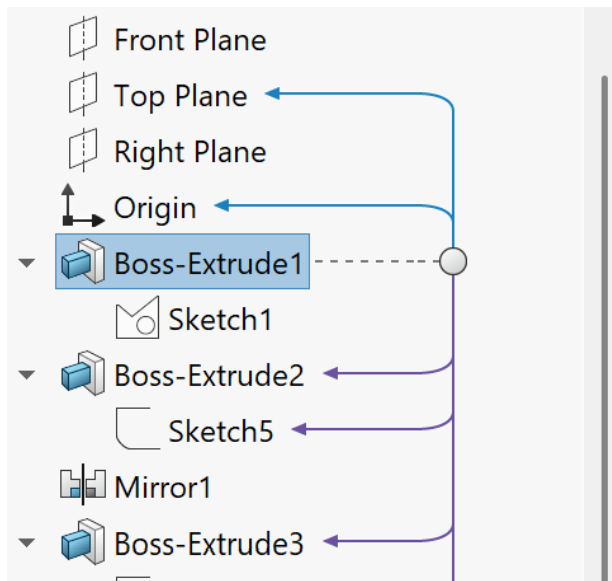
# The underlying dependencies in CAD are complex and intricate!





**But this model is only built with 48 operations!**

# Dependency tracing in commercial CAD



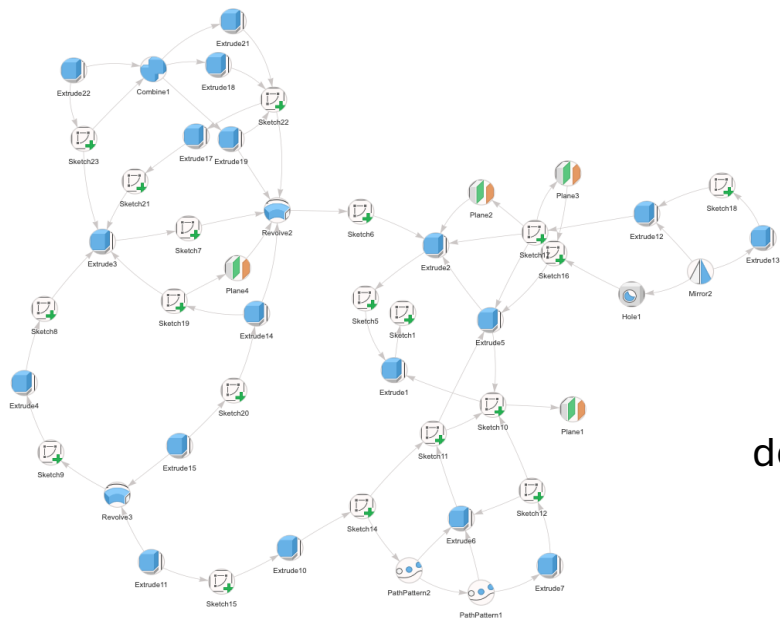
**SolidWorks**



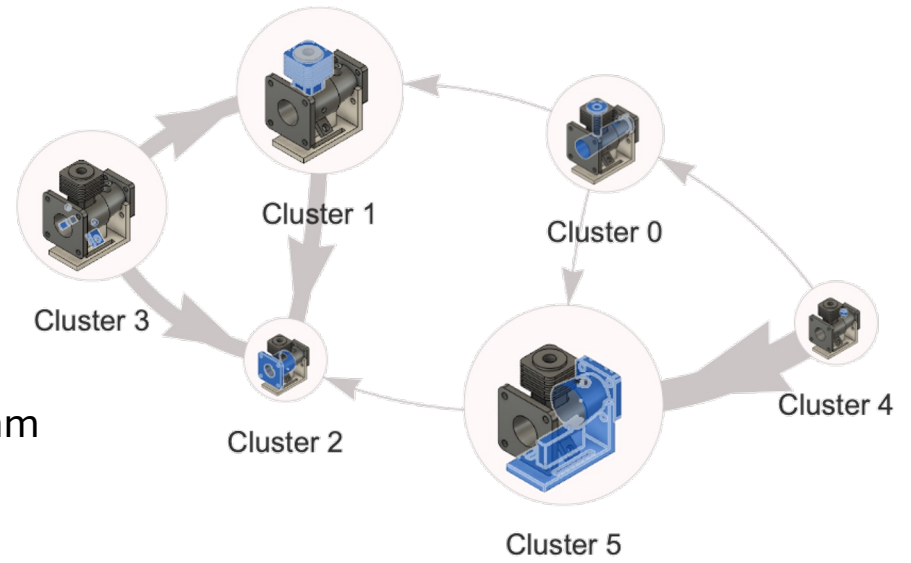
**CATIA V5**

**Challenge: existing visualizations do not scale!**

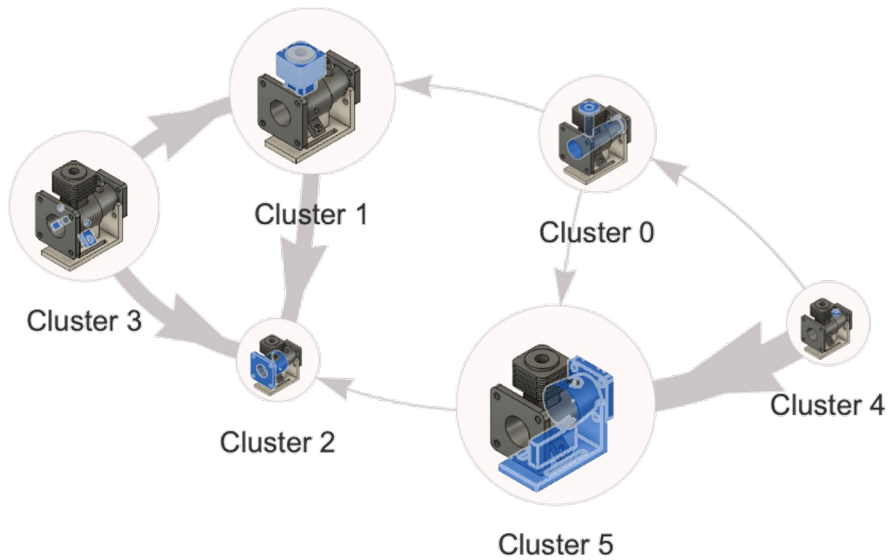
# Operation modularization



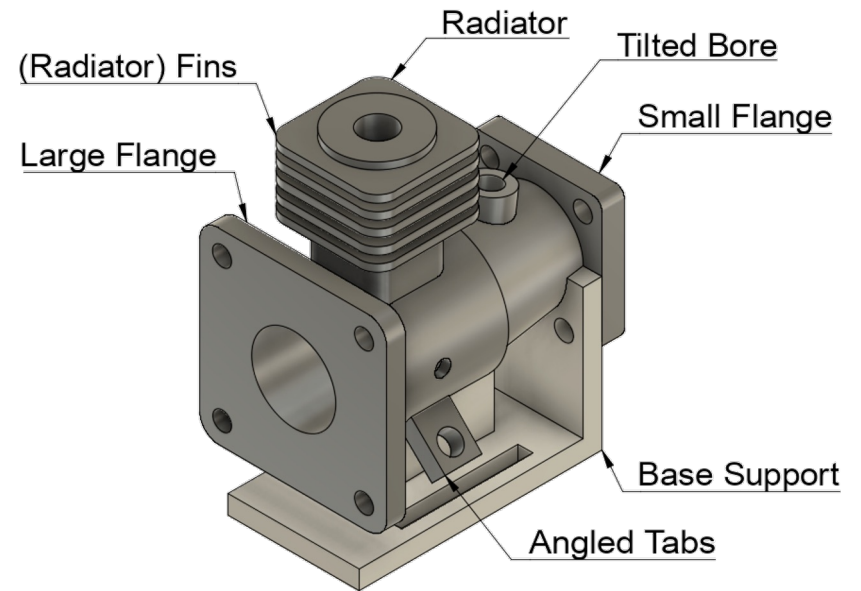
Community  
detection algorithm



# Operation modularization

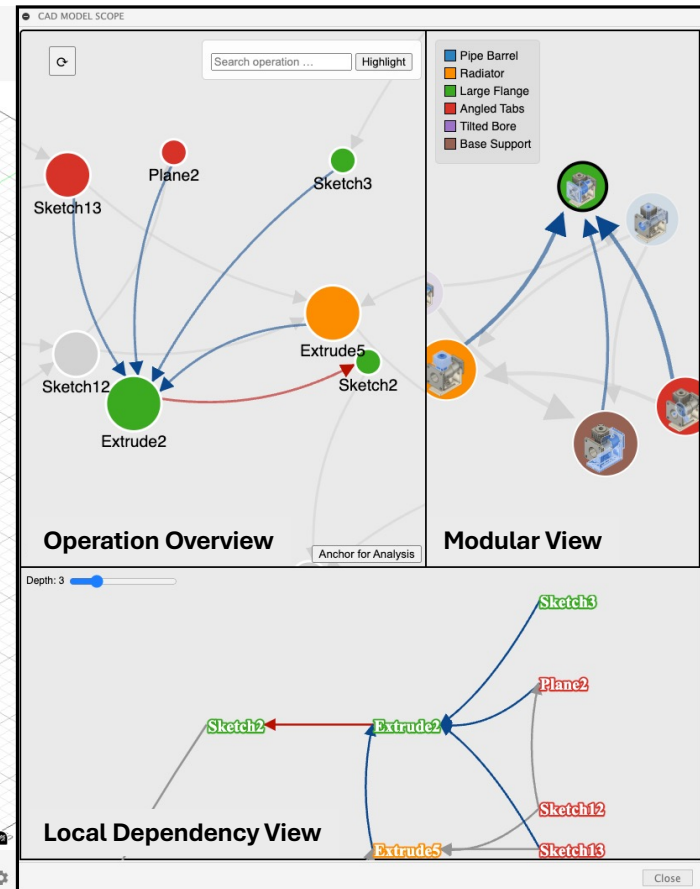
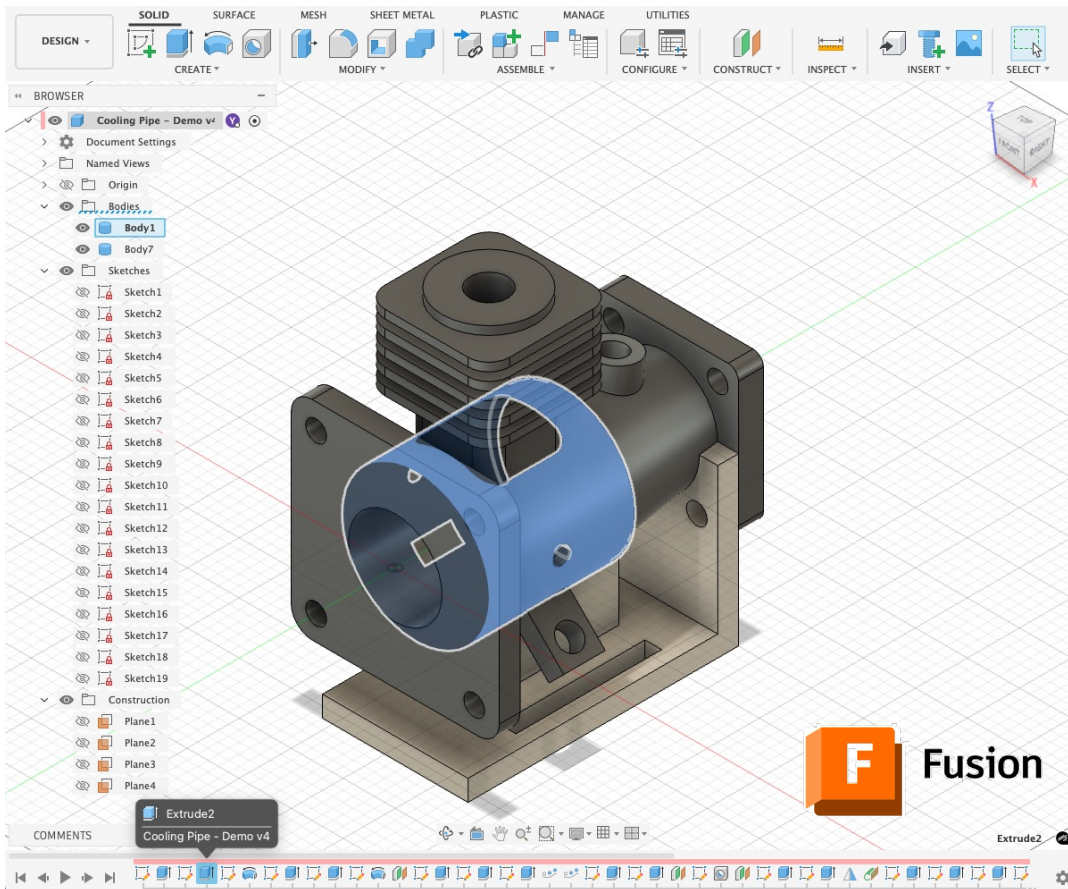


**VS.**



Y. Deng et al., What Sets Proficient and Expert Users Apart? Results of a Computer-Aided Design Experiment, *Journal of Mechanical Design*, 2024.

# CADModelScope

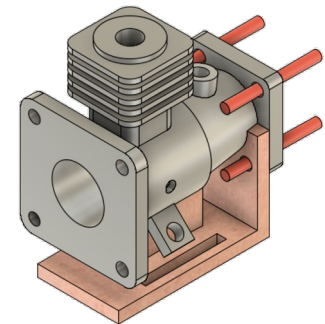


# Evaluation study

ID <sup>†</sup>	Participation	CAD experience (years)	
		FUSION	Other CAD
A1	In-person	0	SOLIDWORKS (3)
A2	Virtual	5	INVENTOR (4), SOLIDWORKS (3)
A3	In-person	3	CATIA (2), SOLIDWORKS (1)
A4	Virtual	5	ONSHAPE (5), SOLIDWORKS (2), CREO (1)
B1	Virtual	3	INVENTOR (4), ONSHAPE (2), SOLIDWORKS (<1)
B2	In-person	1	SOLIDWORKS (3)
B3	In-person	0	SOLIDWORKS (2), ONSHAPE (2)
B4	In-person	3	None

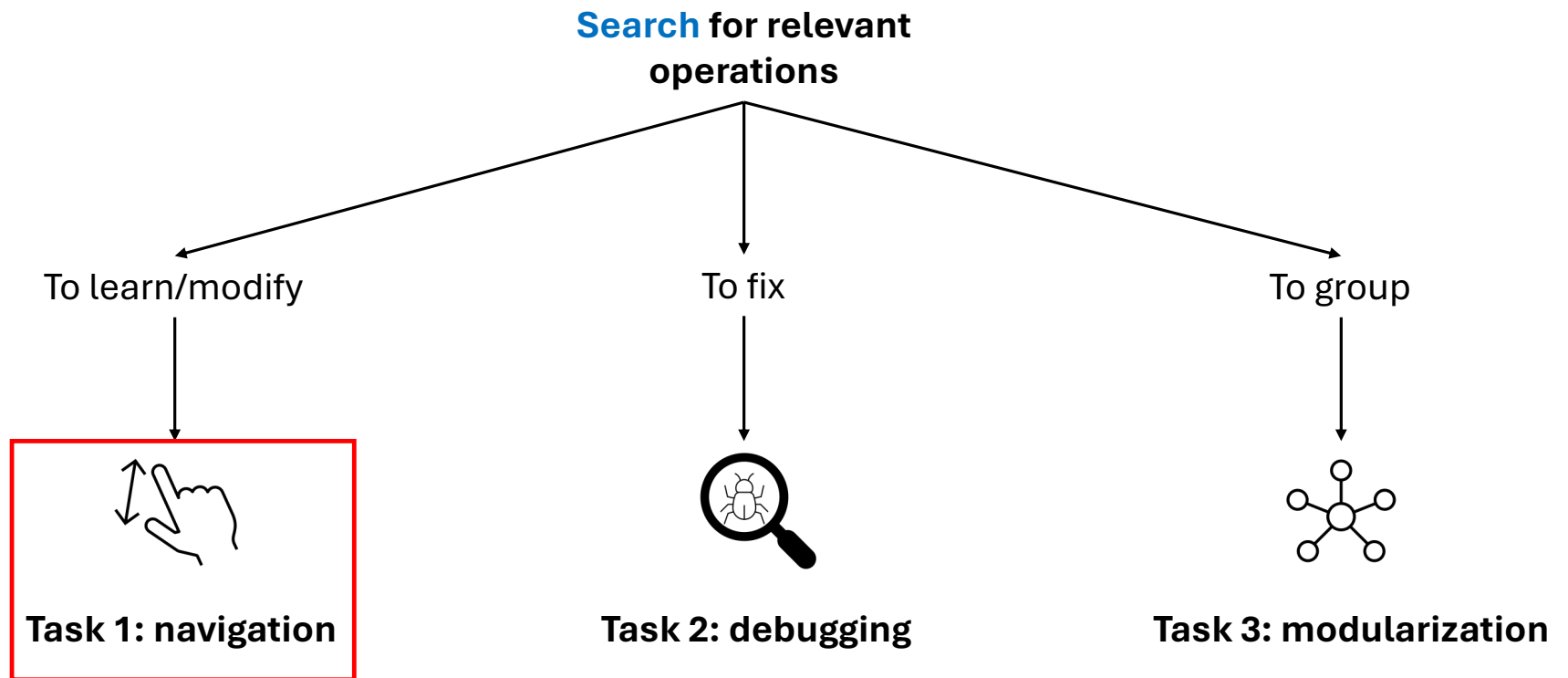


**191 operations**

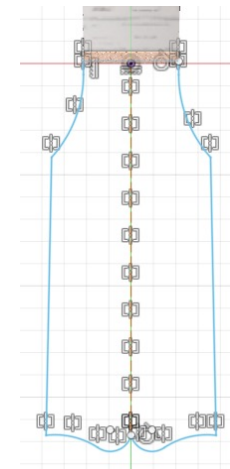
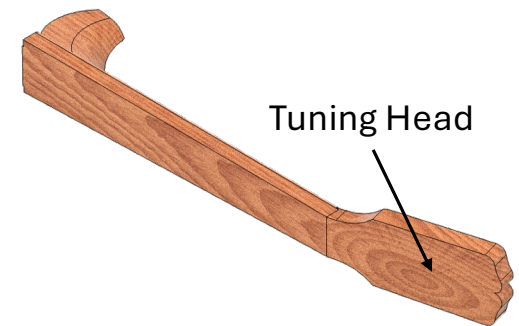
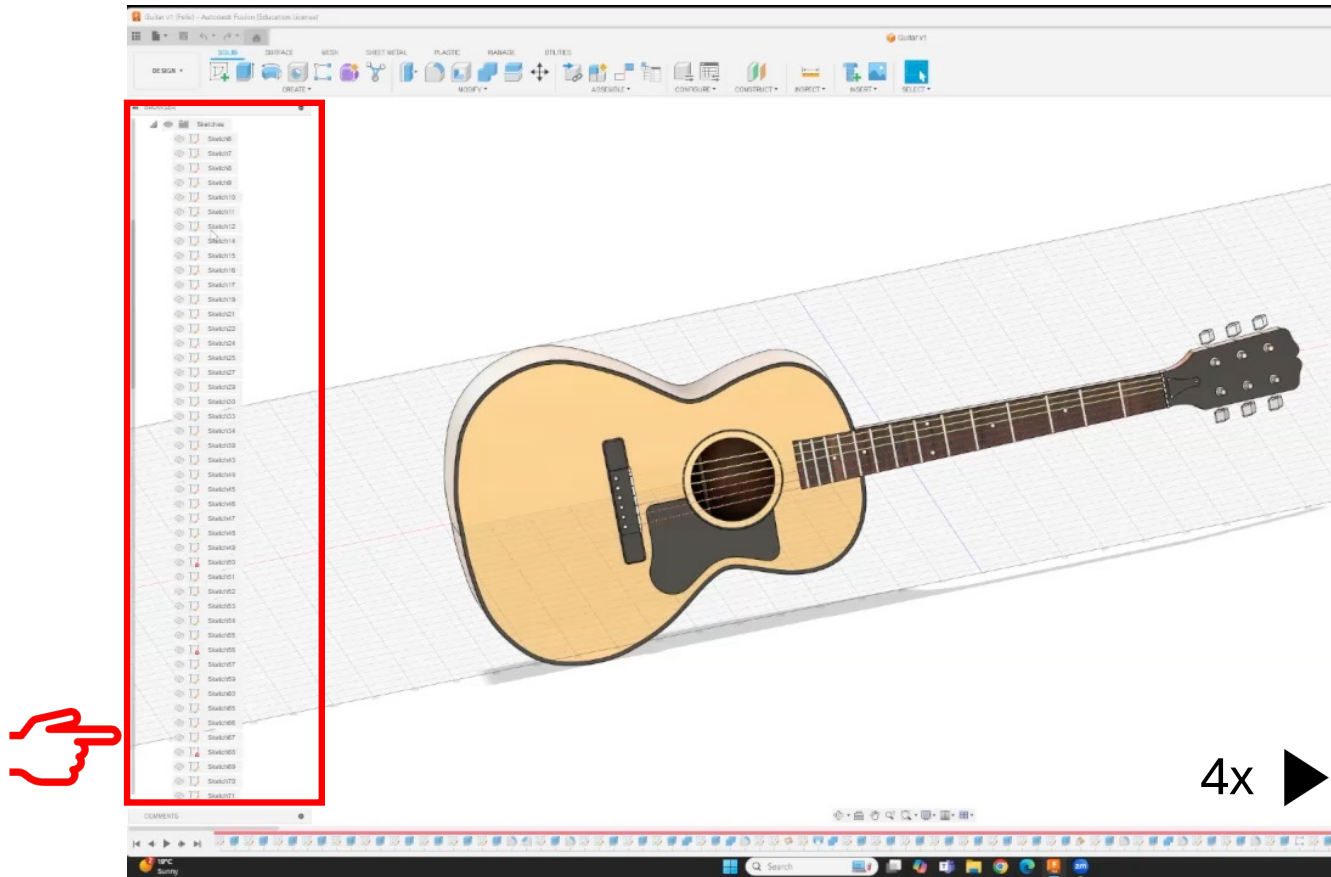


**50 operations**

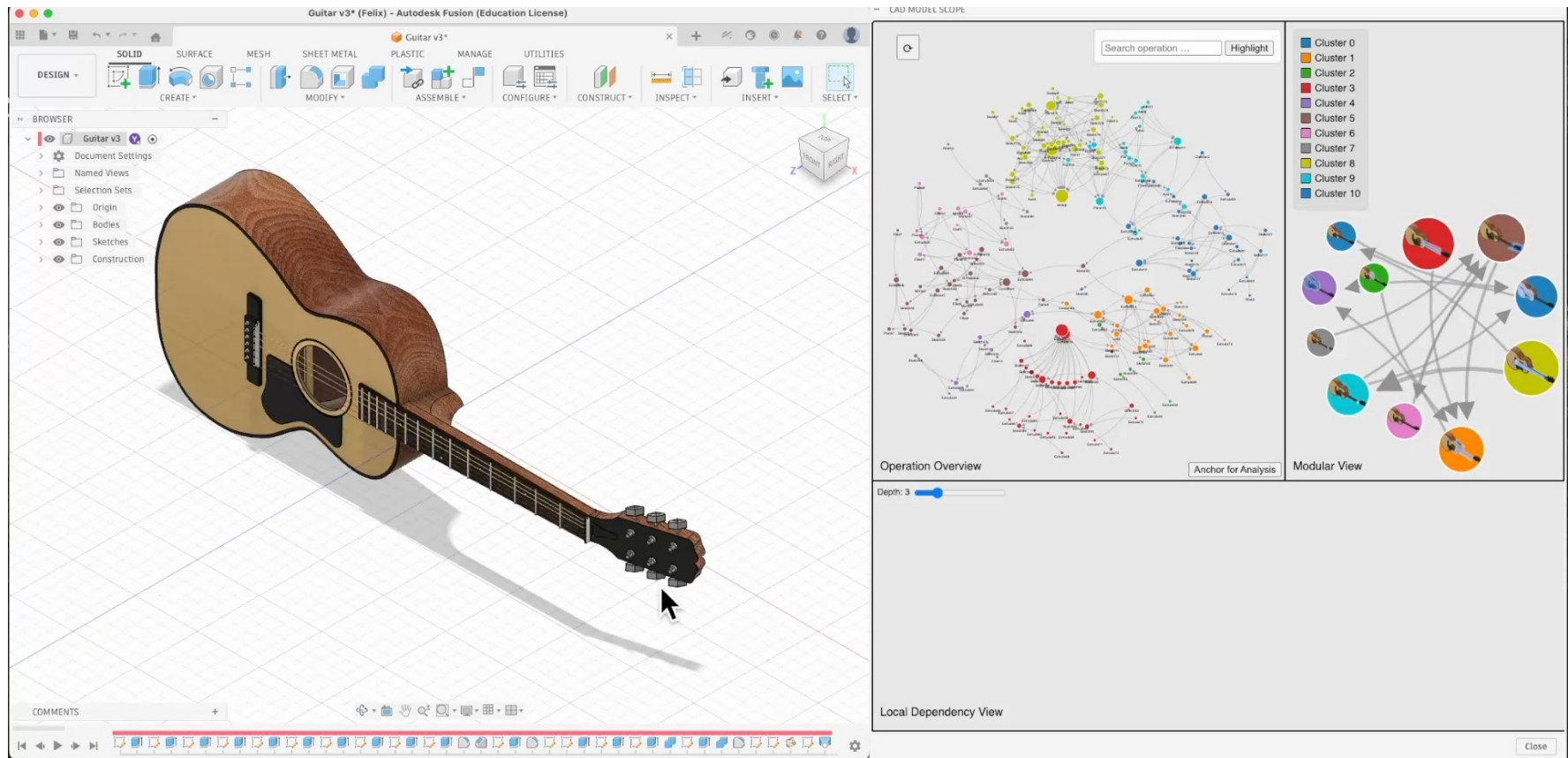
# What novel strategies *does CADModelScope* enable?



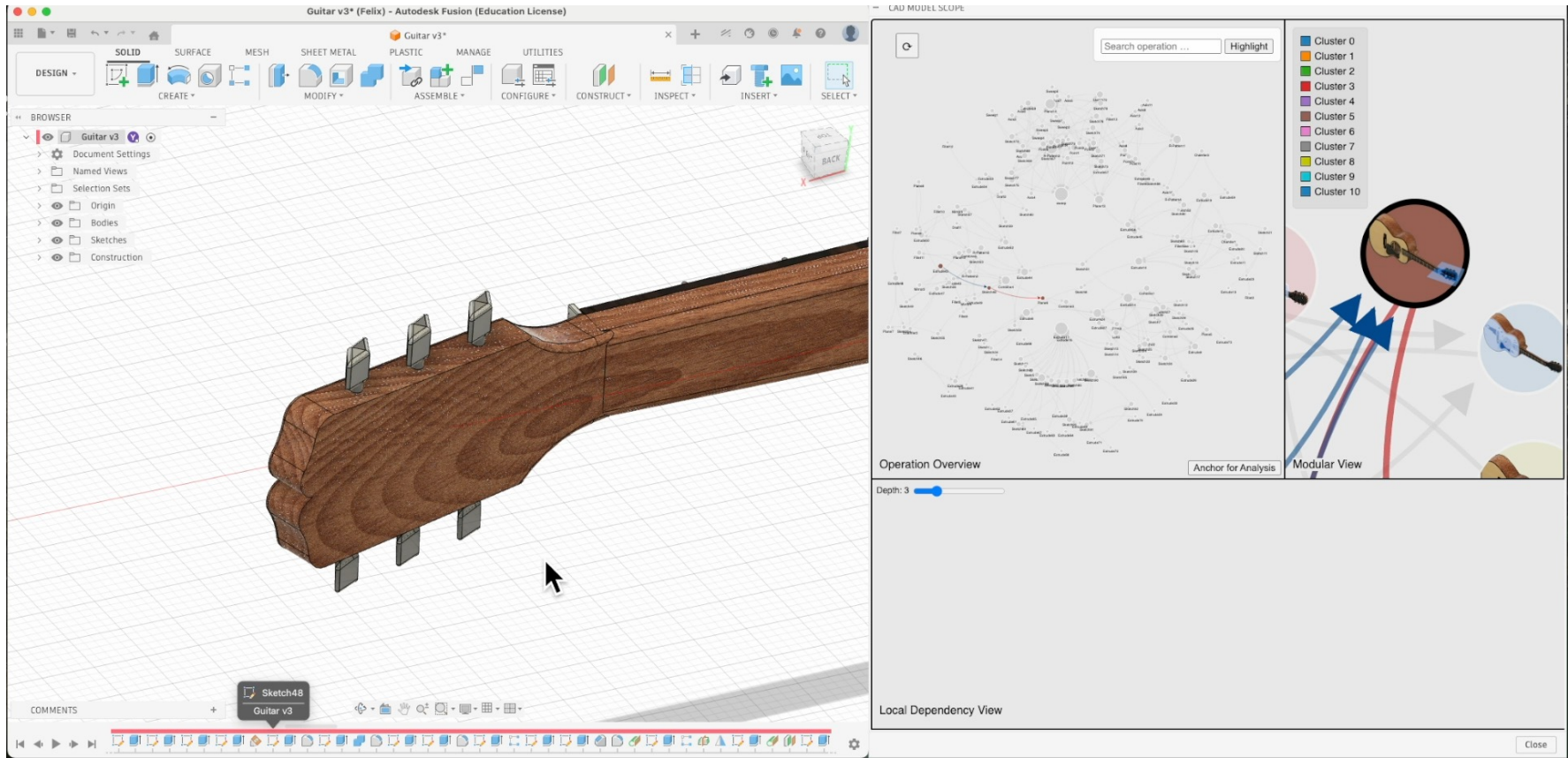
# Without *CADModelScope*: exhaustive and error-prone search



# CADModelScope: more structured navigation processes

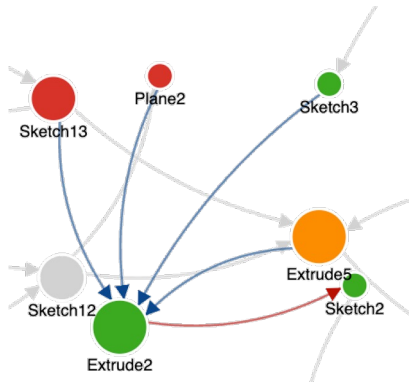


# CADModelScope: more structured navigation processes



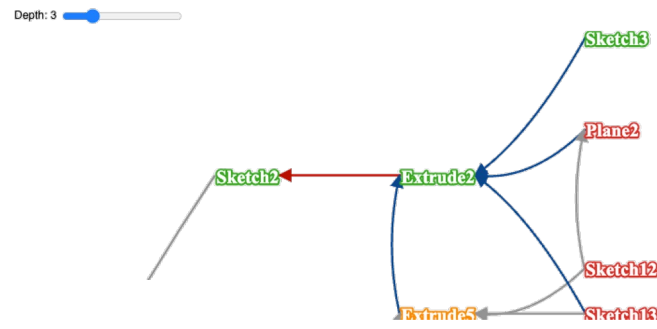
# Design implications

## Operation Overview



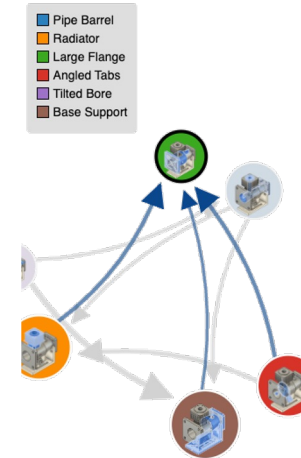
Raise user awareness of the underlying model representation

## Local Dependency View



Juxtapose related operations by dependency

## Modular View



Reduce graph complexity for information foraging

# Interested in learning more about CAD?

## Session Privacy and Security in Software Development

9:00 AM, Thursday  
Area 1+2+3: theatre

**Untangling the Timeline: Challenges and Opportunities in Supporting Version Control in Modern Computer-Aided Design**



Yuanzhe Deng   Shutong Zhang   Dr. Kathy Cheng   Dr. Alison Olechowski   Dr. Shurui Zhou



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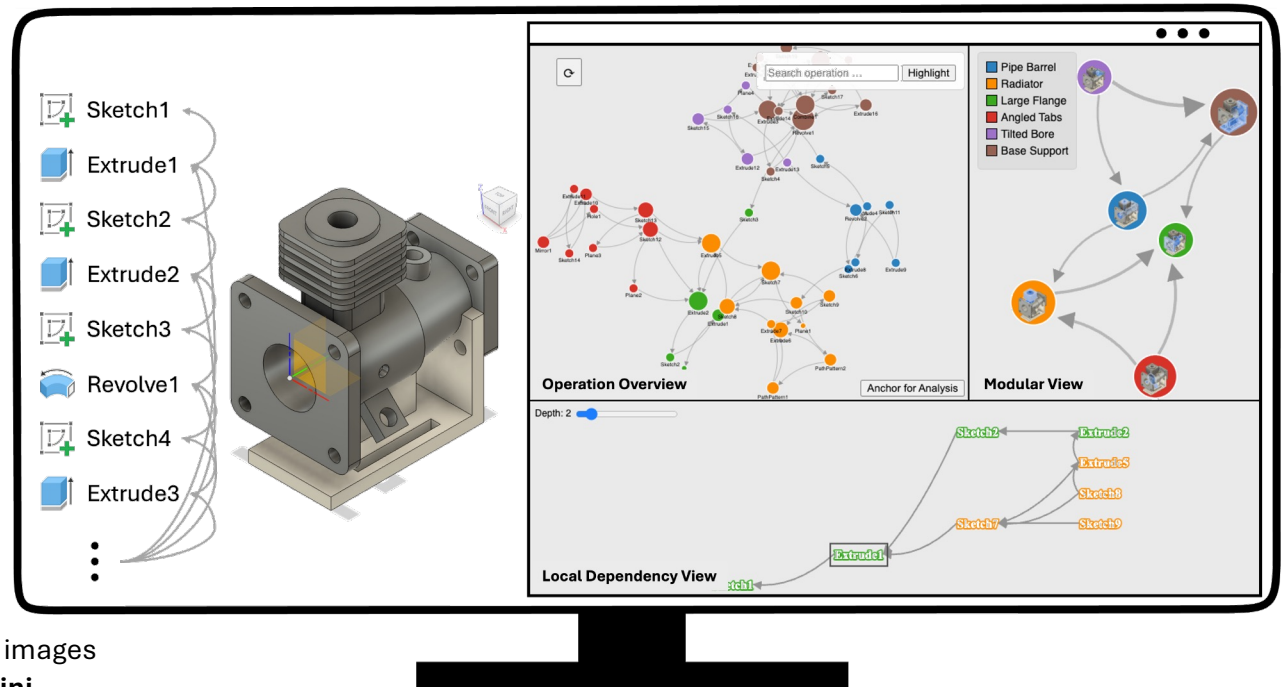
Contact: [yuanzhe.deng@mail.utoronto.ca](mailto:yuanzhe.deng@mail.utoronto.ca)



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