

Supporting Decision Making Through Immersive Exploration

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APPROACH

combining normative & descriptive design approaches

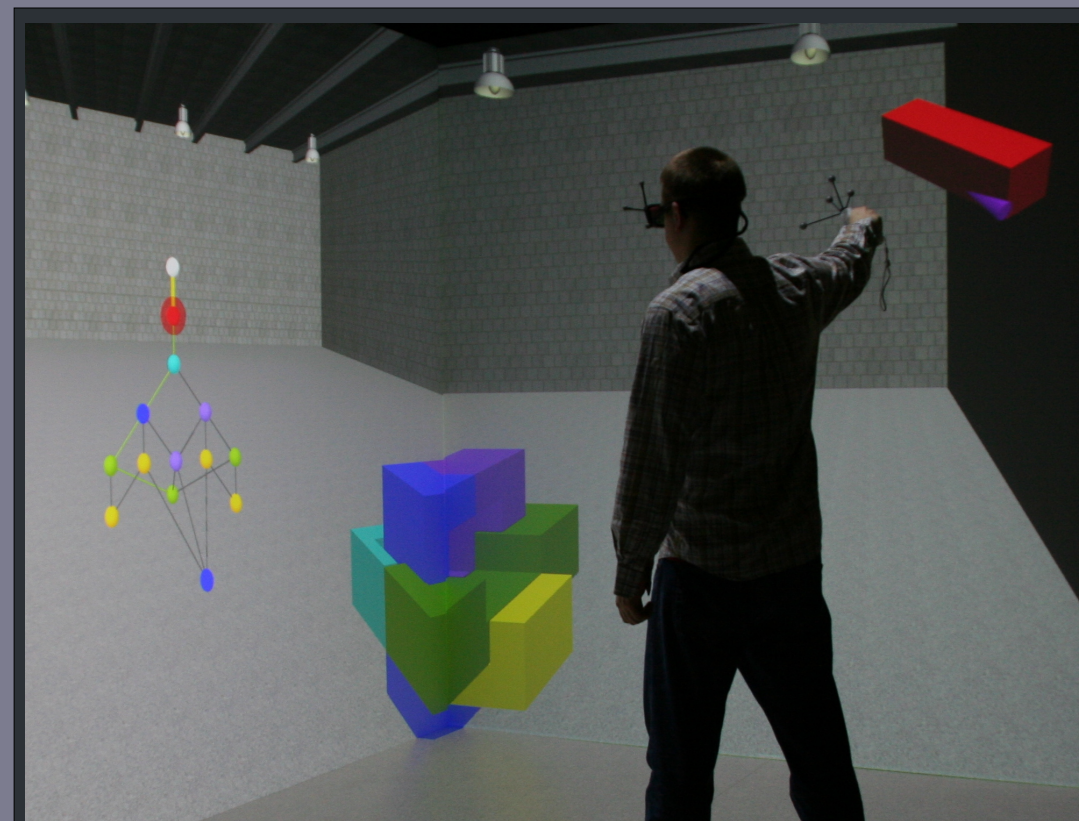
Normative Decision making tools often leverage mathematical models to analyze trade-off opportunities.

Sample Optimization Function

$$f_i(s) = \text{Max}_{j \in J} \{ U_j(x, y, s_i, n_{i+1}) + f_{i+1}(n) \}$$

While useful, normative methods struggle to incorporate descriptive processes and knowledge from the **human experience** (that cannot be captured mathematically). Designers and technicians possess valuable domain knowledge that should be leveraged during all design stages. Rich immersive environments enable designers to incorporate complex mathematical modeling with critical domain expertise to inform the design process.

Descriptive approaches can be used to introduce qualitative and expertise based perspectives, however, through this process **cognitive biases** may influence the overall decisions.

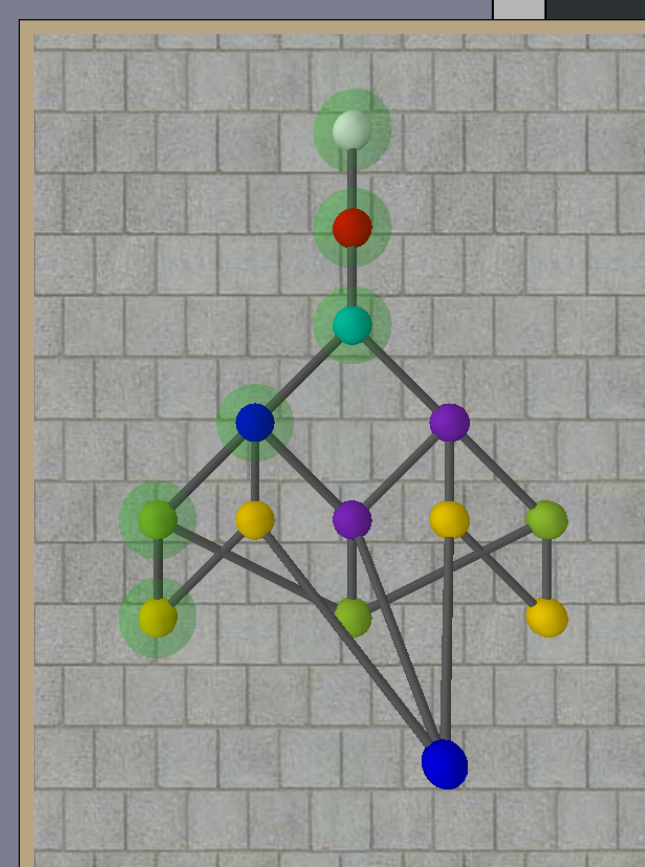


Designer exploring product in immersive environment.

application: disassembly sequence planning

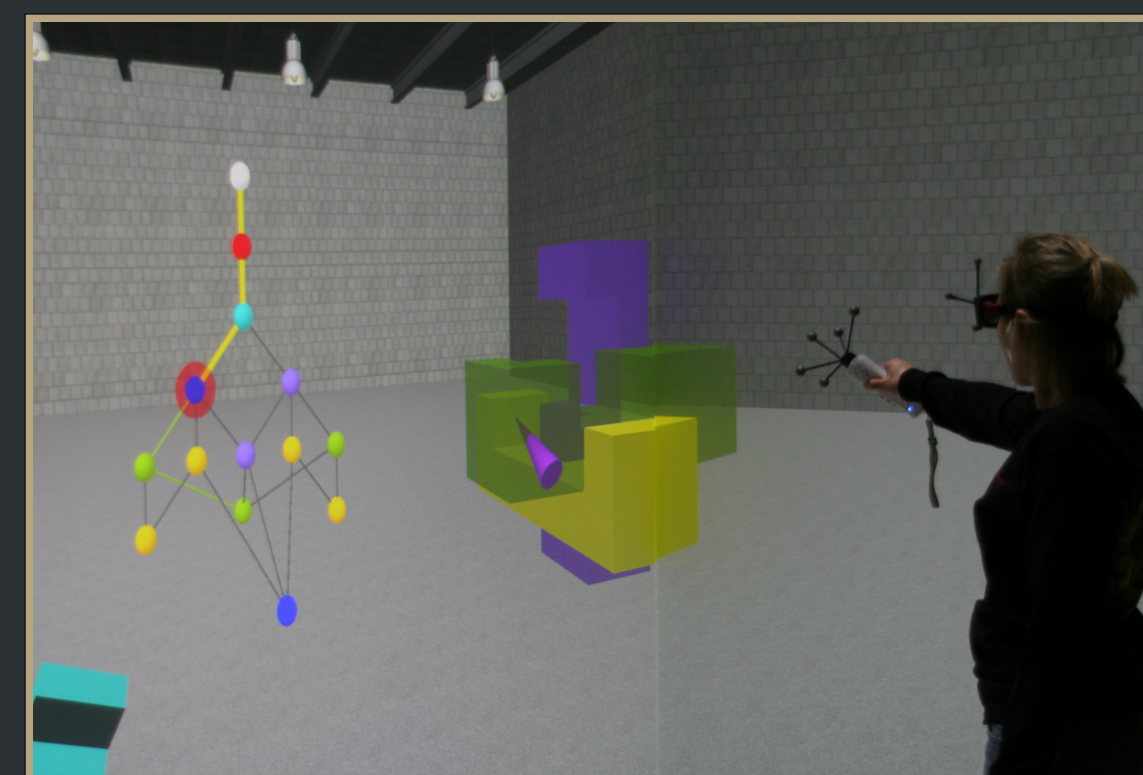
Past research has concentrated on finding the optimal disassembly sequence for a product considering the effect of damage during disassembly. The disassembly sequence can be described by a directed graph, however, this abstract representation removes the context of the individual component geometry. While immersive environments can mimic reality, it is often undesirable when attempting to overcome cognitive biases inherent in the decision making process.

Visualization of optimal disassembly sequence in immersive environment



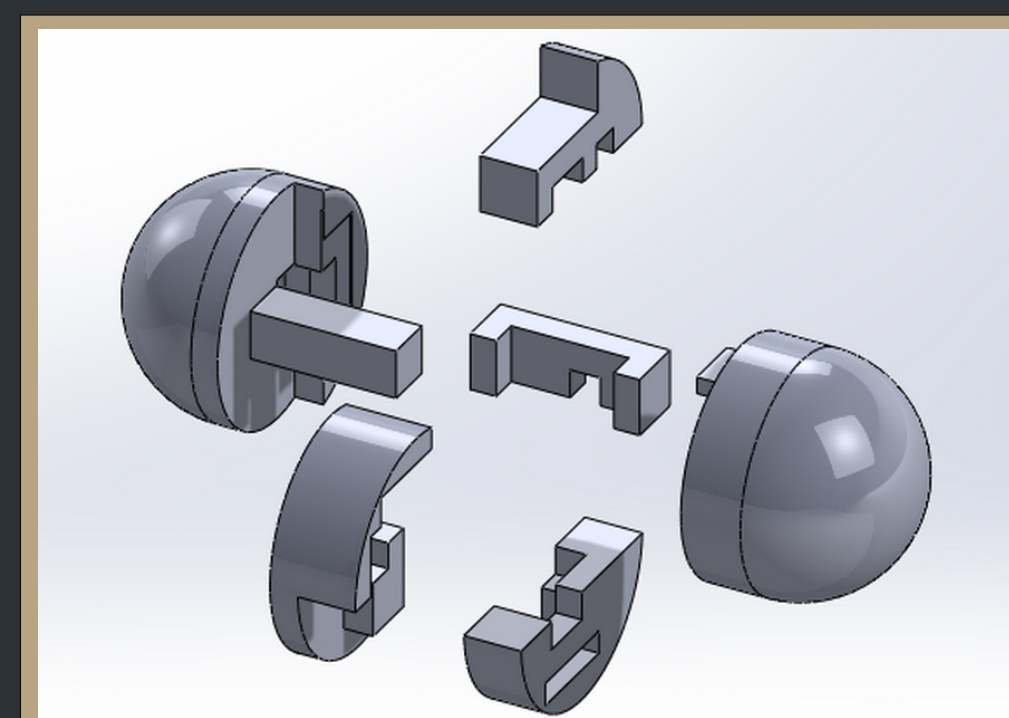
VISION

This research seeks to explore and evaluate new design processes, based on immersive technology, that support **design team interaction** that cannot be achieved through traditional interfaces



Immersive computing technology allows the designer to view and manipulate the geometry while simultaneously observing the effects of these actions on the abstract representation of the product.

How can we better integrate **HUMAN KNOWLEDGE** into decision making?

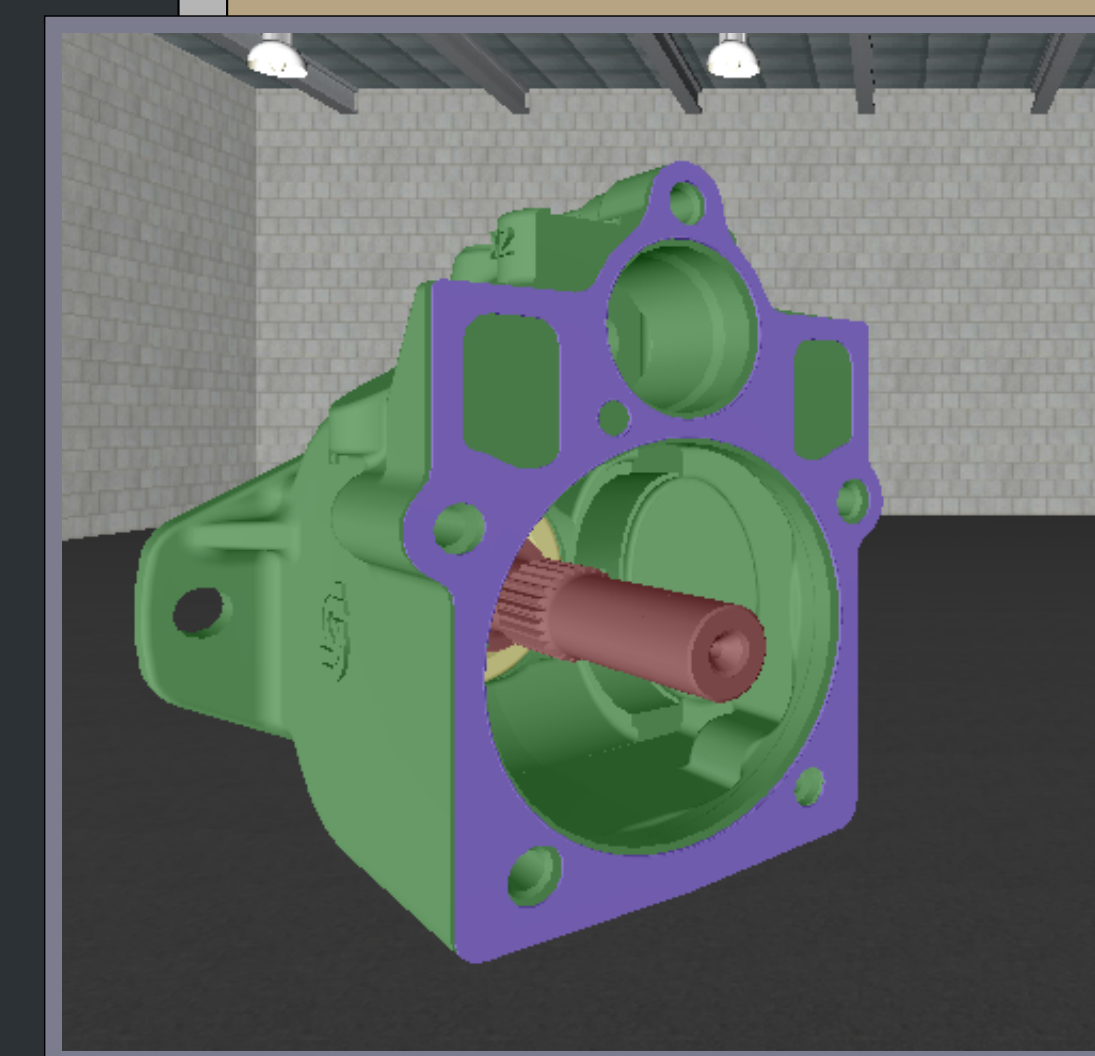


Complex Virtual Geometry: external physical characteristics are not always representative of internal geometry

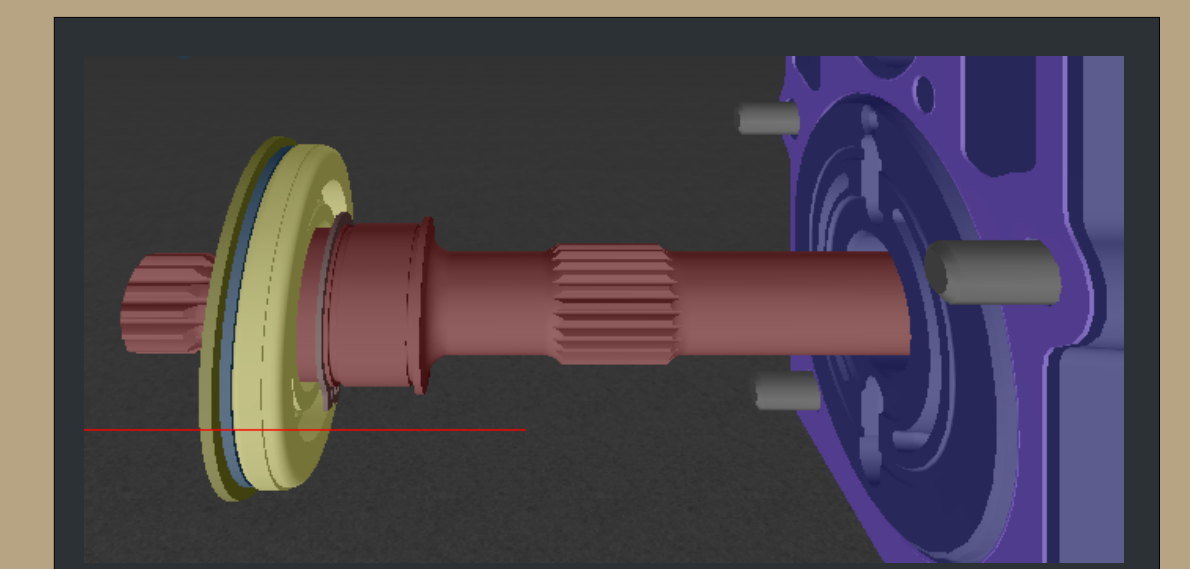
PROGRESS

current research

Current work involves investigating how new methodologies can be employed to impact industry level products. Through interaction and collaboration with relevant industry partners we are able to validate and improve our approaches with real world examples.



Virtual representation of pump assembly



Selected internal components of pump assembly

One project involves applying a disassembly sequence optimization algorithm to better understand how a pump assembly should be taken apart for remanufacture and reuse processes.

future research

Future work will continue to investigate the potential harm associated with naturally present cognitive biases. Additionally, we will concentrate on developing new ways of combating these biases through the use of innovative multimodal displays within immersive computing environments.

Potential questions include:

- How can we help the decision maker remember related product experiences accurately?
- What cognitive biases are closely linked with product disassembly processes?

