1. Background and Motivation

Function modeling is a tool that can be used to map functional requirements of a design problem to the solution space. Research has been done on developing general methods to create function models [1],[2]. However, there is a lack of research focused on understanding how designers create function models. The motivation behind this research is to fill this gap. The goal of this research is to understand how engineers design thinking about mechanical functions by studying their behavior during a function modeling activity.

2. Current Methods

A protocol has been established by previous work in this area. The protocol study is done in an experimental setup as shown in figure 1. A video of the function modeling activity is recorded and later encoded for pattern analysis. The encoding process consists of an element encoding, where each element drawn by the designer is identified and classified; an activity coding which monitors addition, removal or editing of elements; and a topology coding which monitors the sequence of actions.

3. Research Plan

This research will build on the previous work done in this area. The following work is planned
- Improve the experiment protocol
- Create a rubric to evaluate function models. This rubric should have objective measures to evaluate the function structures and have a high agreement between raters
- Incorporate a whiteboard capture system to record the drawing progression.
- Investigate method to capture participant background and determine the effects of individual differences on the way the function structures are modeled.
- Conduct the experiment with more participants
- Increase the number of participants in order to have a statistically significant sample size and capture any differences in modeling techniques that may not be apparent from using less than 10 participants.
- Increase the number of models per participant in order to avoid model bias and to evaluate the impacts of learning.
- Investigate cognitive theories regarding modeling to help understand the results from the studies.
- Conduct a supplementary study to understand the effects of seeding on function structures generated by students.

4. Preliminary Results

In order to improve the experiment protocol, a method to evaluate function structures was explored. A scoring rubric for function structures is provided by Nagel et al in [3]. This rubric was applied to the function structures generated in the previous studies. Questions presented in this rubric are shown in figure 2.

5. Proposed Evaluation Rubric

In order to improve the agreement between raters, a modified rubric has been developed. This rubric is focused on objective questions and allows the raters to provide a range of scores for each question.

6. Future Plans

- Conduct a study to determine inter-rater agreement for the proposed evaluation rubric.
- Conduct a functional modeling activity with whiteboard capture system shown in figure 4.
- Explore problem statements for the experiment and select two problems
- Compile necessary material for conducting the supplementary study

7. Conclusions

As much of the research remains to be done, it is not possible to make major conclusions. From the function structure evaluation study, it was observed that the evaluation rubric presented in [3] did not show strong agreement between raters. Additionally, it was noted that alternative methods for determining inter-rater agreement should be explored.

References

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