Research Plan

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Approximate Convex Decomposition:

Description:

The decomposition of a 3D model consists of defining significant features of the model and splitting the model into significant components. What is a significant component? By looking at the last row of models in the picture below labelled "ACD with Feature Grouping" one can observe that the colored components of the 3D models in the last row are much more logically and usefully grouped than those in the first two rows.



Decomposition can be costly to do, so Approximate Convex Decomposition (ACD) decomposes a model/polygon into approximately convex parts. ACD provides similar benefits to decomposition at a reduced computational cost. ACD can also represent 3D models more accurately by ignoring less important features such as wrinkles and surface texture. On top of providing computational efficacy, ACD provides hierarchical multi-resolution solutions. There are many applications of ACD including particle simulation, mesh generation, motion planning, and skeletonization.

Purpose:

I am interested in ACD because it has a lot of applications in animation and robotics, two topics of interest to me. I hope my C++ and modelling experience will be relevant and help me produce something useful for this project. I am eager to work on a code project of this scale, and I hope my experience on this project will give me credibility when applying for future programming jobs.

Project Goals and Implications:

I plan to work on building a mapping algorithm for translating a cut from a simplified model to the original unsimplified model. During ACD a complex model is simplified to make the decomposition of a model into *significant* parts of the model a simpler process. After the model is simplified, the model is decomposed by making cuts. A cut is basically an edge-loop, or a circle of edges. On a 2D image a cut would be a line.

Improving this mapping algorithm will make for more efficient ACD process. Creating models with a more managable number of components will make manipulating such models simpler and more intuitive. ACD is essentially a simplification process, and by simplifying a model into it's significant components, it will make 3D interaction that much more simple in any field of study.

Personal Goals:

I am eager to work on a code project of this scale, and I hope my experience on this project will contribute to my problem-solving skills as a programmer. I plan to pursue a career in computer science, I am convinced I am going to go to grad school and do research, and I may also continue to study robotics.

Approach: My work will be broken down into several phases as listed below:

* Learning and Development

i. Become familiar with existing ACD algorithms and architectureii. In depth analysis of existing simplification algorithm, run and test simplification algorithm.

iii. Run ACD algorithm on a

simplified model.

iv. Analysis of results.

* Design and Implementation

i. Integrate ACD and simplification.

ii. Propose a mapping algorithm for translating a cut generated on a simplified model to the original model.

- iii. Refining
- iv. Implementation

* Testing and Analysis

- i. Code Testing
- ii. Bug fixing

- iii. Comparison
- iv. Analysis

* Documentation

- i. Create Poster Presentation Draft
- ii. Give poster presentation.
- iii. Write abstract and final paper.

* Deliverables and Dates:

- June 7: Research Plan dueJune 15: Complete learning and development phaseJuly 12: Poster PresentationsJuly 20: Complete design and implementation phaseJuly 24: Complete testing and analysis phaseJuly 25: Abstract dueJuly 31: Complete documentation phaseAugust 1: Research paper due
- August 2: Final Evaluation due

Faculty Mentor:

Project Goals:

The research will help in decomposition of very large geometric models more efficiently.

Below are the major goals involved in the project:

- * Integration of ACD with the simplification algorithm
- * A method for mapping the decomposition on a simplified counterpart of a large complex model back to the original model.

Student Mentee Goals

The student can be assessed on the following:

- * Literature Review
- * Design and Implementation of an efficient algorithm
- * Analysis of the results
- * Presentation