Browser Based Constructive Solid Geometry for Anatomical Models

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Team Members

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Motivation

- 1 in 323 children are born with cerebral palsy in US
- 2 in 3 could walk if they had proper orthotic devices
- Ankle foot orthotic device
 - Corrects gait and prevents deformities
- Create orthosis using scan

USIFORM

- 10 hour process in SolidWorks
- Our goal: browser-based software to drastically reduce this time

Motivation

Deliverables

Demo



Milestones Bibliography

Specific Goals

- Browser-based CSG application (demo later)
- Significantly reduce the amount of time required to design full cast
- Simpler and easier for clinicians





Original Deliverables

- Minimum
 - three.js "playground" in browser using constructive solid geometry algorithms for simple objects (sphere, cube, prism, etc)

Deliverables

Demo

Milestones

Bibliography

- sphere/cube addition algorithm
- CSG union algorithm
- CSG intersect algorithm
- CSG subtract algorithm
- Mesh modification module for simple objects
- Expected
 - Mesh modification module for anatomical scans
 - Mesh cutting algorithm

FUSIFORM

- Mesh smoothing algorithm
- Mesh simplification algorithm
- Watertight mesh algorithm
- Maximum
 - Test cast fabrication using a 3D printer and test "fits" on patients

New Deliverables

- Minimum
 - three.js "playground" in browser using constructive solid geometry algorithms for simple objects (sphere, cube, prism, etc)
 - sphere/cube addition algorithm ✓
 - CSG union algorithm
 - CSG intersect algorithm
 - CSG subtract algorithm
 - Mesh modification module for simple objects
 - Playground with mesh importing (for .stl files)* ✓
- Expected
 - Mesh modification module for anatomical scans (in progress)
 - Mesh cutting algorithm (in progress)
 - Mesh smoothing algorithm
 - Mesh simplification algorithm
 - Watertight mesh algorithm (in progress)
 - Mesh scaling (in progress)*
 - Playground with mesh exporting*

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- Maximum
 - Test cast fabrication using a 3D printer and test "fits" on patients

Motivation

Playground with improved usability - sliders (to change parameters), rotation of objects independently of axis*

Deliverables

Demo

**Documentation found in Wiki

Milestones

Bibliography





Old Milestones

FUSIFORM

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Deliverables

Demo

Milestones

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Deliverables

Demo

Milestones

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Completed Milestones

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Deliverables

Demo

Motivation

Bibliography

Milestones

Dependencies

Minimum/Expected:

USIFORM

 Three.js - 3D Javascript library used to interface with WebGL - Open Source library

Deliverables

Demo

Milestones

Bibliography

- Anatomical scans of legs using iPad mounted scanner Mentors ✓
- The Visualization and Computer Graphics Library for mesh modification algorithms (in C/C++) - Available online ✓
- Emscripten to port C/C++ code to Javascript Available online ✔
- ThreeBSP.js to perform CSG Available online ✔

Remaining Challenges

- Memory issues when loading multiple large meshes
 - preallocate memory
- Speed issues when running CSG on large meshes
 - simplifying CSG
- Random points and faces appear inside of loaded meshes
 - propagate through mesh and delete disconnected points
- Mesh Color
 - calculating normals



Next Steps

- Water tight and scaling
- Improving UI and usability (exporting, sliders, rotation, inputs, etc)
- Automating process



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Deliverables

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Milestones

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