THE UNIVERSITY OF TEXAS AT DALLAS

Wearable Inertial Measurement Unit (IMU) Shoe for Gait Analysis

Group 10

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Guided by

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Computer Aided Design

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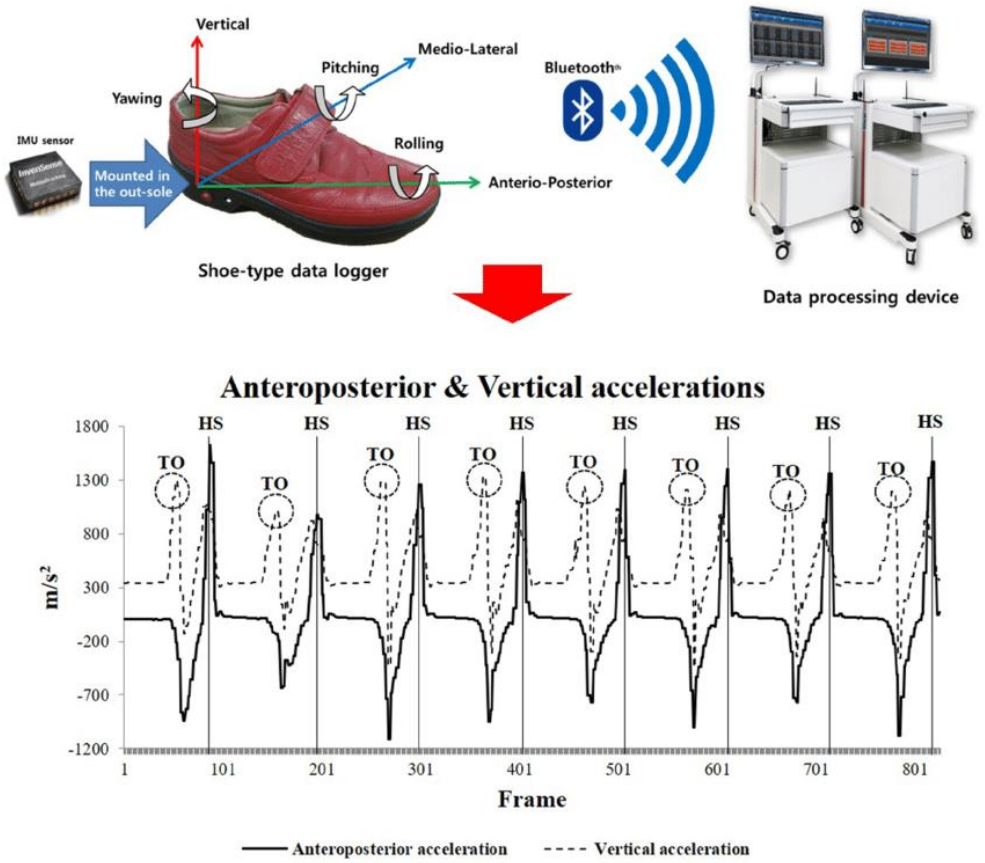
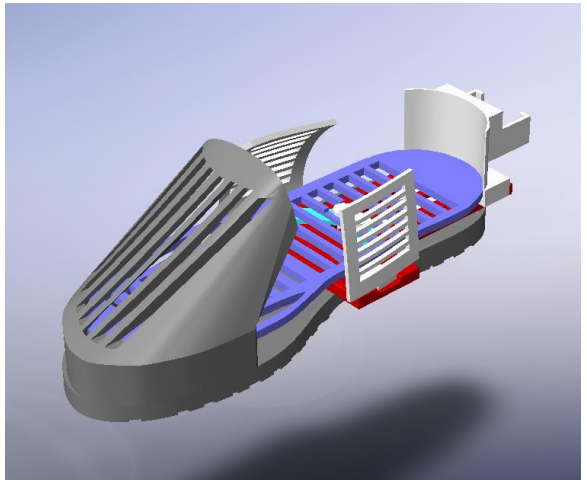
Background

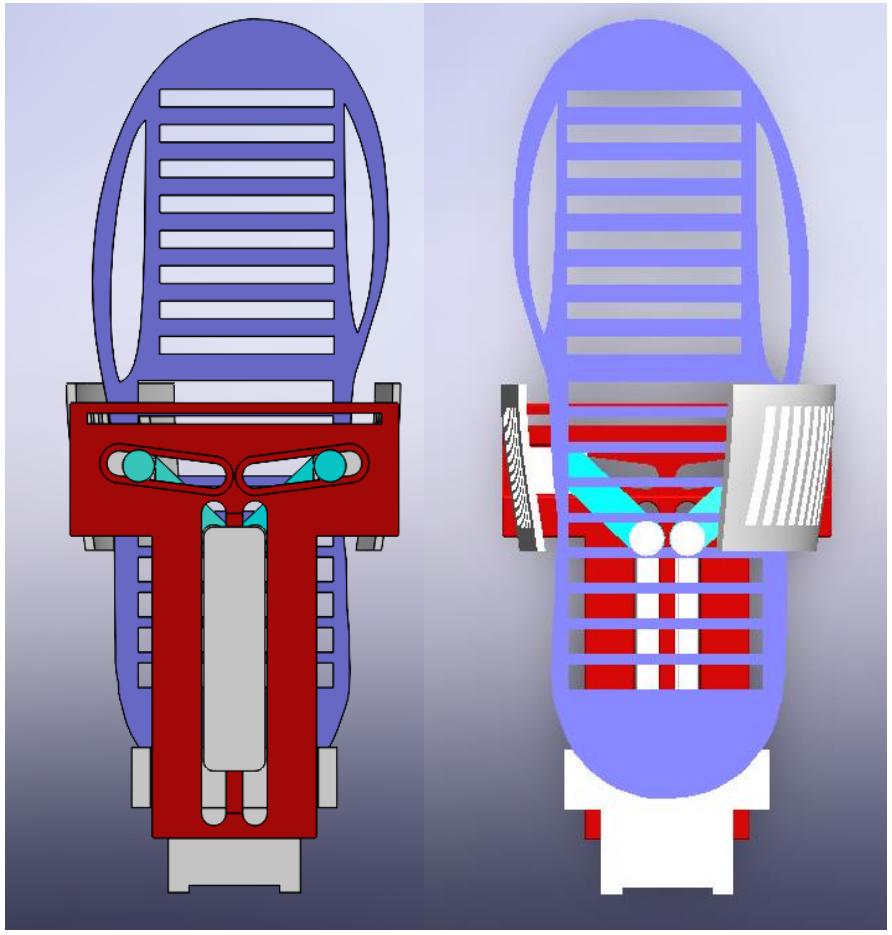
- Inertial measurement units (IMU) are electronic devices that contain accelerometers and gyroscopes to measure acceleration, angular rates, and orientation.
- IMU-based gait analysis uses this data to identify phases of the gait cycle during walking or running. This technology is not only helpful in the field of sports analysis but also the detection of early onset Parkinson's disease.
- The goal of this project was to design, analyze and develop a CAD model of a 3D-printable shoe with a mount for a wireless Inertial Measurement Unit and make the design modular, so the shoe could accommodate different foot sizes.



Schematic diagram for the working system

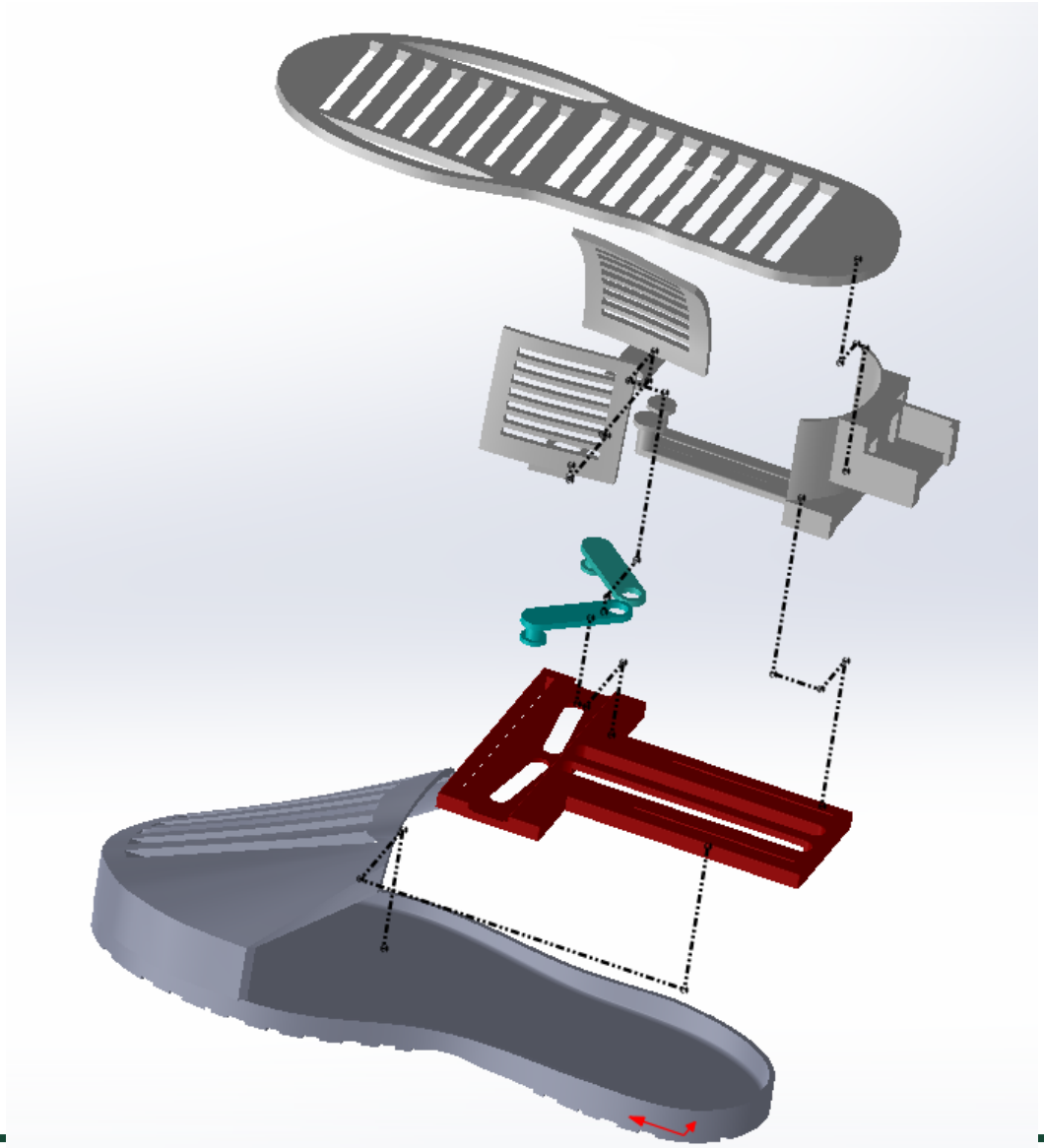
Overall Assembly

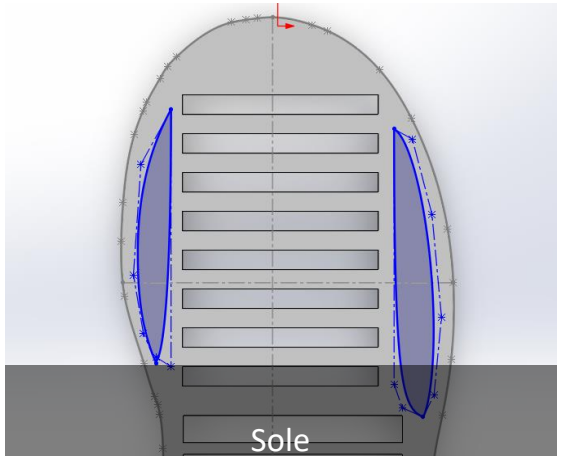


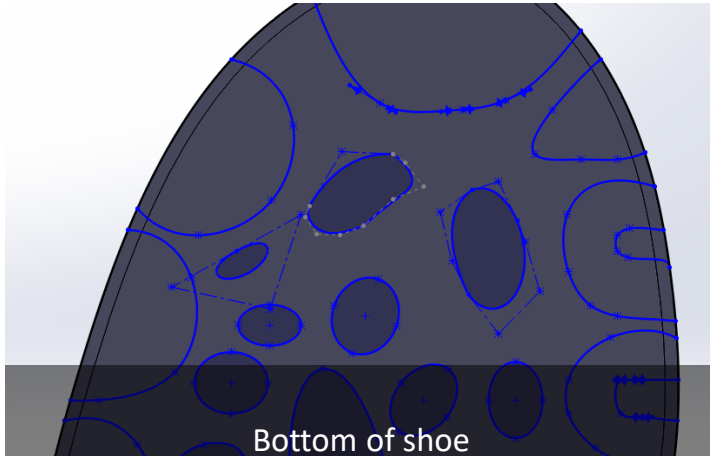


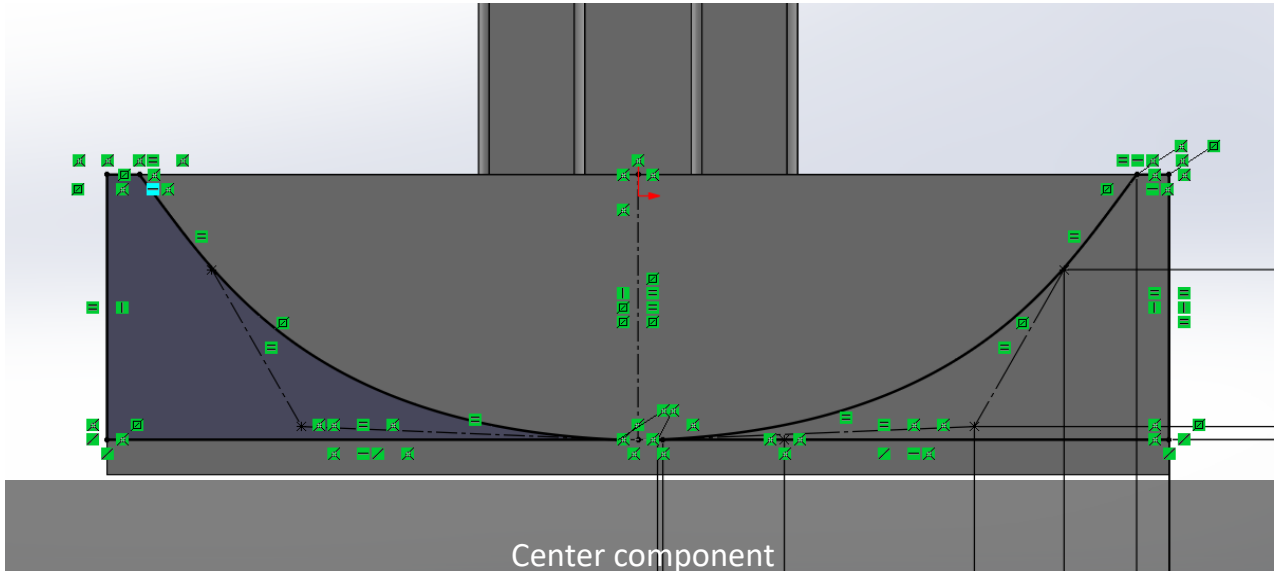
- 3 subassemblies for printing: center, sole, top/bottom
  - Center: ABS
  - Sole and top/bottom: TPU

Exploded View



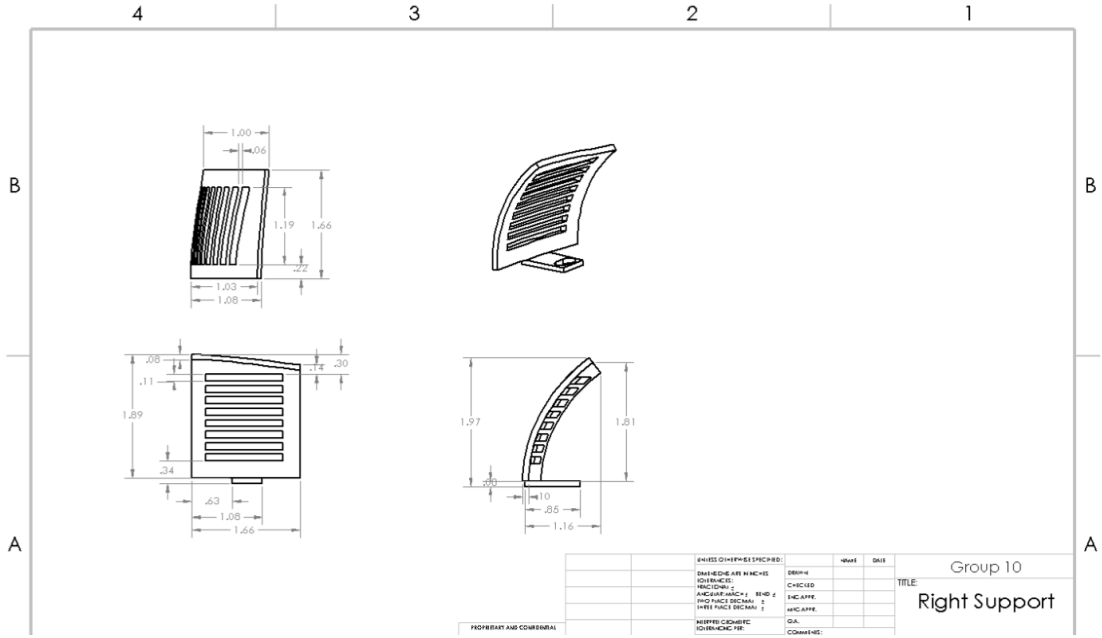


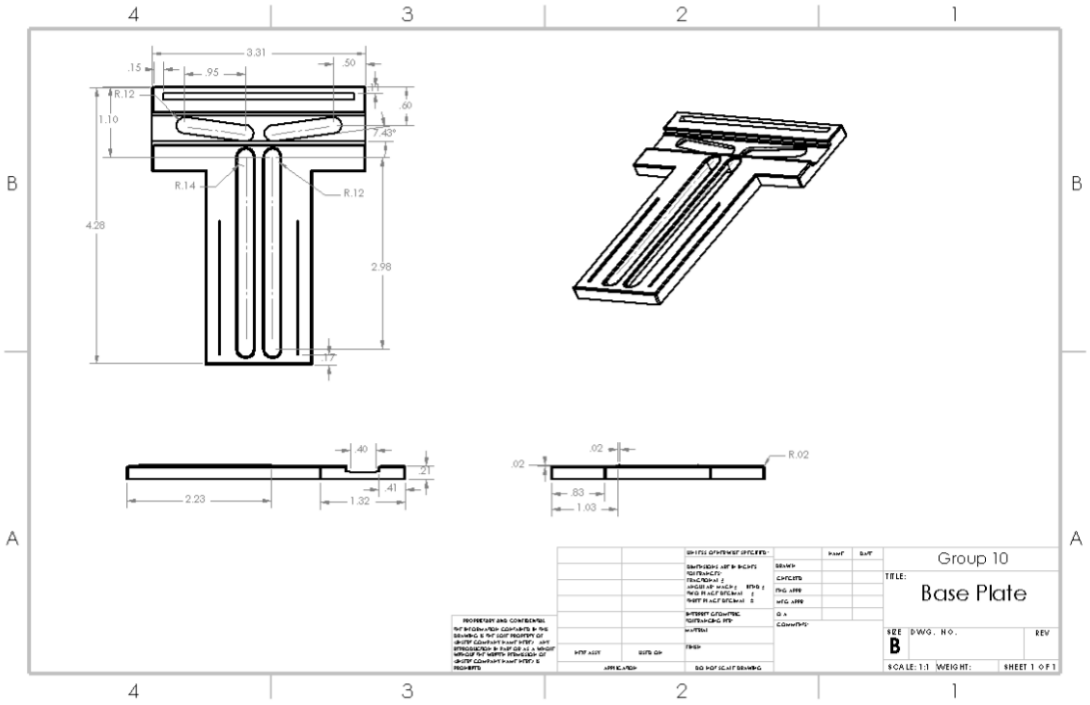


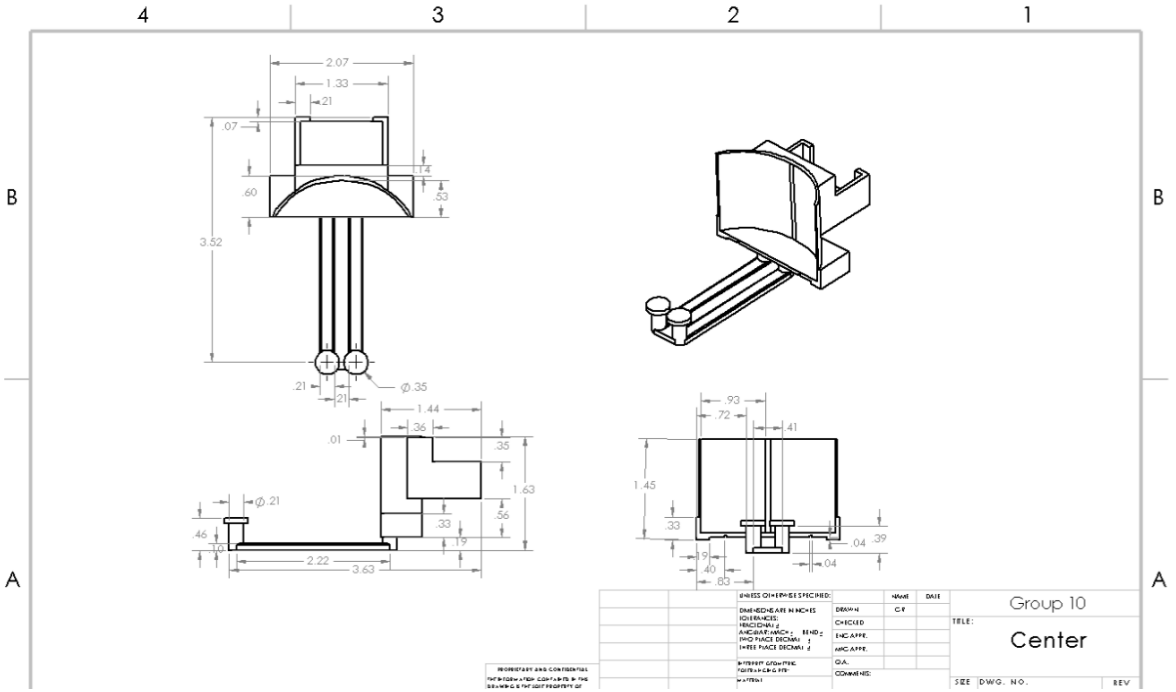


Parts with Parametric Curves

Drawings

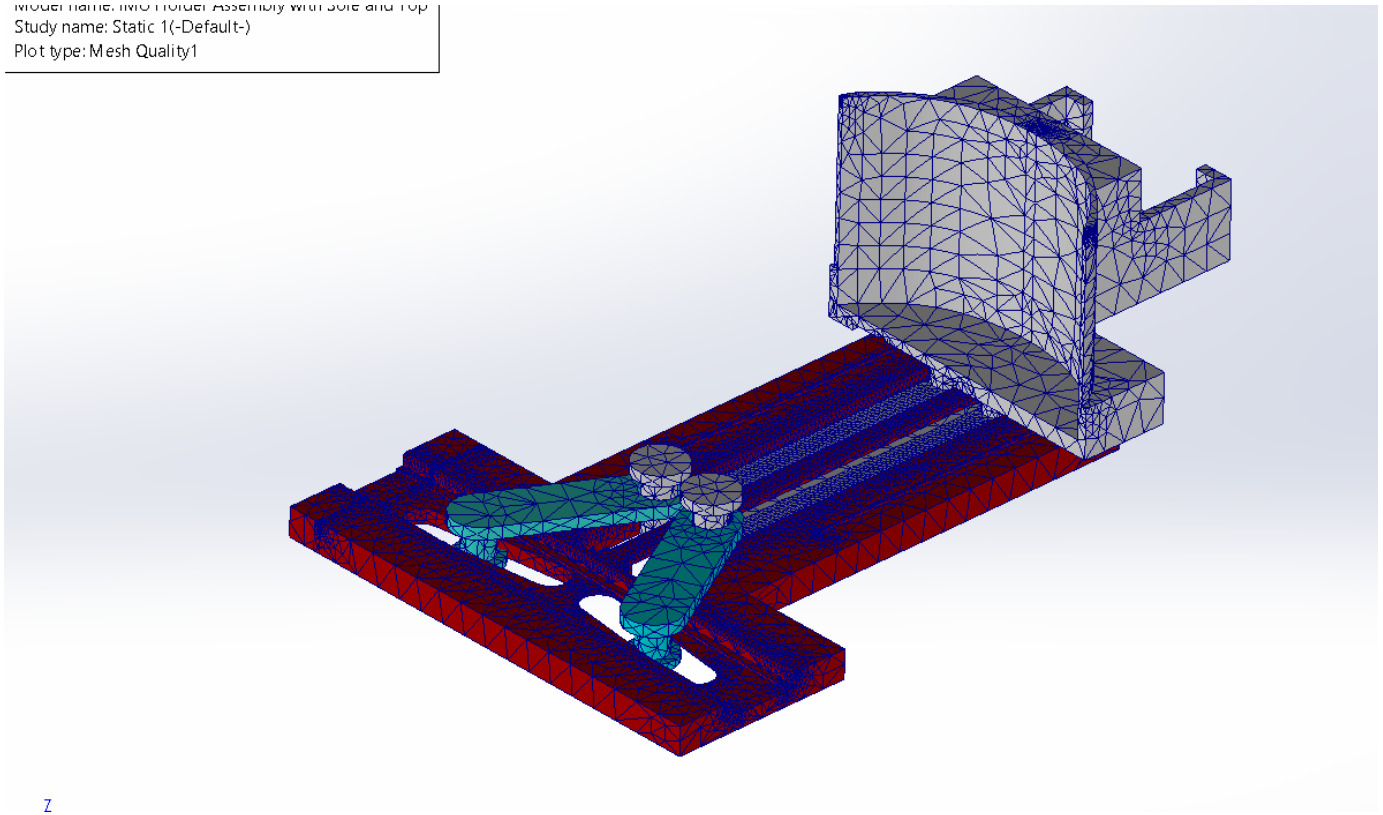






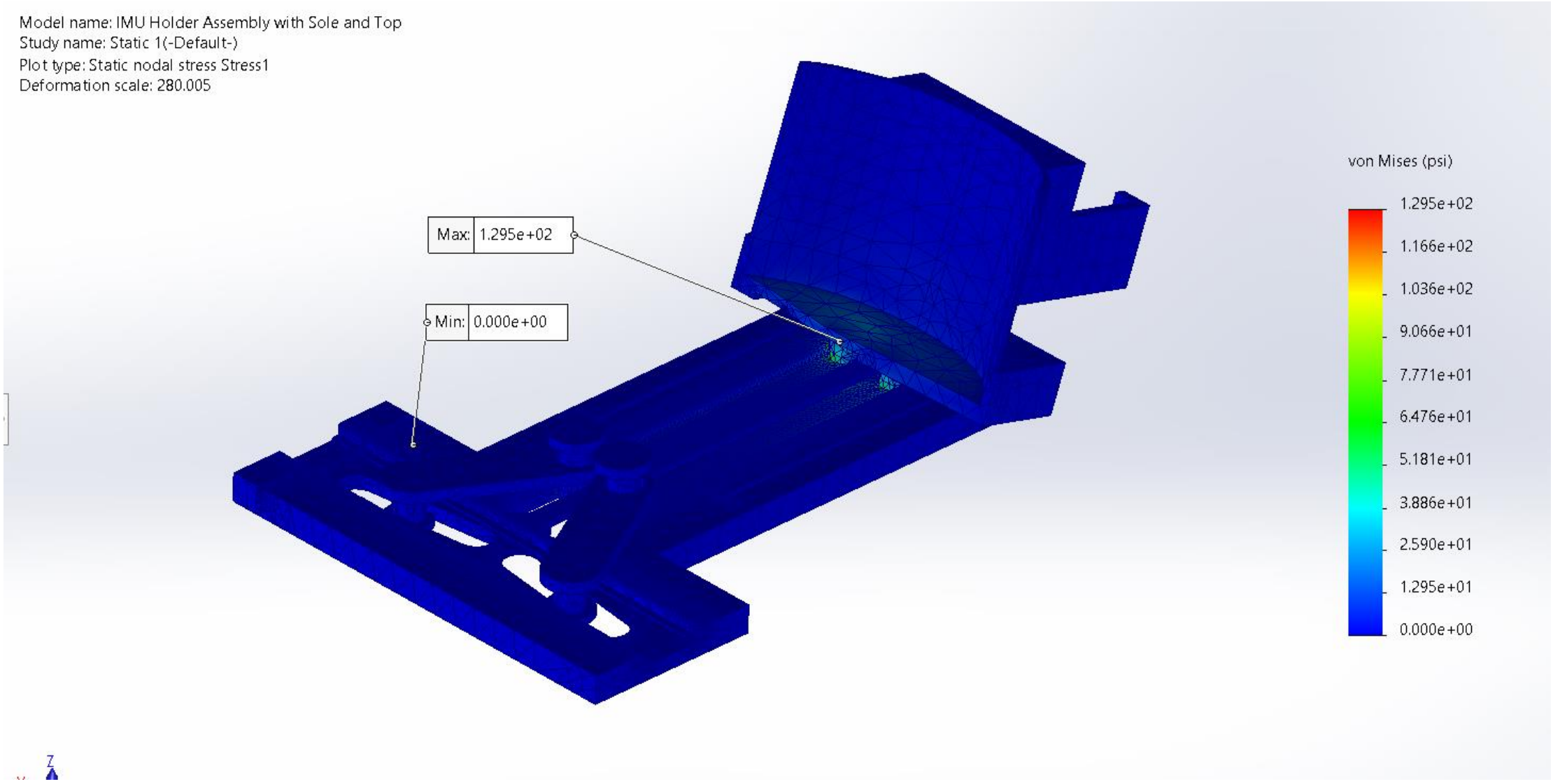
Animation

Simulation

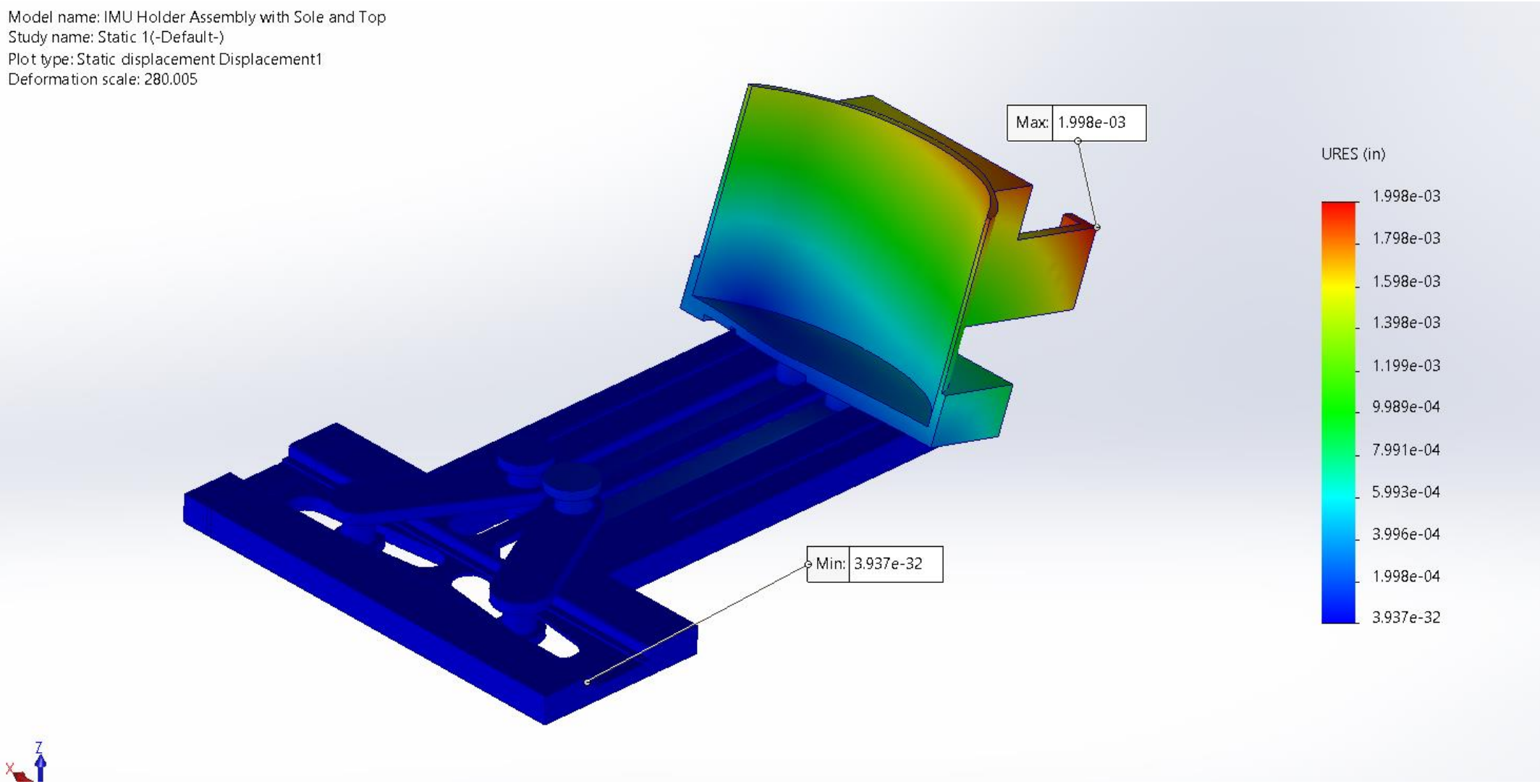


Mesh Details

Study name	Static 1* (-Default-)
DetailsMesh type	Solid Mesh
Mesher Used	Standard mesh
Automatic Transition	On
Include Mesh Auto Loops	On
Jacobian points for High quality mesh	16 points
Element size	0.176407 in
Tolerance	0.00882035 in
Mesh quality	High
Total nodes	94135
Total elements	53659
Maximum Aspect Ratio	77.002
Percentage of elements with Aspect Ratio < 3	86.5
Percentage of elements with Aspect Ratio > 10	0.212
Percentage of distorted elements	0
Number of distorted elements	0
Remesh failed parts independently	On
Time to complete mesh(hh:mm:ss)	00:00:03
Computer name	


Model name: IMU Holder Assembly with Sole and Top
Study name: Static 1(-Default-)
Plot type: Static nodal stress Stress1
Deformation scale: 280.005
Max: 1.295e+02
Min: 0.000e+00
von Mises (psi)
1.295e+02
1.166e+02
1.036e+02
9.066e+01
7.771e+01
6.476e+01
5.181e+01
3.886e+01
2.590e+01
1.295e+01
0.000e+00
Z

Model name: IMU Holder Assembly with Sole and Top
Study name: Static 1(-Default-)
Plot type: Static displacement Displacement1
Deformation scale: 280.005



Challenges

Due to the volume constraint in the project specifications (<8 in^3), several changes had to be made to the design. These included the following:

- Shoe could not be enclosed
- Slots and holes were created in each part
- The entire assembly had to be scaled down
- A mount for the IMU was used rather than a housing and moved to the rear
- Creating small moving parts with 3D printing was challenging

Thank You

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