Stress Analysis Report

Analyzed File:	Assemby 3.iam
Autodesk Inventor Version:	2023 (Build 270158000, 158)
Creation Date:	7/4/2022, 6:02 PM
Study Author:	earls
Summary:	

Static Analysis:1

General objective and settings:

Design Objective	Single Point
Study Type	Static Analysis
Last Modification Date	7/4/2022, 5:22 PM
Model State	[Primary]
Design View	Default
Positional	[Primary]
Detect and Eliminate Rigid Body Modes	No
Separate Stresses Across Contact Surfaces	No
Motion Loads Analysis	No

iProperties

Summary

Author	earls

Project

Part Number	Assemby 3
Designer	earls
Cost	$0.00
Date Created	6/30/2022

Status

Design Status	WorkInProgress

Physical

Mass	2.04222 kg
Area	521050 mm^2
Volume	756378 mm^3
Center of Gravity	x=-5.11334 mm y=-5.76516 mm z=26.0107 mm

Note: Physical values could be different from Physical values used by FEA reported below.

Mesh settings:

Avg. Element Size (fraction of model diameter)	0.1
Min. Element Size (fraction of avg. size)	0.2
Grading Factor	1.5
Max. Turn Angle	60 deg
Create Curved Mesh Elements	No
Use part based measure for Assembly mesh	Yes

Material(s)

Name	Aluminum 6061	
General	Mass Density	2.7 g/cm^3
	Yield Strength	275 MPa
	Ultimate Tensile Strength	310 MPa
Stress	Young's Modulus	68.9 GPa
	Poisson's Ratio	0.33 ul
	Shear Modulus	25.9023 GPa
Part Name(s)	Bottom plate 2.5mm.ipt Servo arm.ipt Test flange.ipt Servo.ipt Part2.ipt Rod qty-6.ipt Part1.ipt Moving platform.ipt	

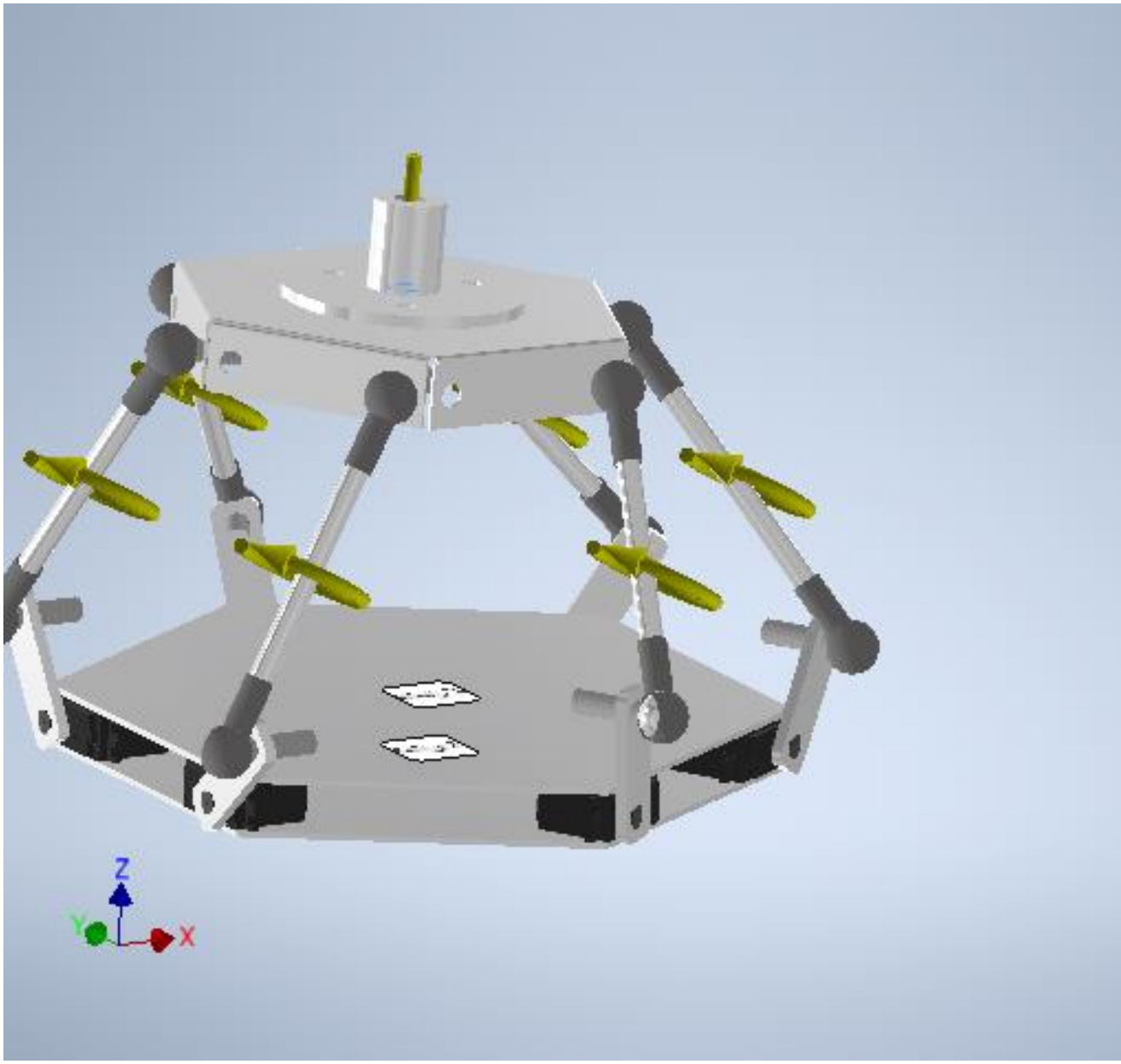
Operating conditions

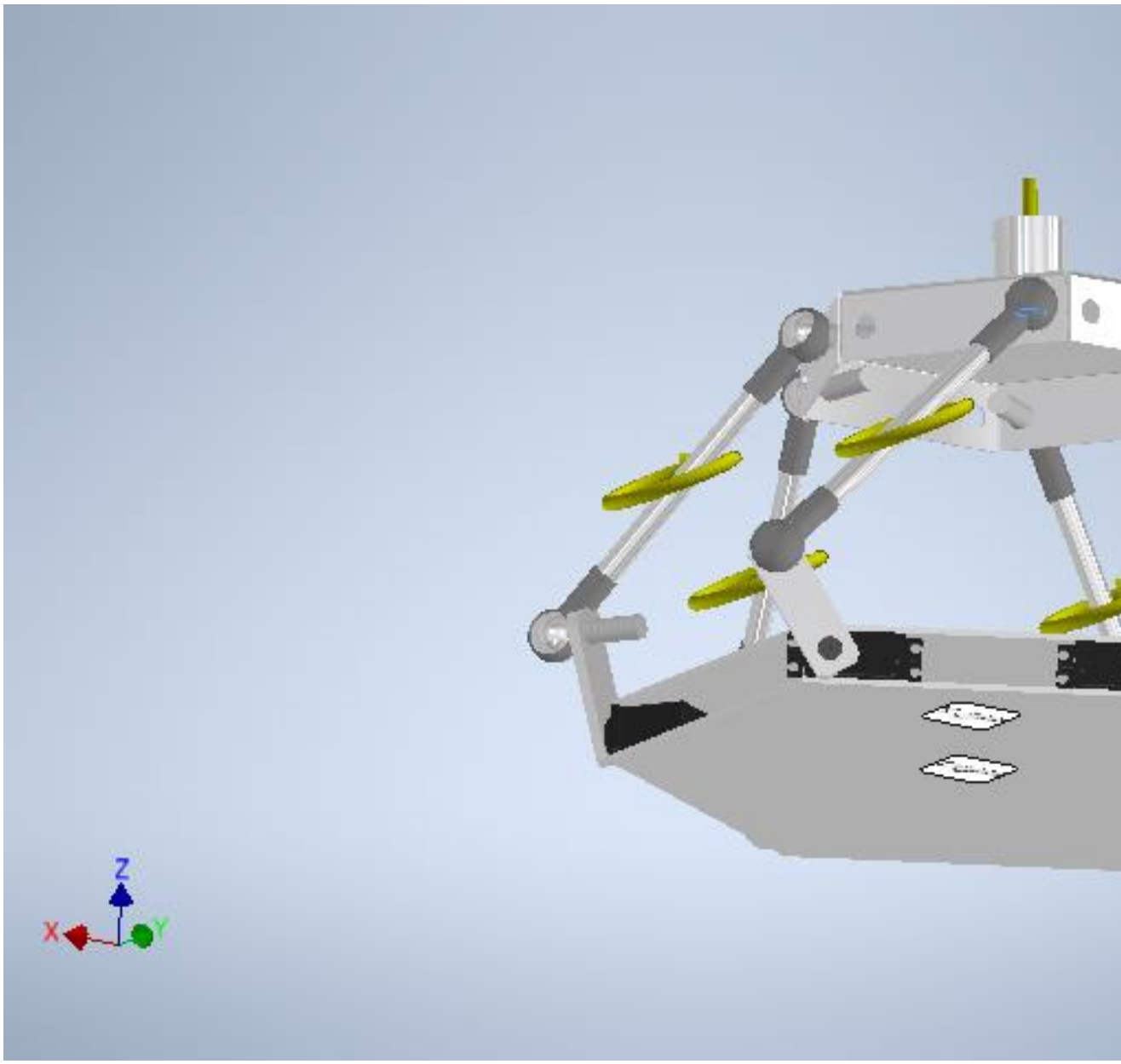
Force:1

Load Type	Force
Magnitude	20.000 N
Vector X	-1.205 N

Vector Y	-0.287 N
Vector Z	-19.962 N

Selected Face(s)

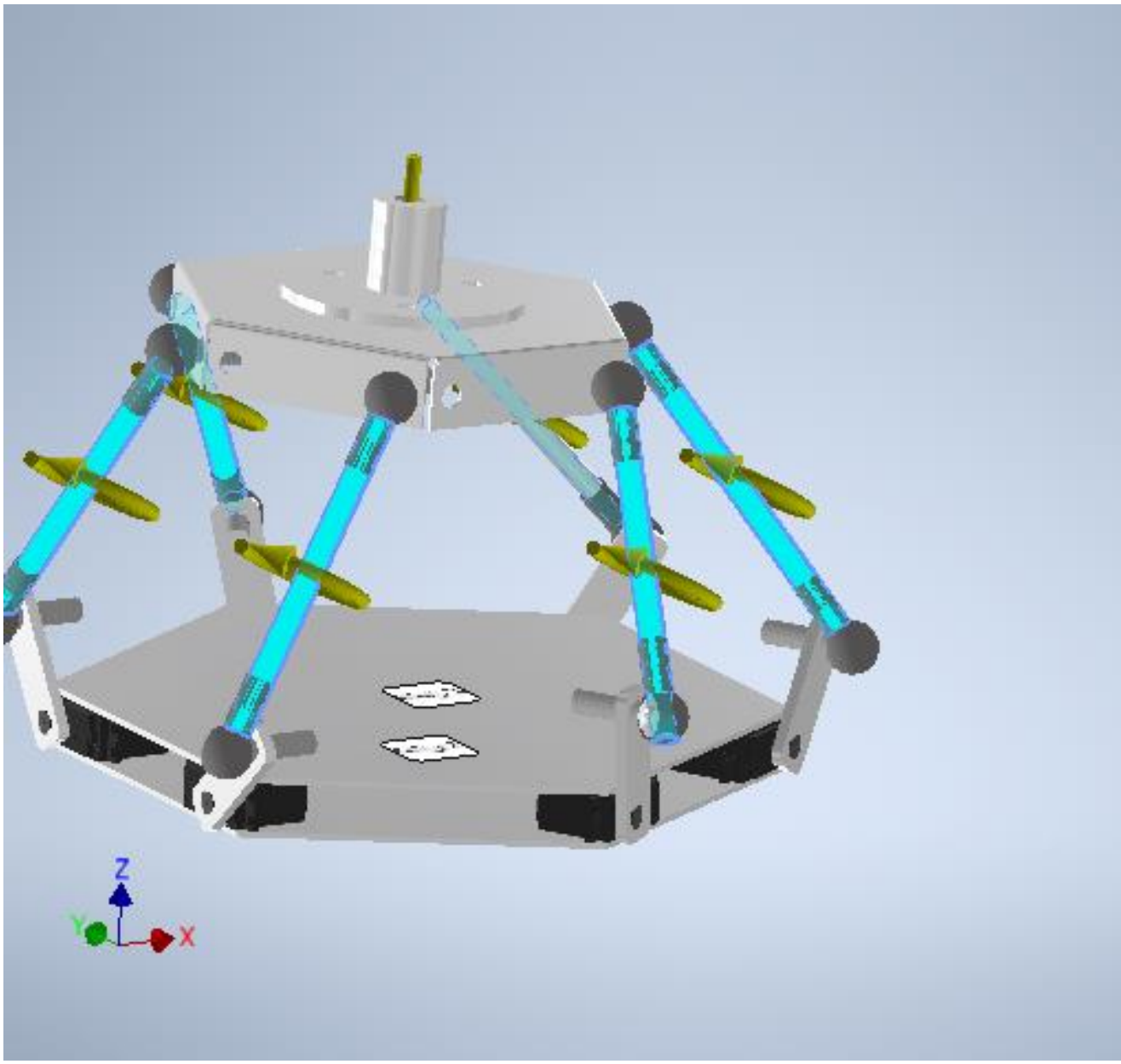


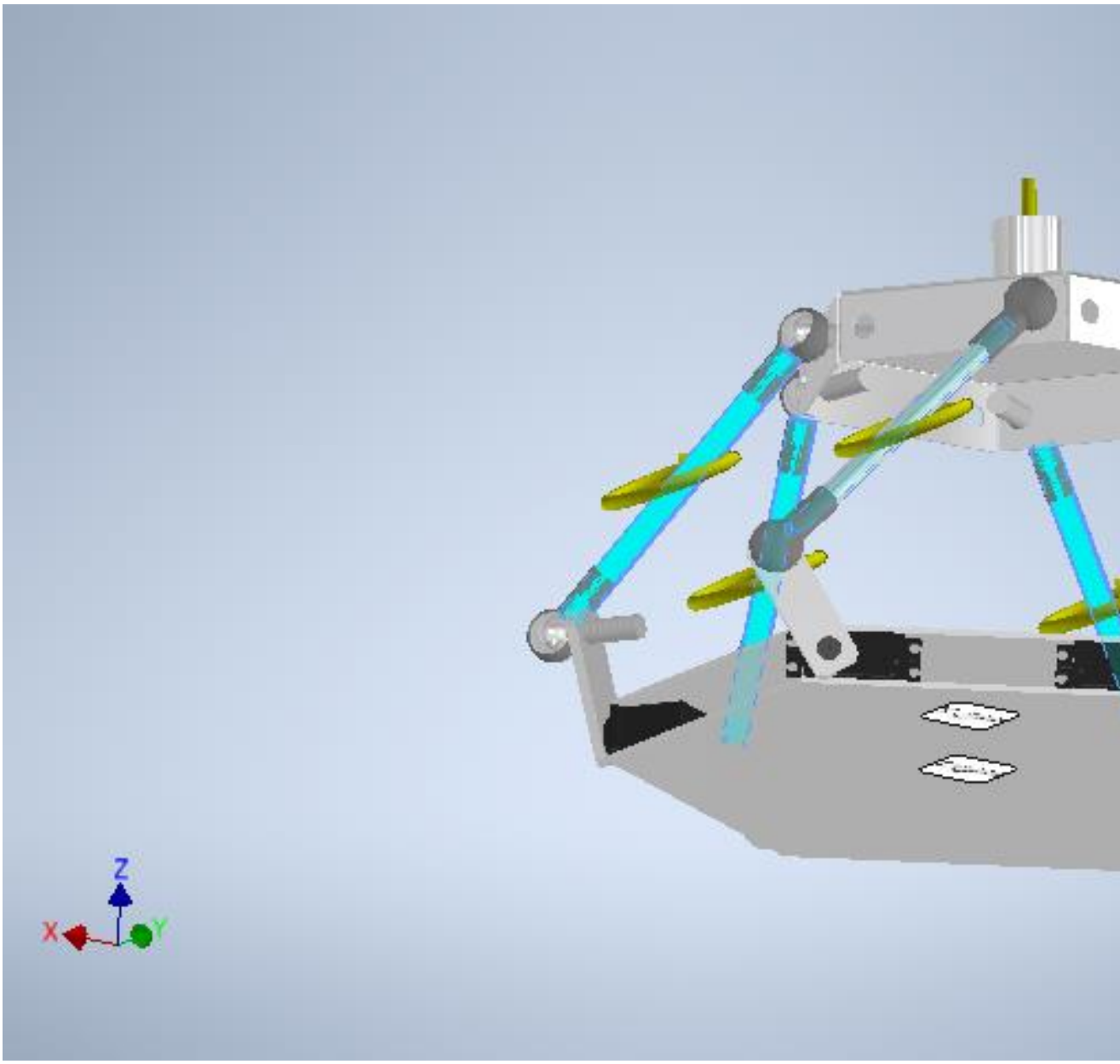


Moment:1

Load Type	Moment
Magnitude	10.000 N mm
Vector X	-4.993 N mm
Vector Y	-0.834 N mm
Vector Z	-8.624 N mm

Selected Face(s)

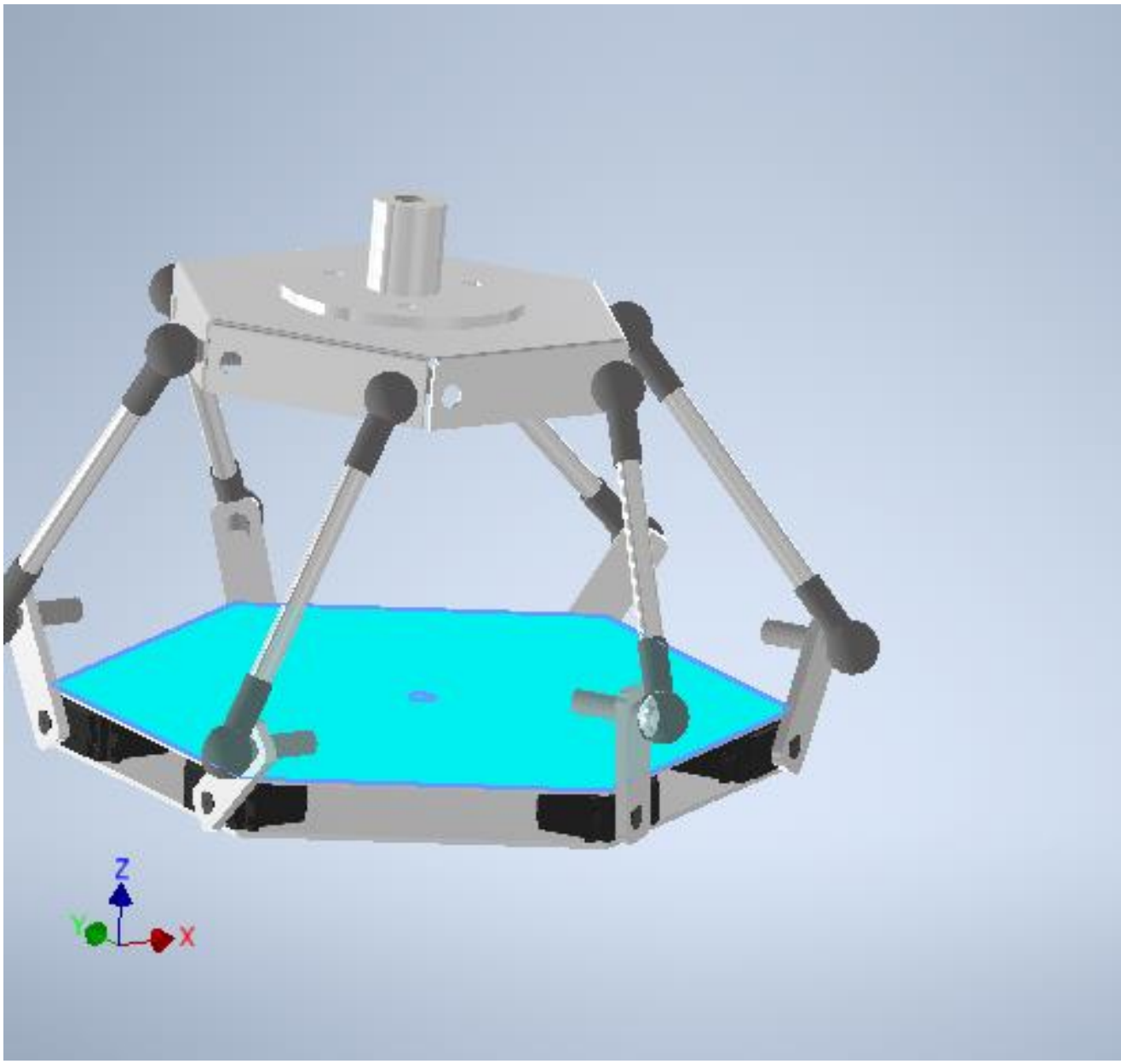

Z
Y
X

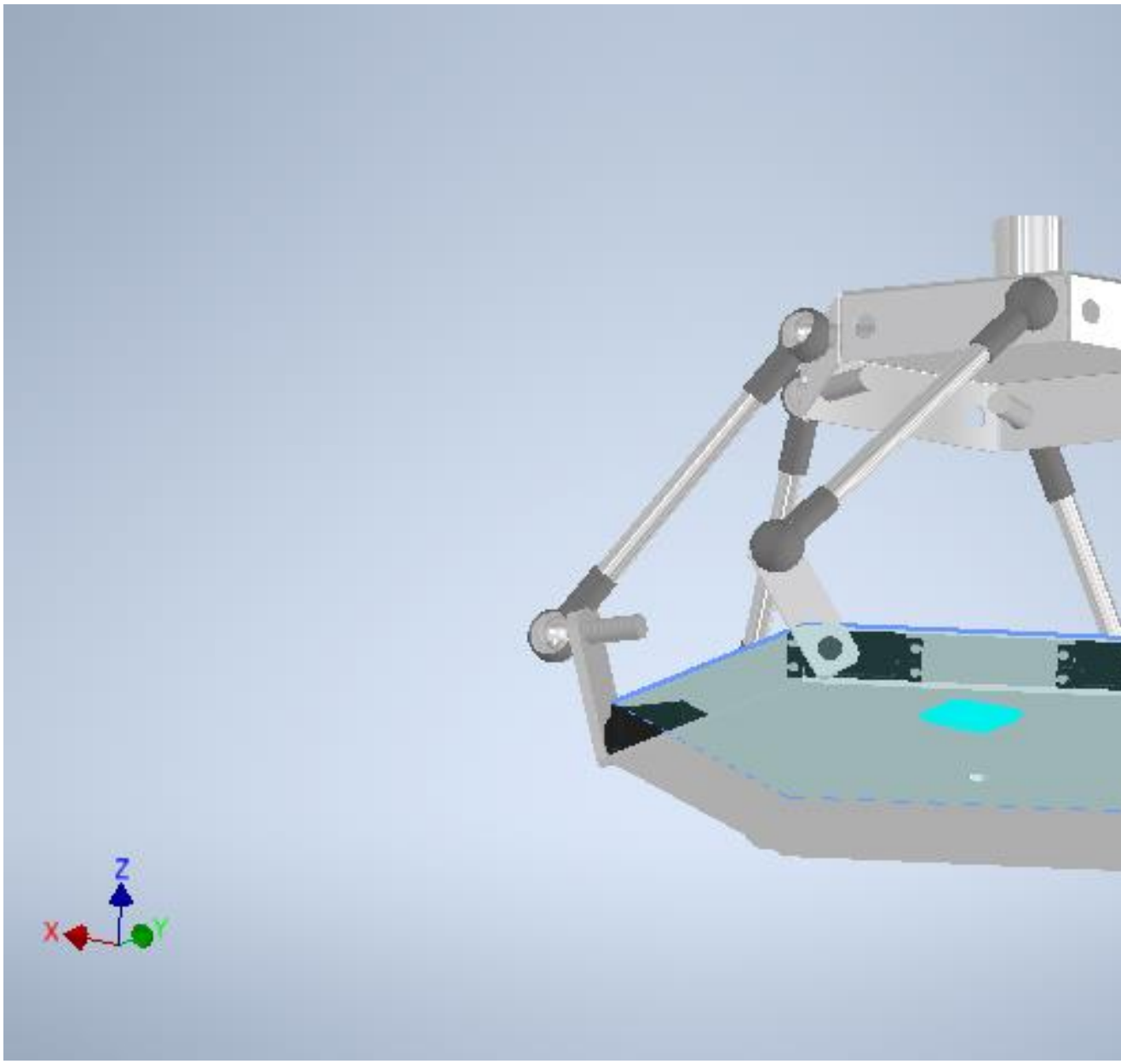


Fixed Constraint:1

Constraint Type	Fixed Constraint

Selected Face(s)

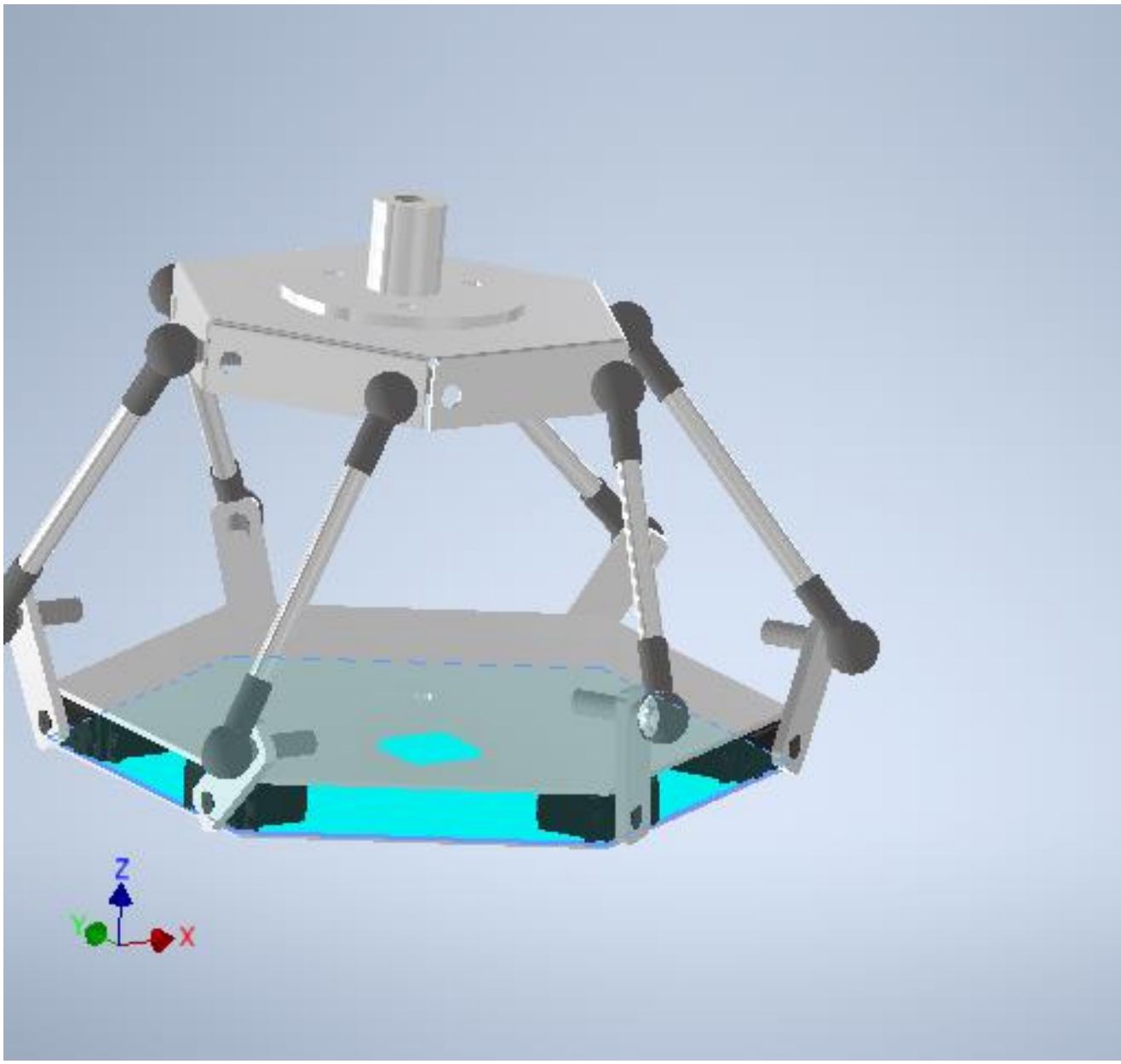

Z
Y
X

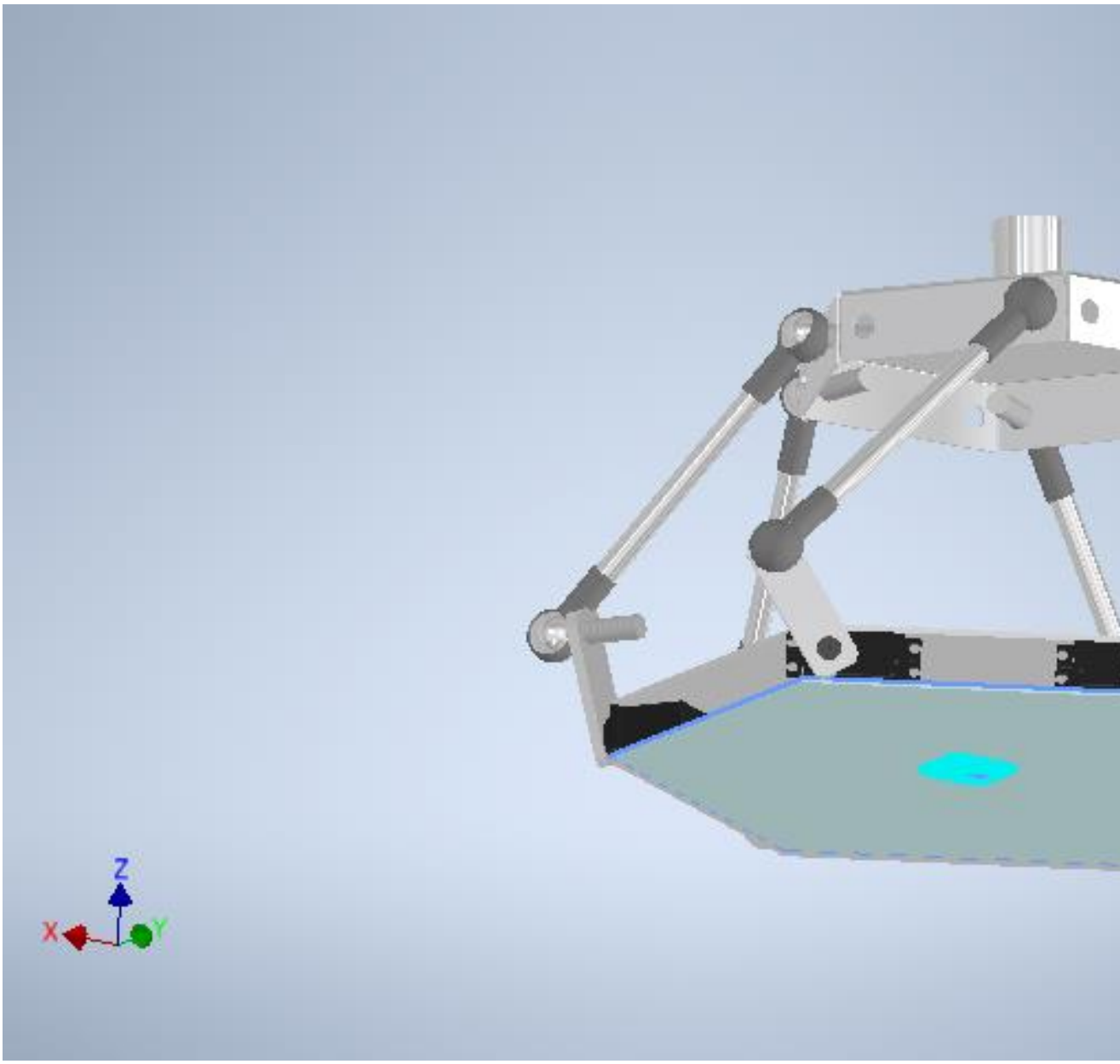


Fixed Constraint:2

Constraint Type	Fixed Constraint

Selected Face(s)


Z
Y
X



Contacts (Bonded)

Name	Part Name(s)
Bonded:1	Stewart Assembly:1/Servo:5 Stewart Assembly:1/Servo arm:1
Bonded:2	Stewart Assembly:1/Servo:2 Stewart Assembly:1/Servo arm:5
Bonded:3	Stewart Assembly:1/Servo:4 Stewart Assembly:1/Servo arm:2
Bonded:4	Stewart Assembly:1/Servo:3 Stewart Assembly:1/Servo arm:6

Bonded:5	Stewart Assembly:1/Servo:7 Stewart Assembly:1/Servo arm:4
Bonded:6	Stewart Assembly:1/Servo:6 Stewart Assembly:1/Servo arm:3
Bonded:7	Moving platform:1 Part2:11
Bonded:8	Moving platform:1 Part2:7
Bonded:9	Moving platform:1 Part2:3
Bonded:10	Moving platform:1 Part2:9
Bonded:11	Moving platform:1 Part2:1
Bonded:12	Moving platform:1 Part2:6
Bonded:13	Part1:12 Rod qty-6:6
Bonded:14	Part1:1 Rod qty-6:1
Bonded:15	Part1:2 Rod qty-6:1
Bonded:16	Part1:8 Rod qty-6:4
Bonded:17	Part1:7 Rod qty-6:4
Bonded:18	Part1:5 Rod qty-6:3
Bonded:19	Part1:6 Rod qty-6:3
Bonded:20	Part1:9 Rod qty-6:5
Bonded:21	Part1:10 Rod qty-6:5
Bonded:22	Part1:11 Rod qty-6:6
Bonded:23	Part1:9 Rod qty-6:5
Bonded:24	Part1:8 Rod qty-6:4
Bonded:25	Part1:7 Rod qty-6:4
Bonded:26	Part1:6 Rod qty-6:3

Bonded:27	Part1:5 Rod qty-6:3
Bonded:28	Part1:12 Rod qty-6:6
Bonded:29	Part1:10 Rod qty-6:5
Bonded:30	Part1:2 Rod qty-6:1
Bonded:31	Part1:11 Rod qty-6:6
Bonded:32	Part1:1 Rod qty-6:1
Bonded:33	Moving platform:1 Test flange:1
Bonded:34	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:3
Bonded:35	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:6
Bonded:36	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:4
Bonded:37	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:7
Bonded:38	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:5
Bonded:39	Stewart Assembly:1/Bottom plate 2.5mm:1 Stewart Assembly:1/Servo:2
Bonded:40	Stewart Assembly:1/Servo arm:3 Part2:2
Bonded:41	Stewart Assembly:1/Servo arm:4 Part2:12
Bonded:42	Stewart Assembly:1/Servo arm:5 Part2:8
Bonded:43	Stewart Assembly:1/Servo arm:6 Part2:10
Bonded:44	Stewart Assembly:1/Servo arm:2 Part2:5
Bonded:45	Stewart Assembly:1/Servo arm:1 Part2:4
Bonded:46	Stewart Assembly:1/Servo arm:3 Part1:1
Bonded:47	Stewart Assembly:1/Servo:7 Stewart Assembly:1/Servo arm:4
Bonded:48	Stewart Assembly:1/Servo:5 Stewart Assembly:1/Servo arm:1

Bonded:49	Stewart Assembly:1/Servo:4 Stewart Assembly:1/Servo arm:2
Bonded:50	Stewart Assembly:1/Servo:3 Stewart Assembly:1/Servo arm:6
Bonded:51	Stewart Assembly:1/Servo:2 Stewart Assembly:1/Servo arm:5
Bonded:52	Stewart Assembly:1/Servo:6 Stewart Assembly:1/Servo arm:3
Bonded:53	Stewart Assembly:1/Servo:5 Stewart Assembly:1/Servo arm:1
Bonded:54	Stewart Assembly:1/Servo:2 Stewart Assembly:1/Servo arm:5
Bonded:55	Stewart Assembly:1/Servo:6 Stewart Assembly:1/Servo arm:3
Bonded:56	Stewart Assembly:1/Servo:7 Stewart Assembly:1/Servo arm:4
Bonded:57	Stewart Assembly:1/Servo:5 Stewart Assembly:1/Servo arm:1
Bonded:58	Stewart Assembly:1/Servo:4 Stewart Assembly:1/Servo arm:2
Bonded:59	Stewart Assembly:1/Servo:3 Stewart Assembly:1/Servo arm:6
Bonded:60	Stewart Assembly:1/Servo:7 Stewart Assembly:1/Bottom plate 2.5mm:2
Bonded:61	Stewart Assembly:1/Servo:5 Stewart Assembly:1/Bottom plate 2.5mm:2
Bonded:62	Stewart Assembly:1/Servo:2 Stewart Assembly:1/Bottom plate 2.5mm:2
Bonded:63	Rod qty-6:2 Part1:3
Bonded:64	Rod qty-6:2 Part1:4
Bonded:65	Stewart Assembly:1/Servo:6 Stewart Assembly:1/Bottom plate 2.5mm:2
Bonded:66	Stewart Assembly:1/Servo:4 Stewart Assembly:1/Bottom plate 2.5mm:2
Bonded:67	Stewart Assembly:1/Servo:3 Stewart Assembly:1/Bottom plate 2.5mm:2

Results

Reaction Force and Moment on Constraints

Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)

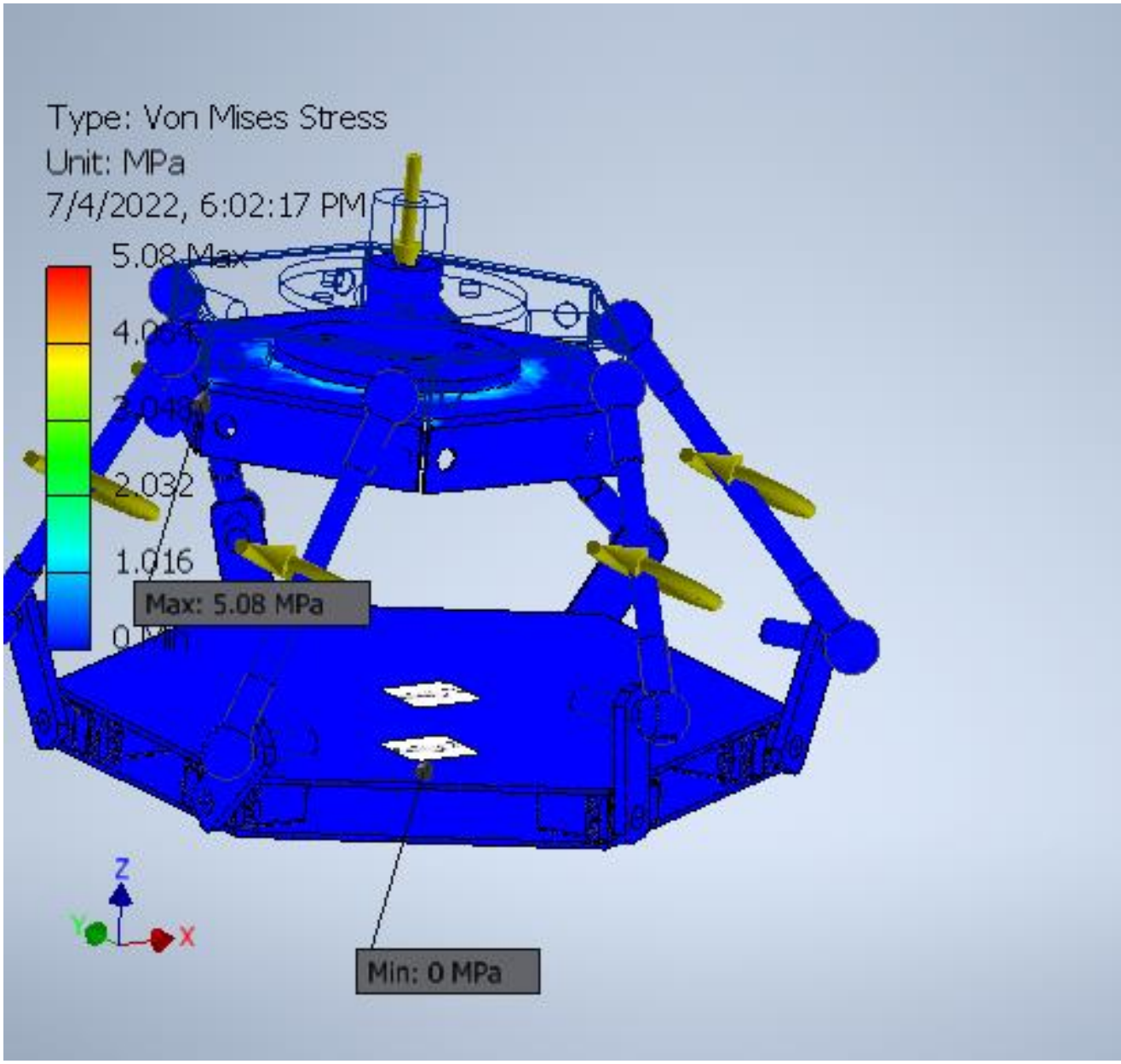
Fixed Constraint:1	0.0153746 N	0.00525595 N	0.00220246 N m	0.000217753 N m
		0.0142399 N		0.000313358 N m
		-0.00244549 N		0.00216915 N m
Fixed Constraint:2	0.0051646 N	-0.00231277 N	0.000663287 N m	0.0000509424 N m
		-0.00390277 N		0.000425016 N m
		-0.00246832 N		-0.000506672 N m

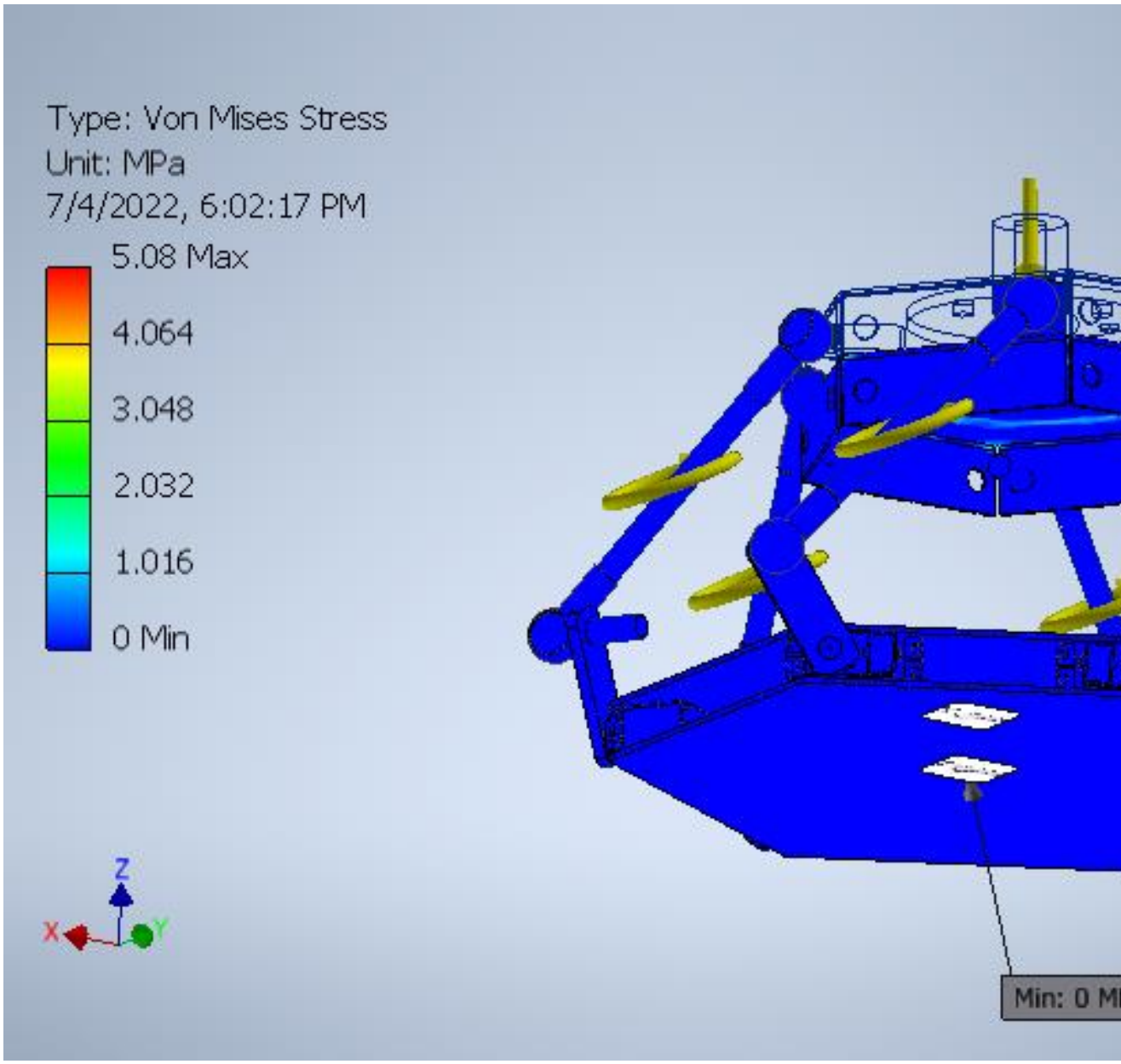
Result Summary

Name	Minimum	Maximum
Volume	756379 mm^3	
Mass	2.04222 kg	
Von Mises Stress	0 MPa	5.07957 MPa
1st Principal Stress	-0.912666 MPa	4.94717 MPa
3rd Principal Stress	-2.90498 MPa	0.684427 MPa
Displacement	0 mm	12.4904 mm
Safety Factor	15 ul	15 ul
Stress XX	-2.42034 MPa	3.09606 MPa
Stress XY	-2.25265 MPa	1.9206 MPa
Stress XZ	-1.97605 MPa	2.05501 MPa
Stress YY	-2.78161 MPa	3.60469 MPa
Stress YZ	-1.53613 MPa	1.63416 MPa
Stress ZZ	-1.62077 MPa	2.82324 MPa
X Displacement	-0.765093 mm	0.016595 mm
Y Displacement	-0.193711 mm	0.0160965 mm
Z Displacement	-12.4663 mm	0.0161289 mm
Equivalent Strain	0 ul	0.0000659585 ul
1st Principal Strain	-0.000000653023 ul	0.0000663663 ul
3rd Principal Strain	-0.0000473887 ul	0.000000837321 ul
Strain XX	-0.0000298823 ul	0.0000395742 ul
Strain XY	-0.0000434836 ul	0.0000370739 ul
Strain XZ	-0.0000381444 ul	0.0000396686 ul
Strain YY	-0.0000357781 ul	0.0000444316 ul
Strain YZ	-0.0000296523 ul	0.0000315447 ul
Strain ZZ	-0.0000189259 ul	0.0000349978 ul
Contact Pressure	0 MPa	5.39535 MPa
Contact Pressure X	-3.52998 MPa	3.90544 MPa
Contact Pressure Y	-3.76239 MPa	4.9582 MPa
Contact Pressure Z	-1.94385 MPa	1.78567 MPa

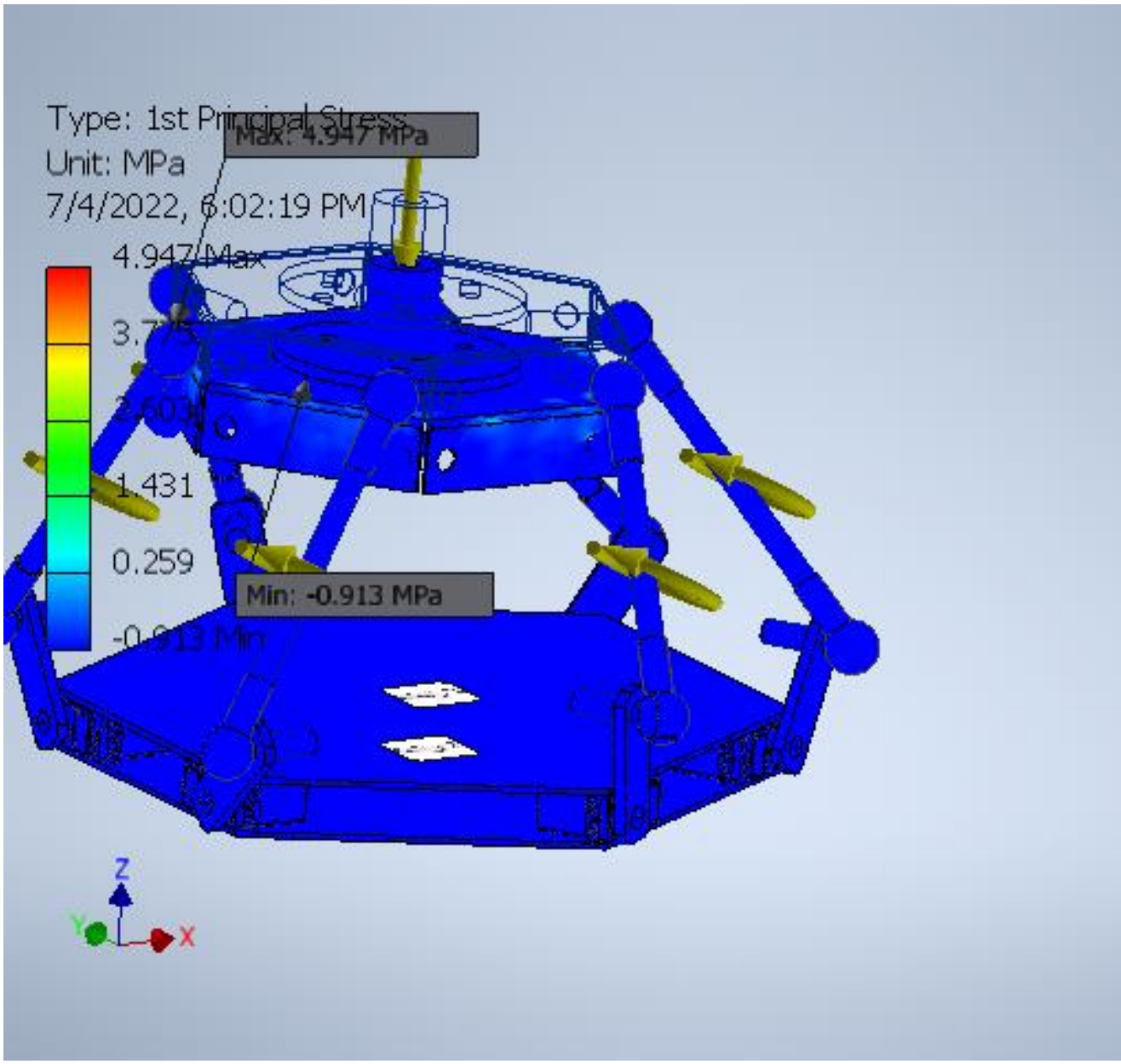
Figures

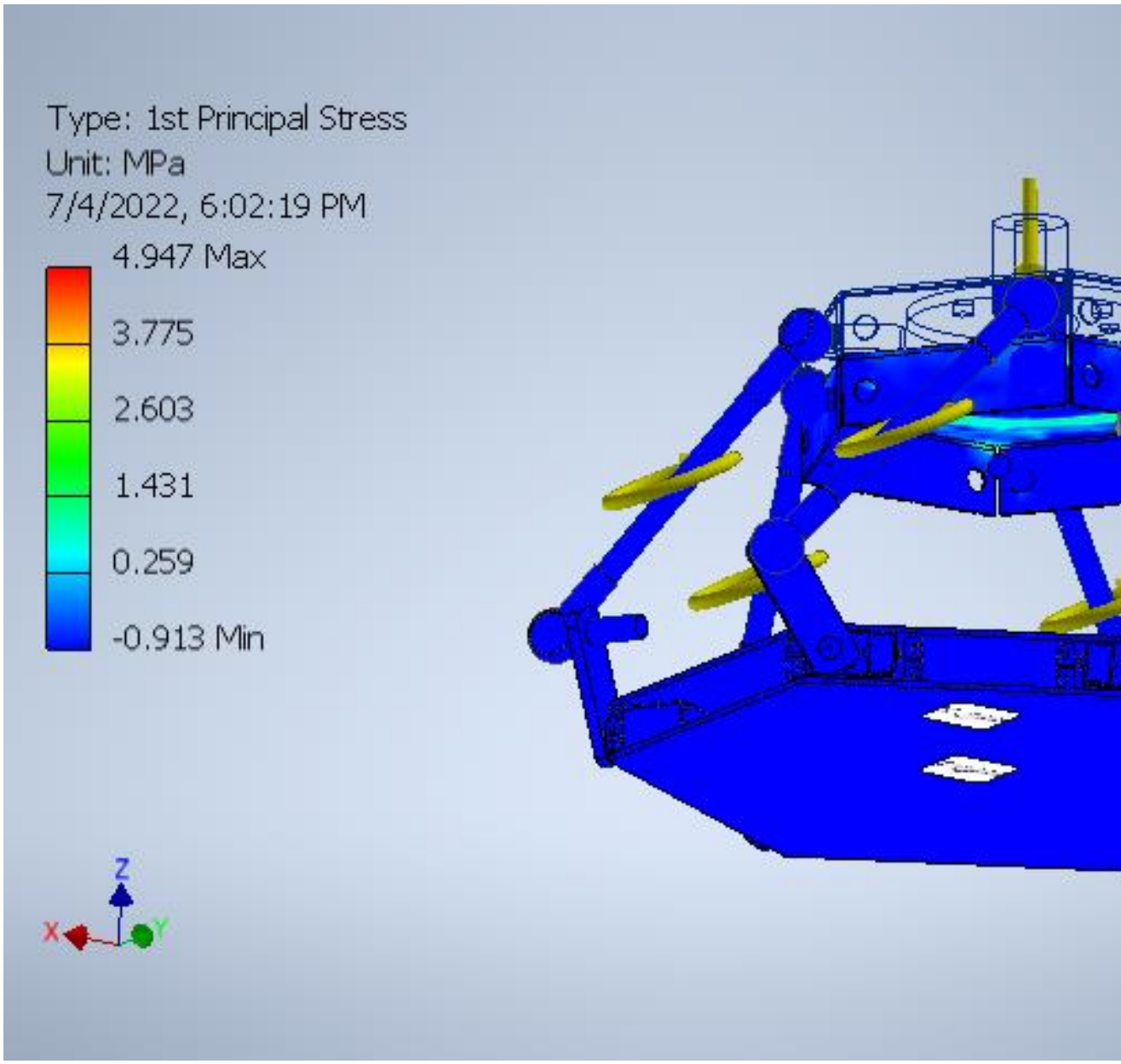
Von Mises Stress



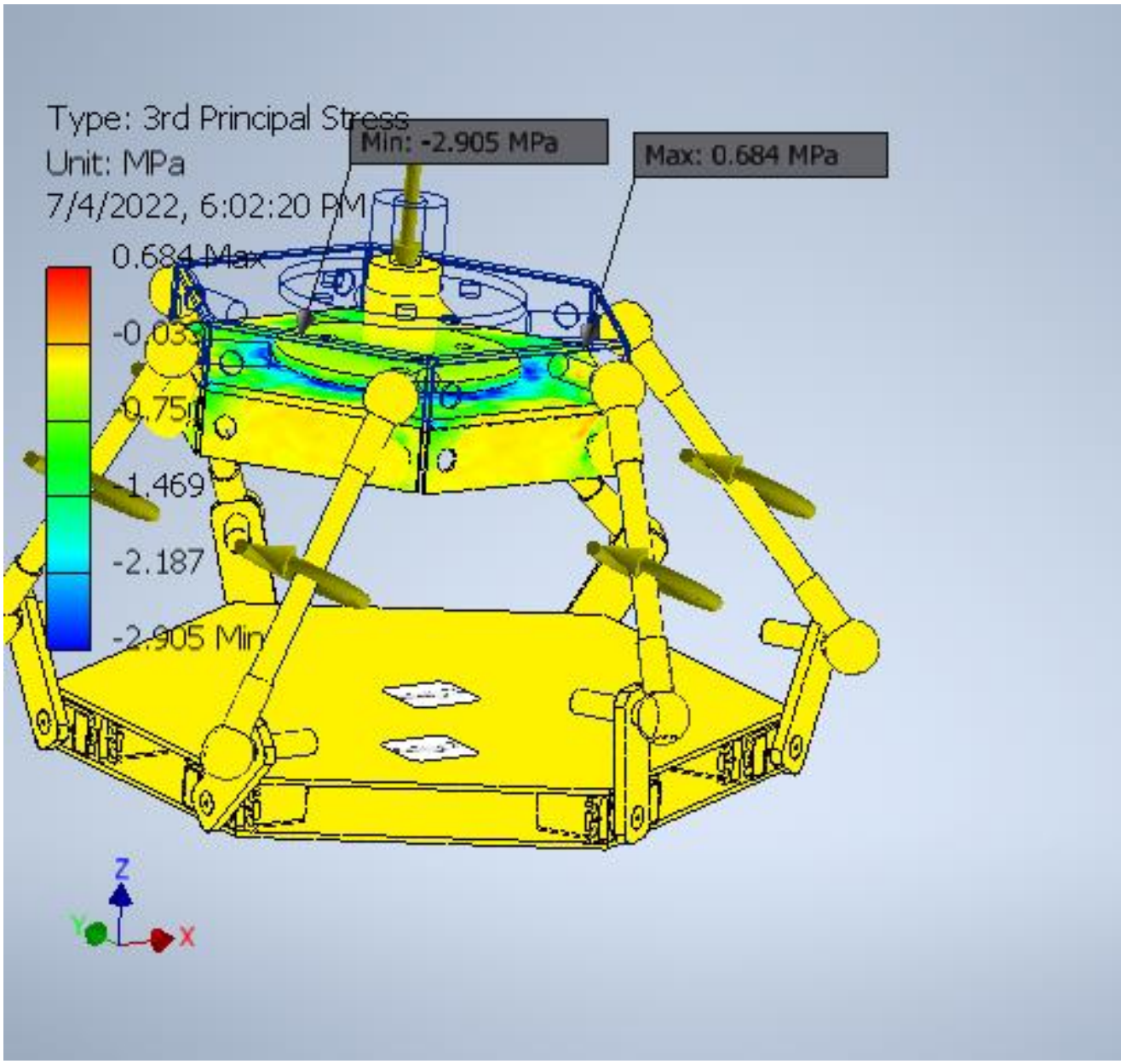


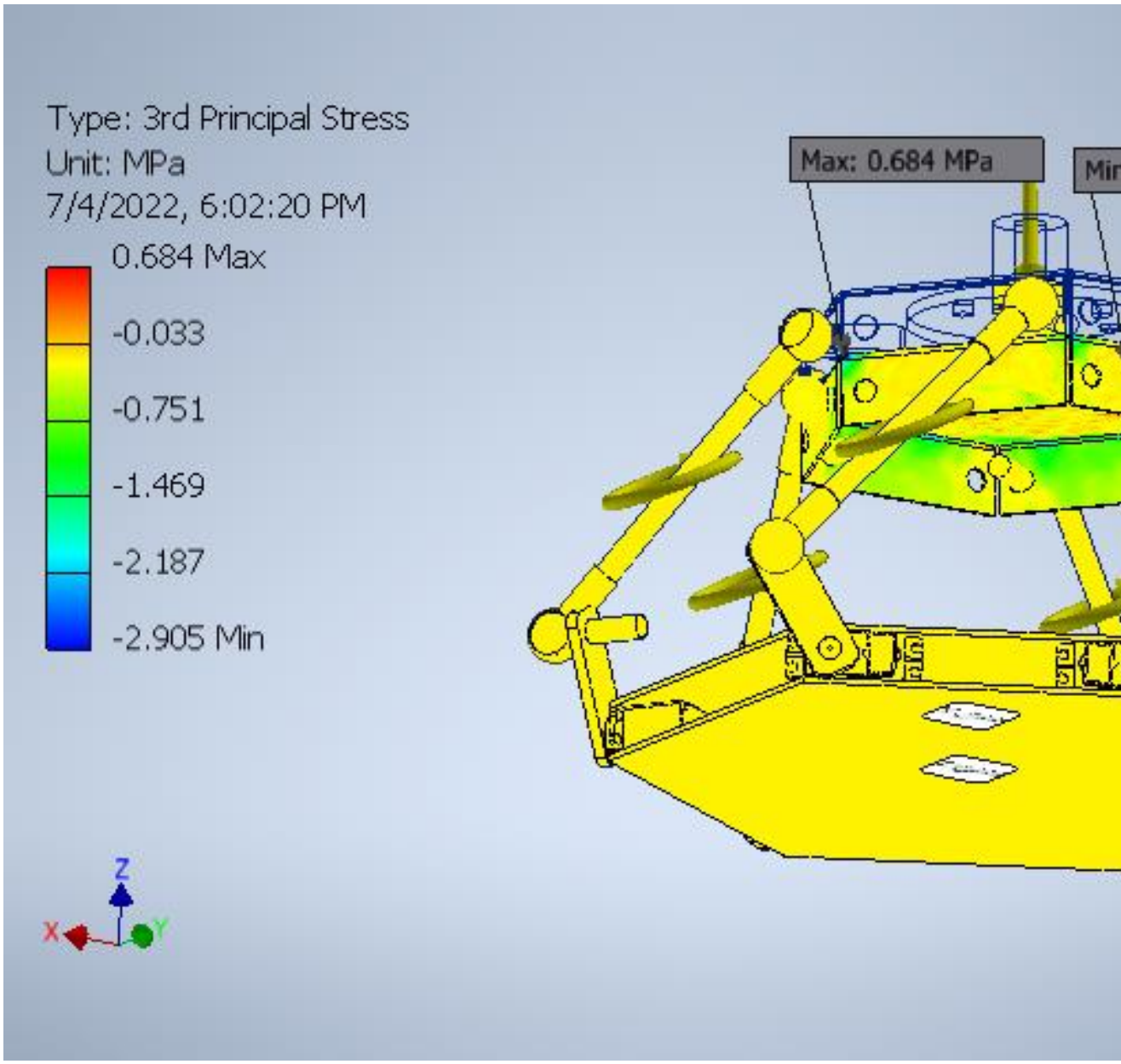
1st Principal Stress


Type: 1st Principal Stress
Unit: MPa
7/4/2022, 6:02:19 PM
Max: 4.947 MPa
4.947 Max
1.431
0.259
Min: -0.913 MPa
Z
Y
X

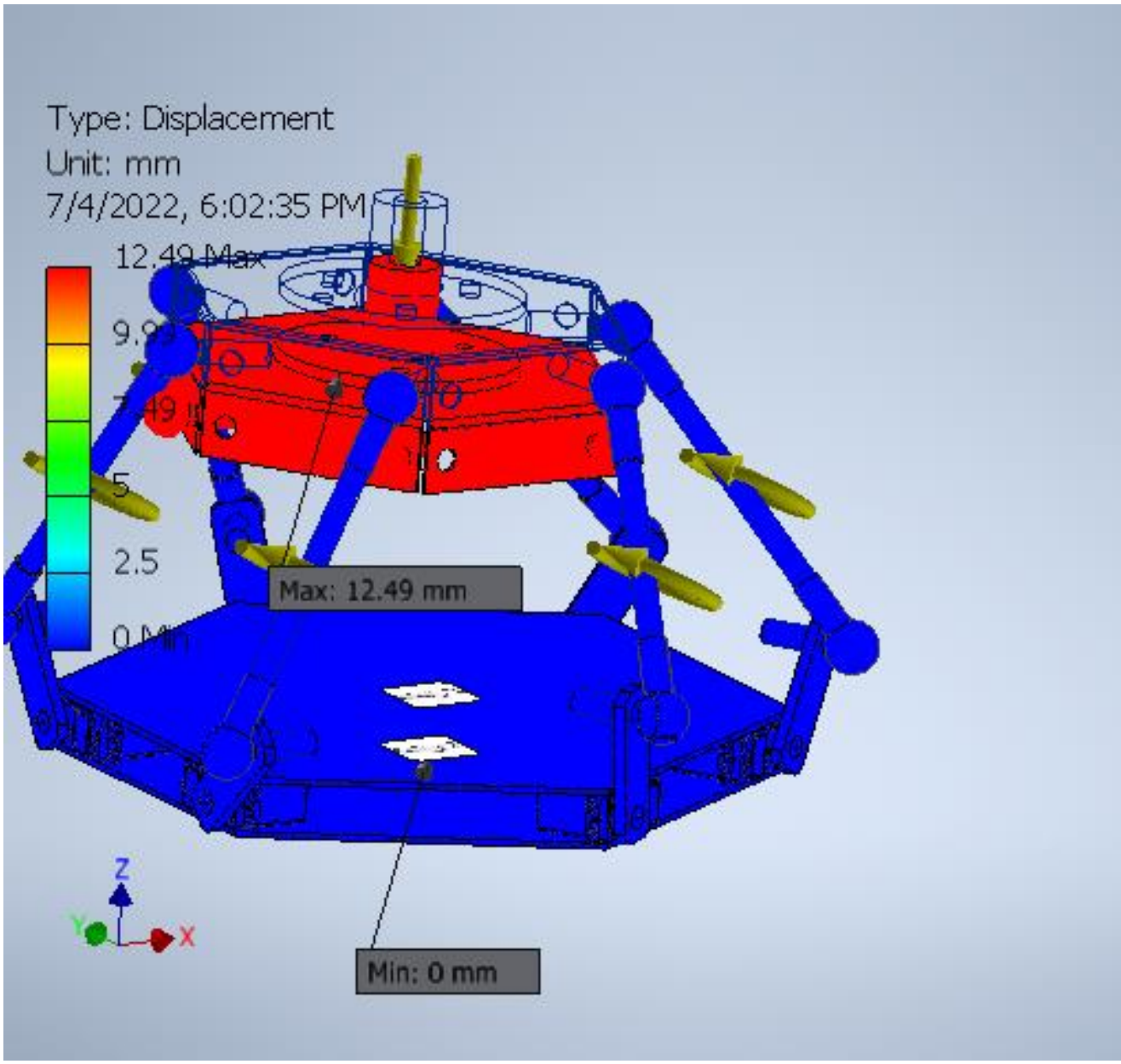


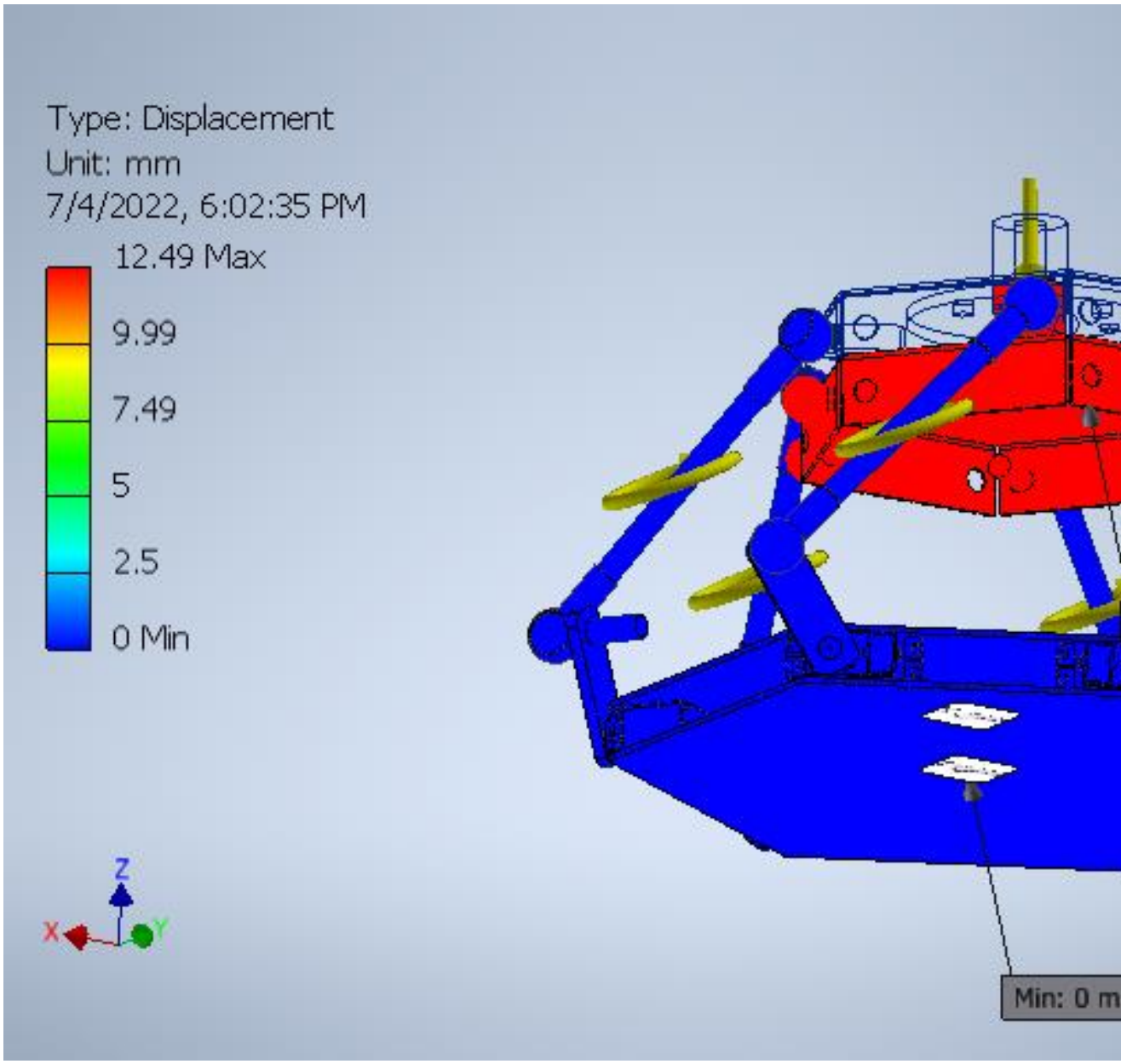
3rd Principal Stress


Type: 3rd Principal Stress
Unit: MPa
7/4/2022, 6:02:20 PM
Min: -2.905 MPa
Max: 0.684 MPa
0.684 Max
-0.033
-0.751
-1.469
-2.187
-2.905 Min
Z
Y
X

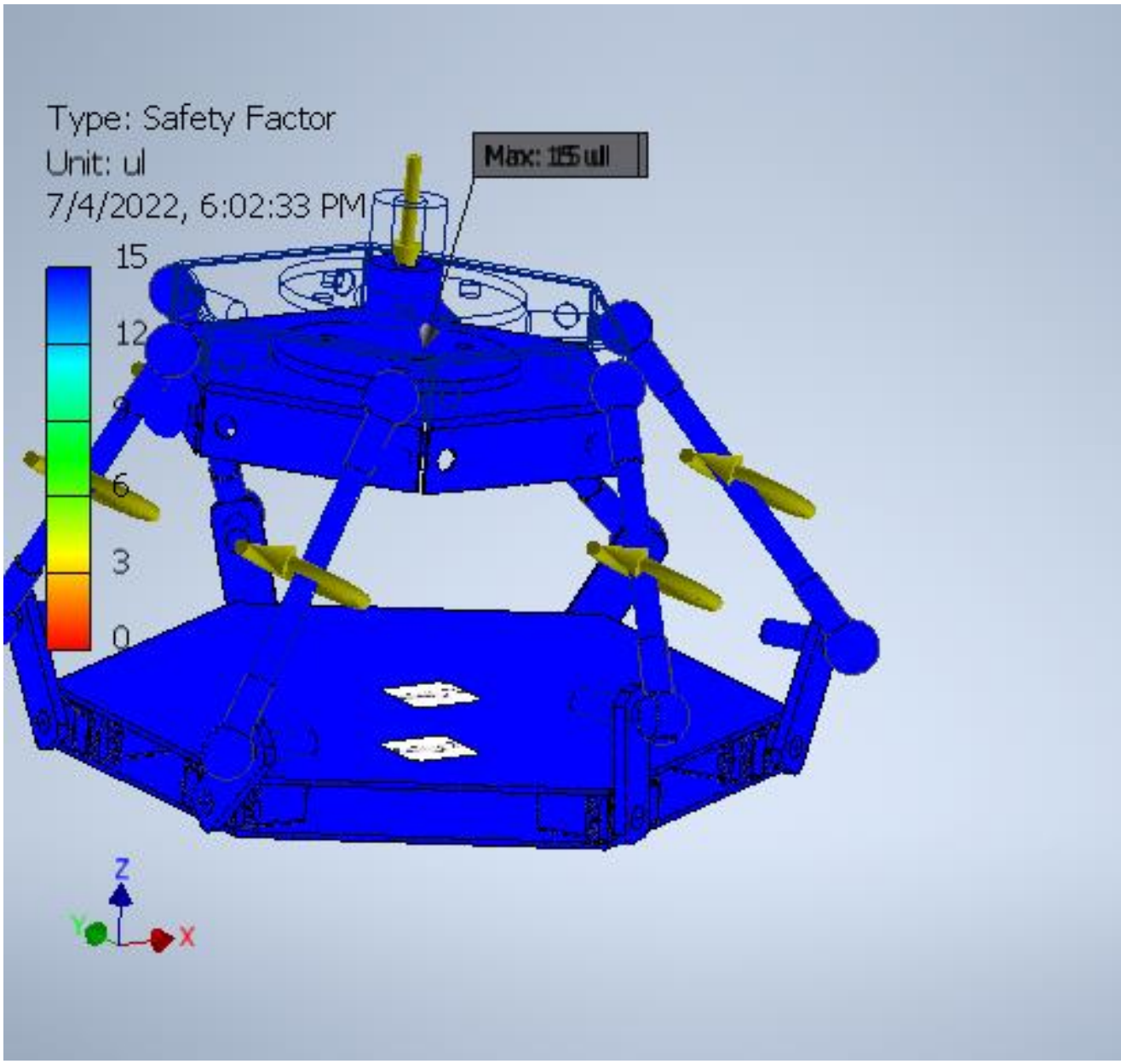


Displacement


Type: Displacement
Unit: mm
7/4/2022, 6:02:35 PM
12.49 Max
9.9
7.49
5
2.5
0 Min
Max: 12.49 mm
Min: 0 mm
Z
Y
X



Safety Factor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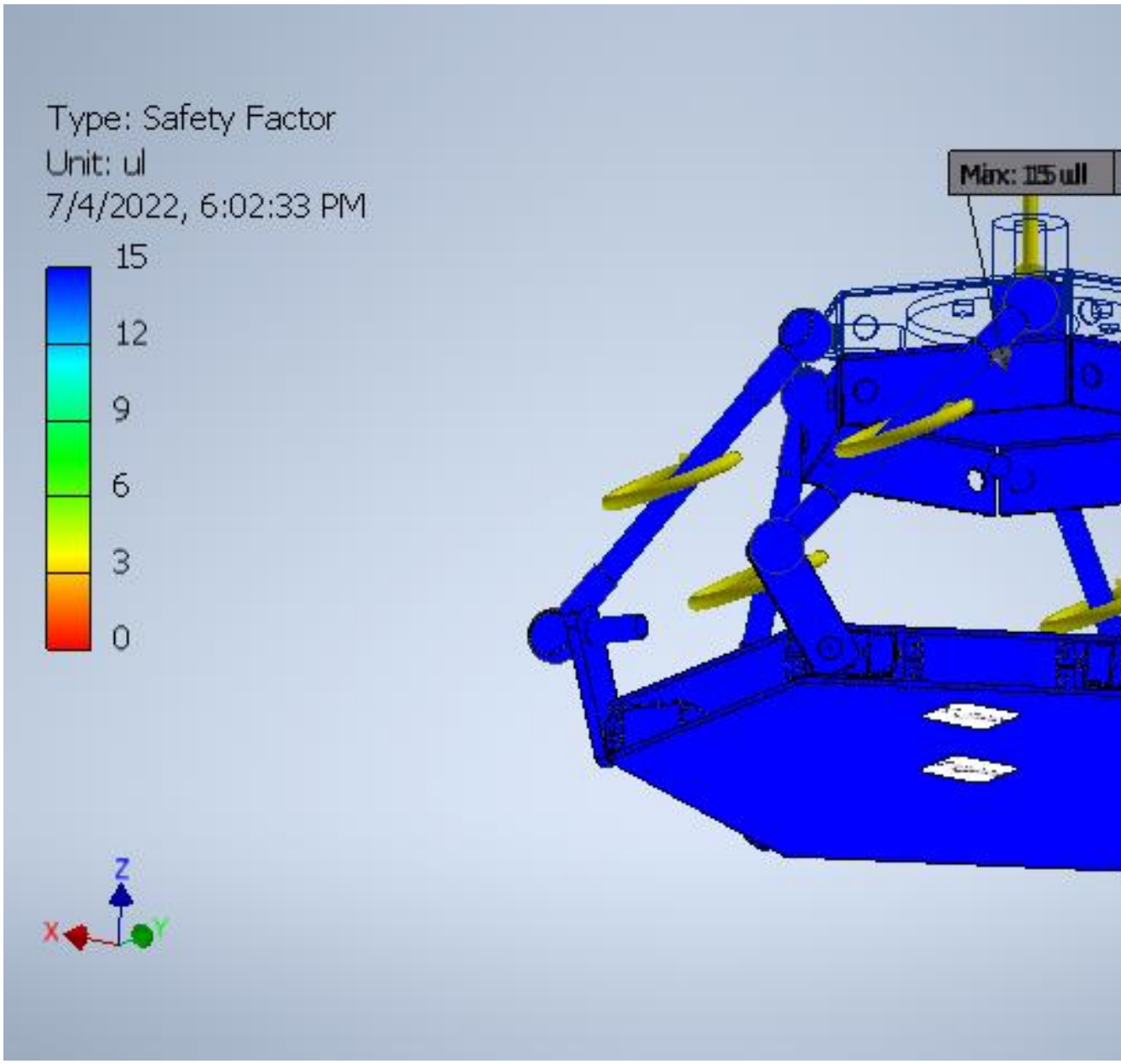
15
12
9
6
3
0
Z
Y
X


Type: Safety Factor
Unit: ul
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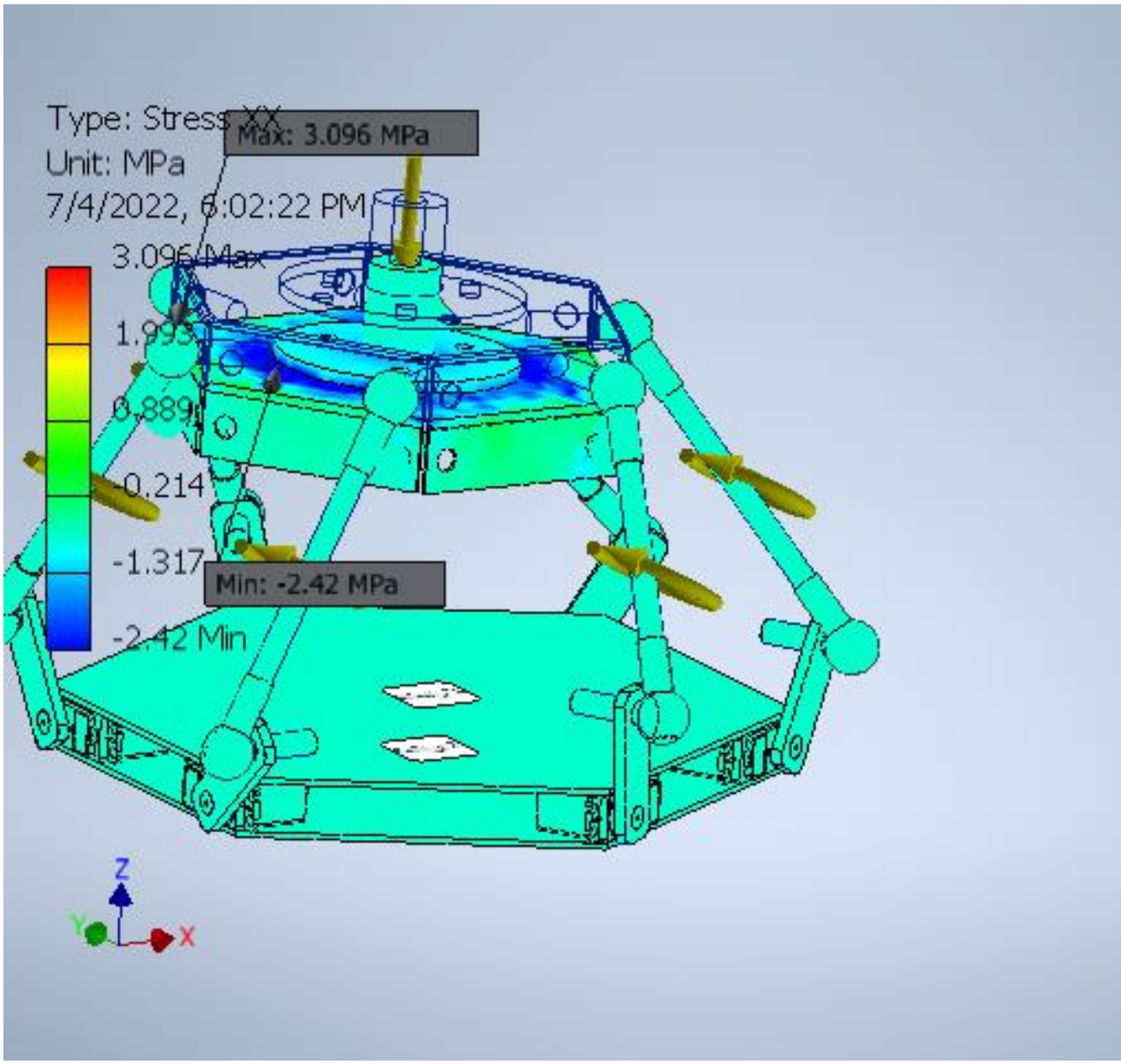
15
12
9
6
3
0
Min: 15 ul
Z
X
Y

Stress XX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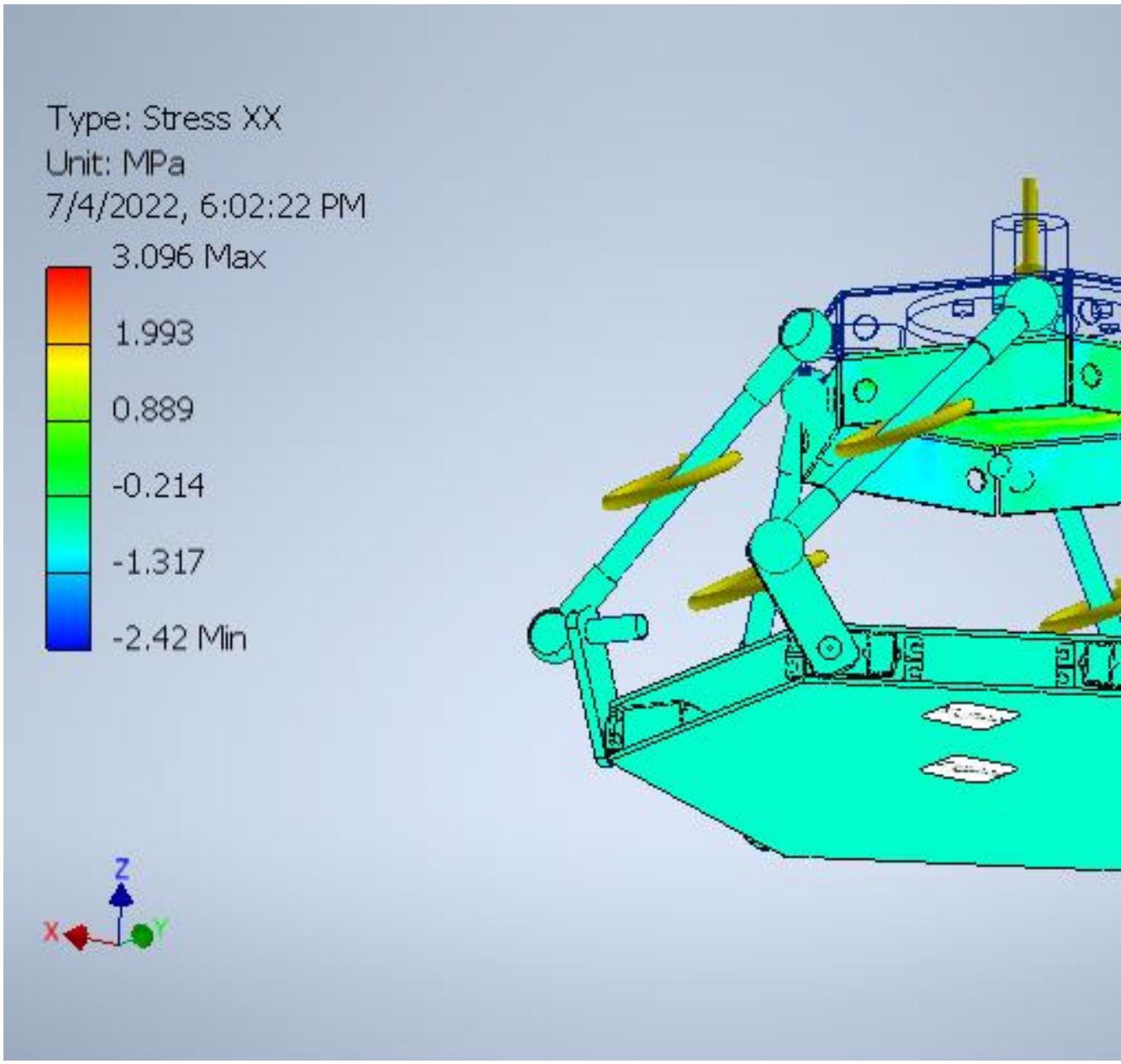
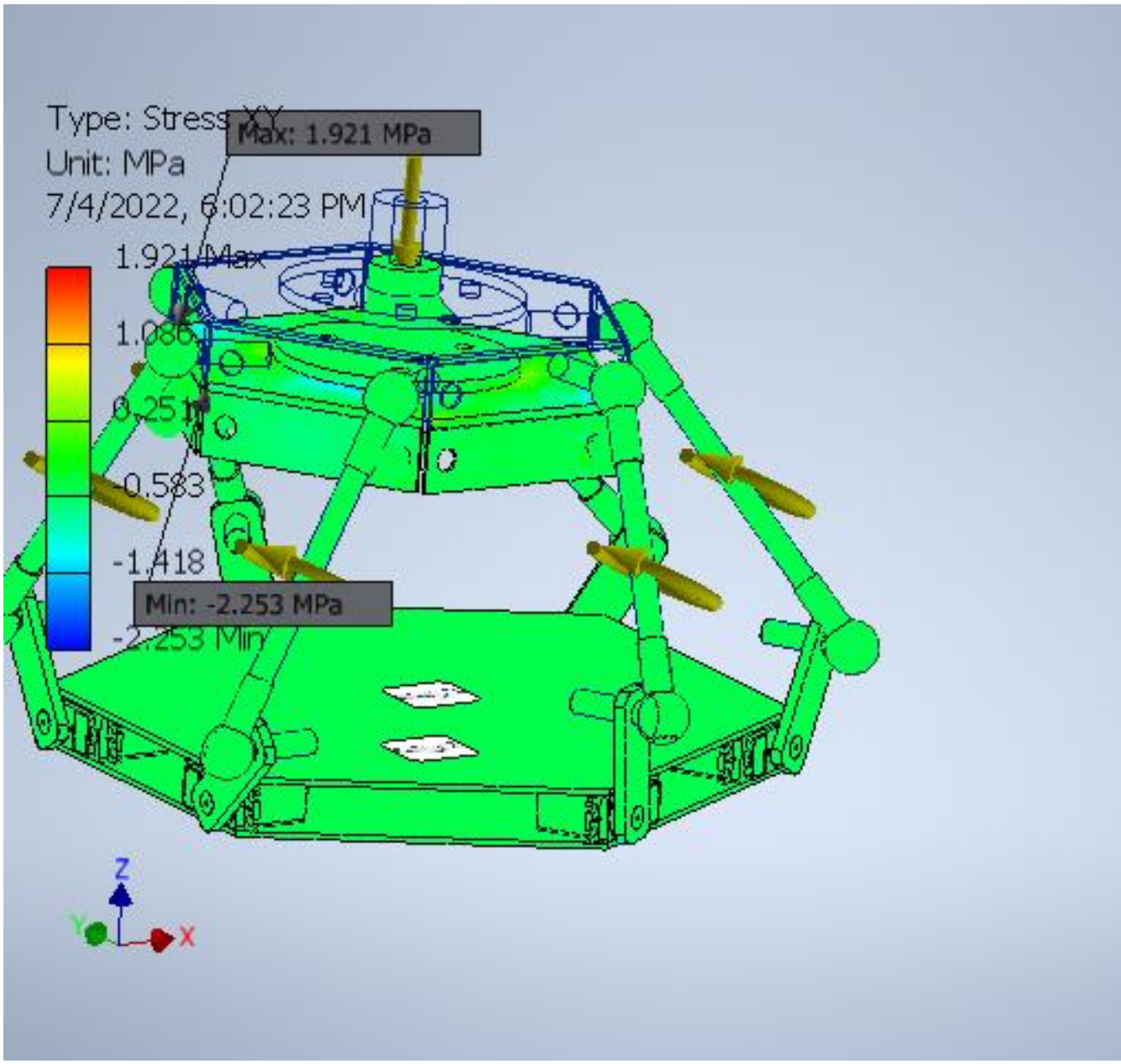
Unit: MPa
7/4/2022, 6:02:22 PM
Max: 3.096 MPa
3.096 Max
1.993
0.889
-0.214
-1.317
Min: -2.42 MPa
-2.42 Min
Z
Y
X


Type: Stress XX
Unit: MPa
7/4/2022, 6:02:22 PM
3.096 Max
1.993
0.889
-0.214
-1.317
-2.42 Min
Z
X
Y

Stress XY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Unit: MPa
7/4/2022, 6:02:23 PM
Max: 1.921 MPa
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1.086
0.251
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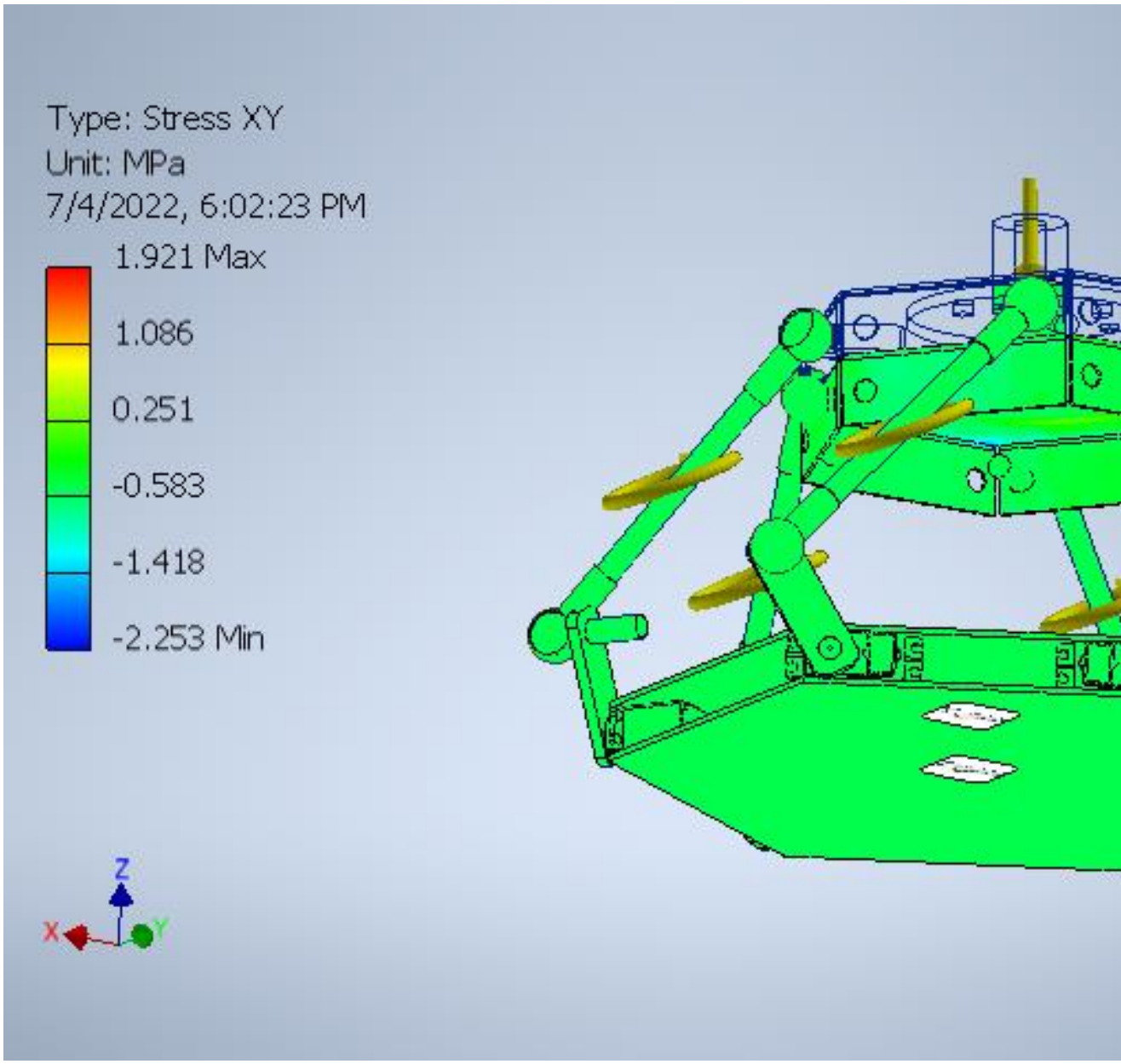
-1.418
Min: -2.253 MPa
-2.253 Min
Z
Y
X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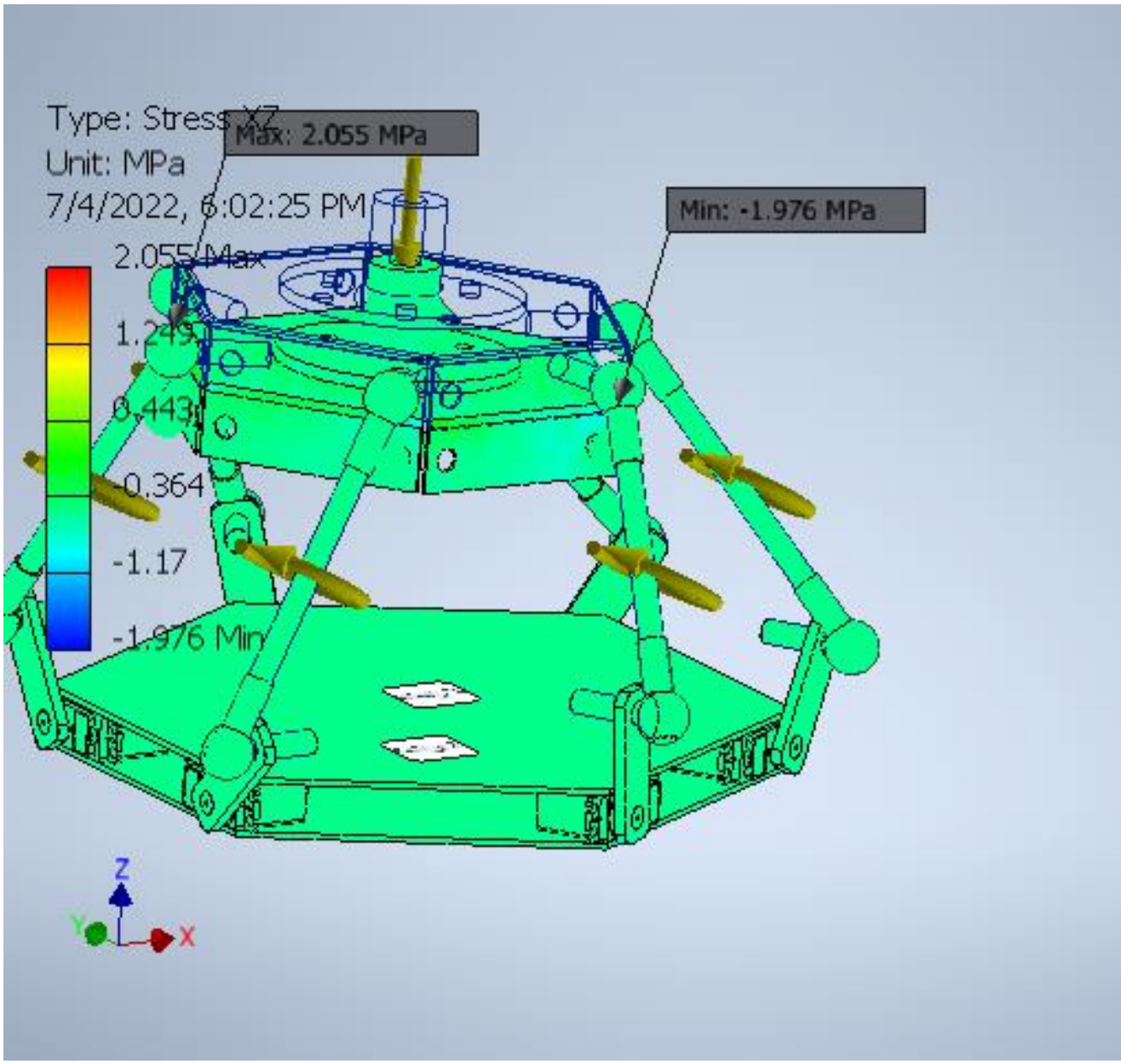
1.086
0.251
-0.583
-1.418
-2.253 Min
Z
X
Y

Stress XZ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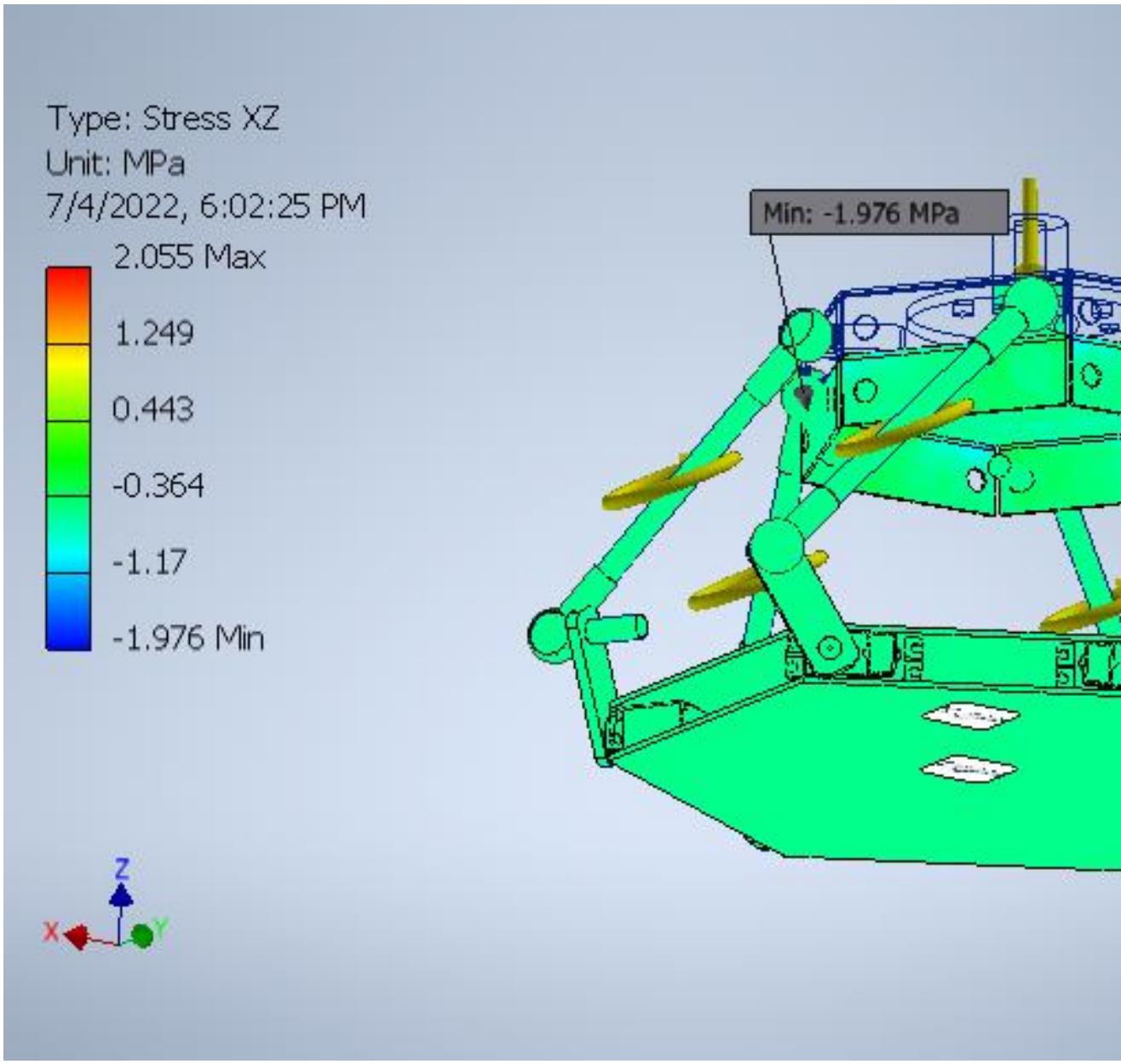
Max: 2.055 MPa
Min: -1.976 MPa
2.055 Max
1.249
0.443
-0.364
-1.17
-1.976 Min
Z
Y
X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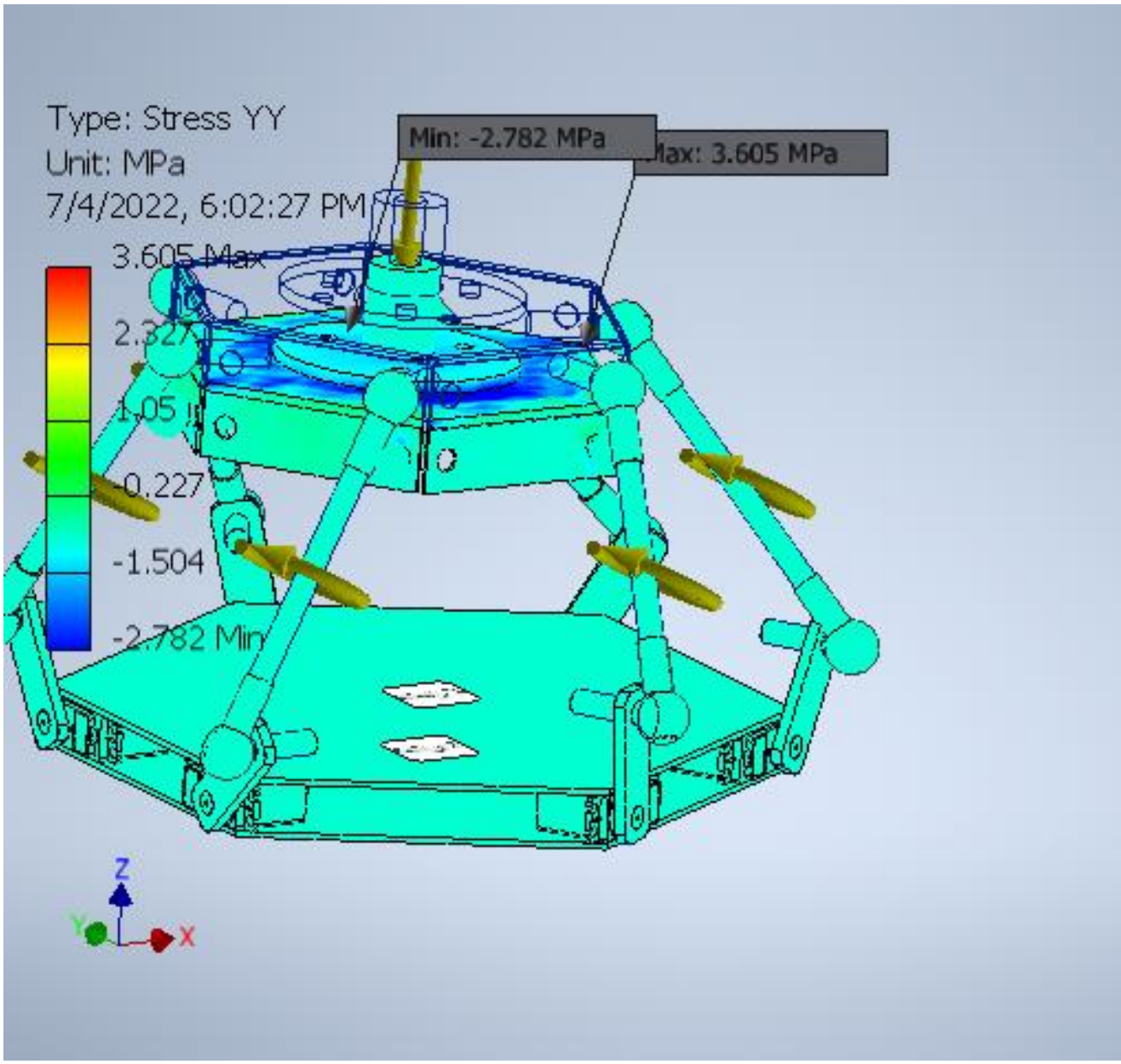
Unit: MPa
7/4/2022, 6:02:25 PM
2.055 Max
1.249
0.443
-0.364
-1.17
-1.976 Min
Min: -1.976 MPa
Z
X
Y

Stress YY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Unit: MPa
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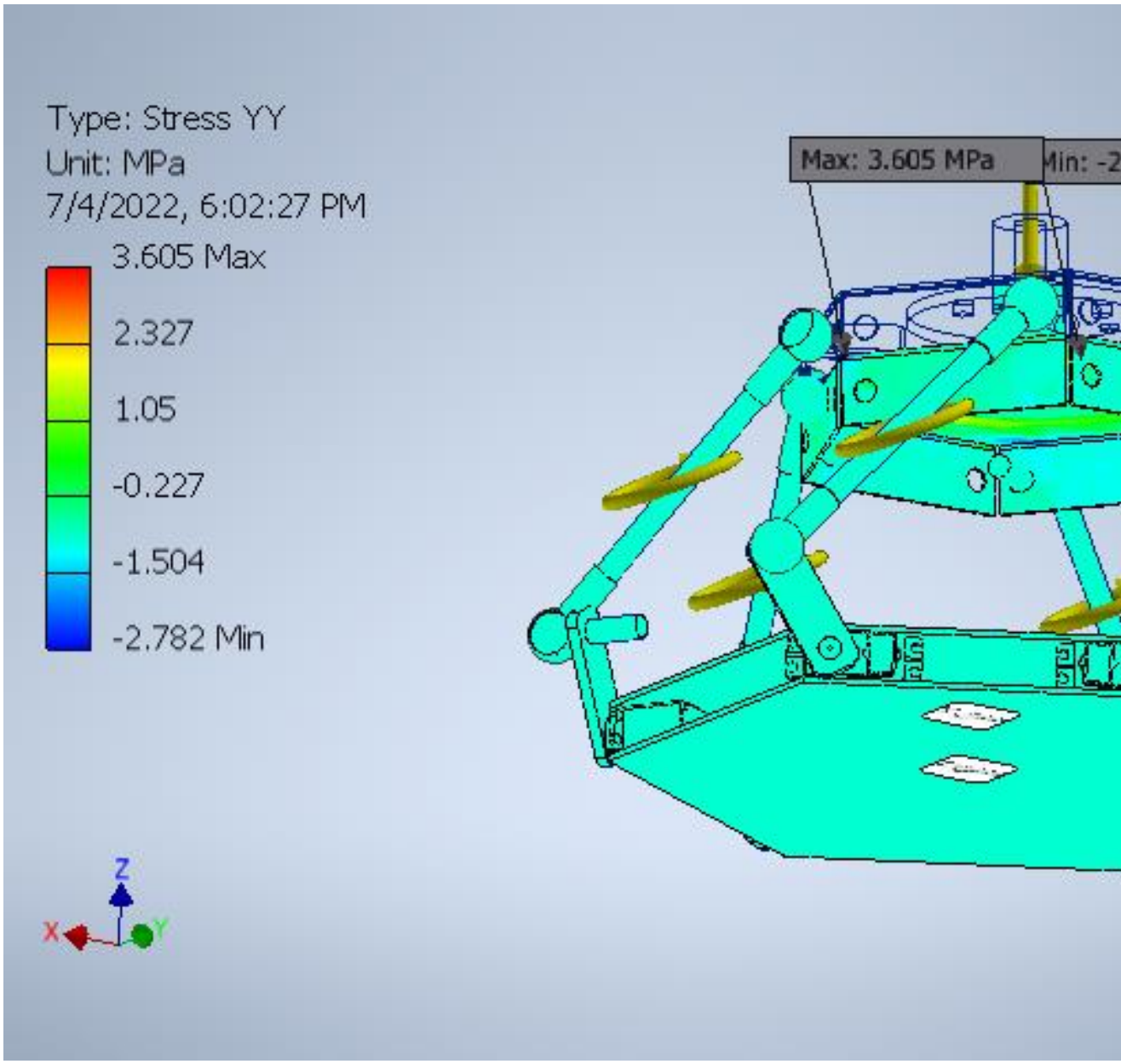
Min: -2.782 MPa
ax: 3.605 MPa
3.605 Max
2.327
1.05
-0.227
-1.504
-2.782 Min
Z
Y
X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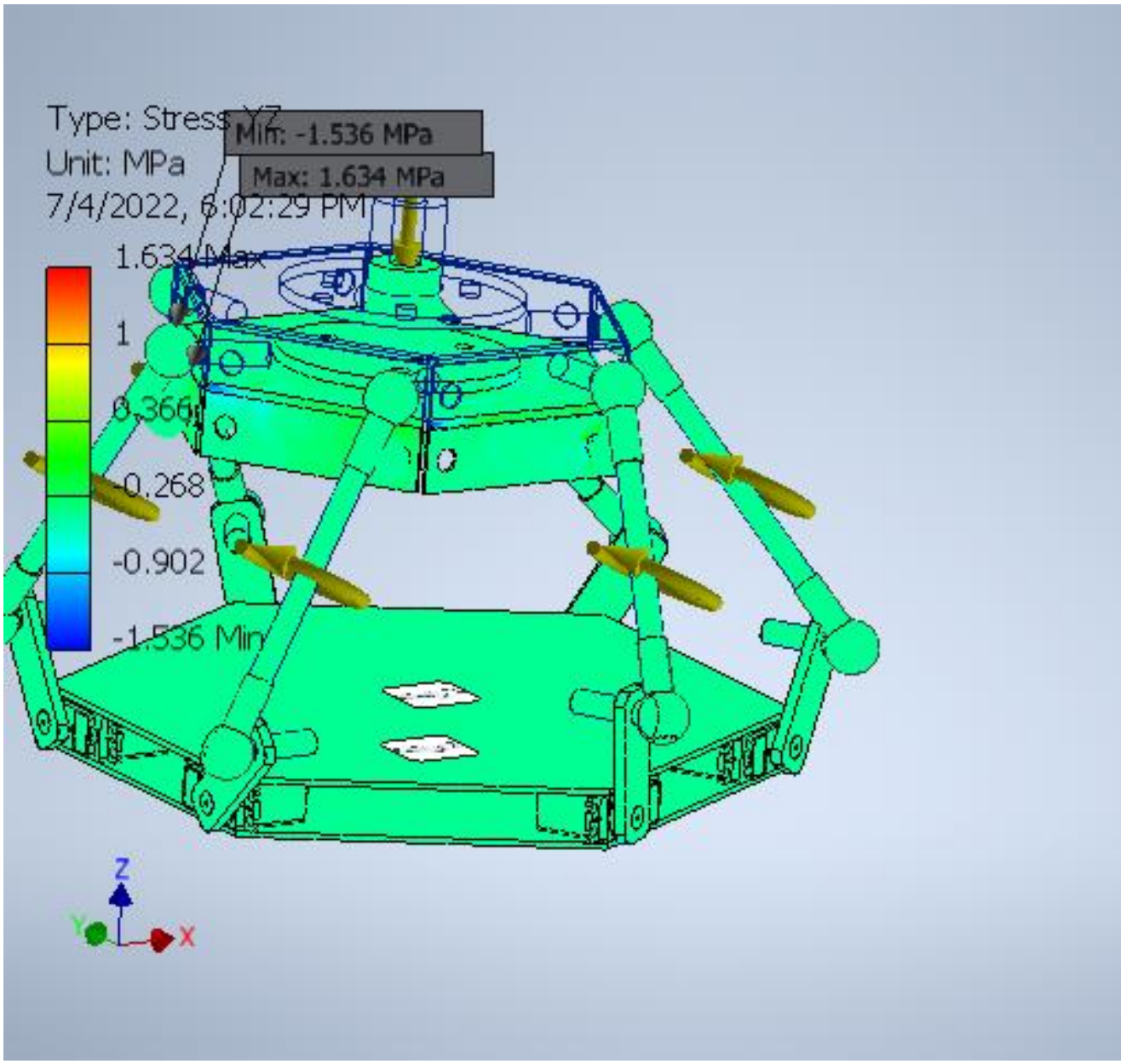
7/4/2022, 6:02:27 PM
3.605 Max
2.327
1.05
-0.227
-1.504
-2.782 Min
Max: 3.605 MPa
Z
X
Y

Stress YZ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Unit: MPa
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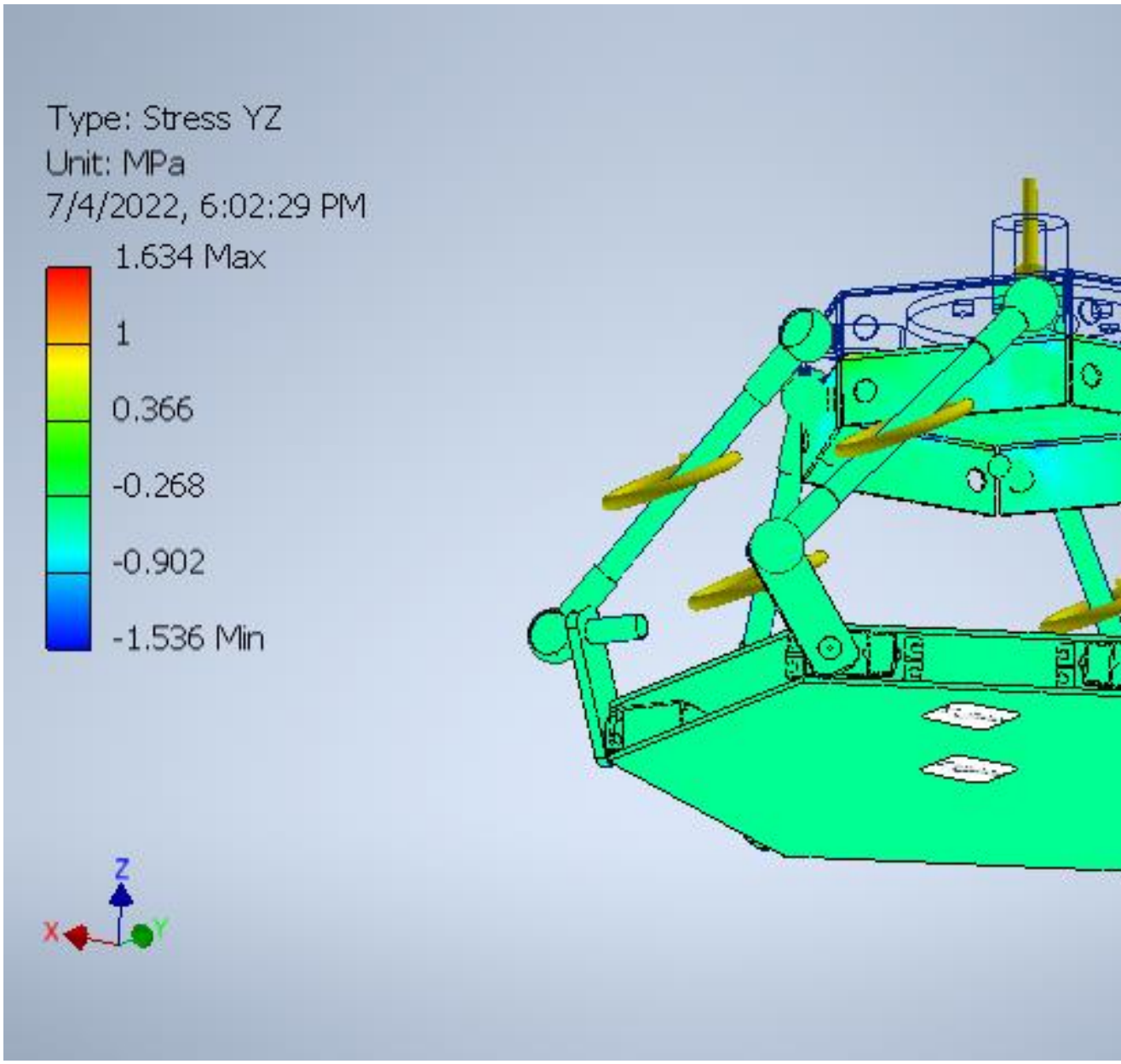
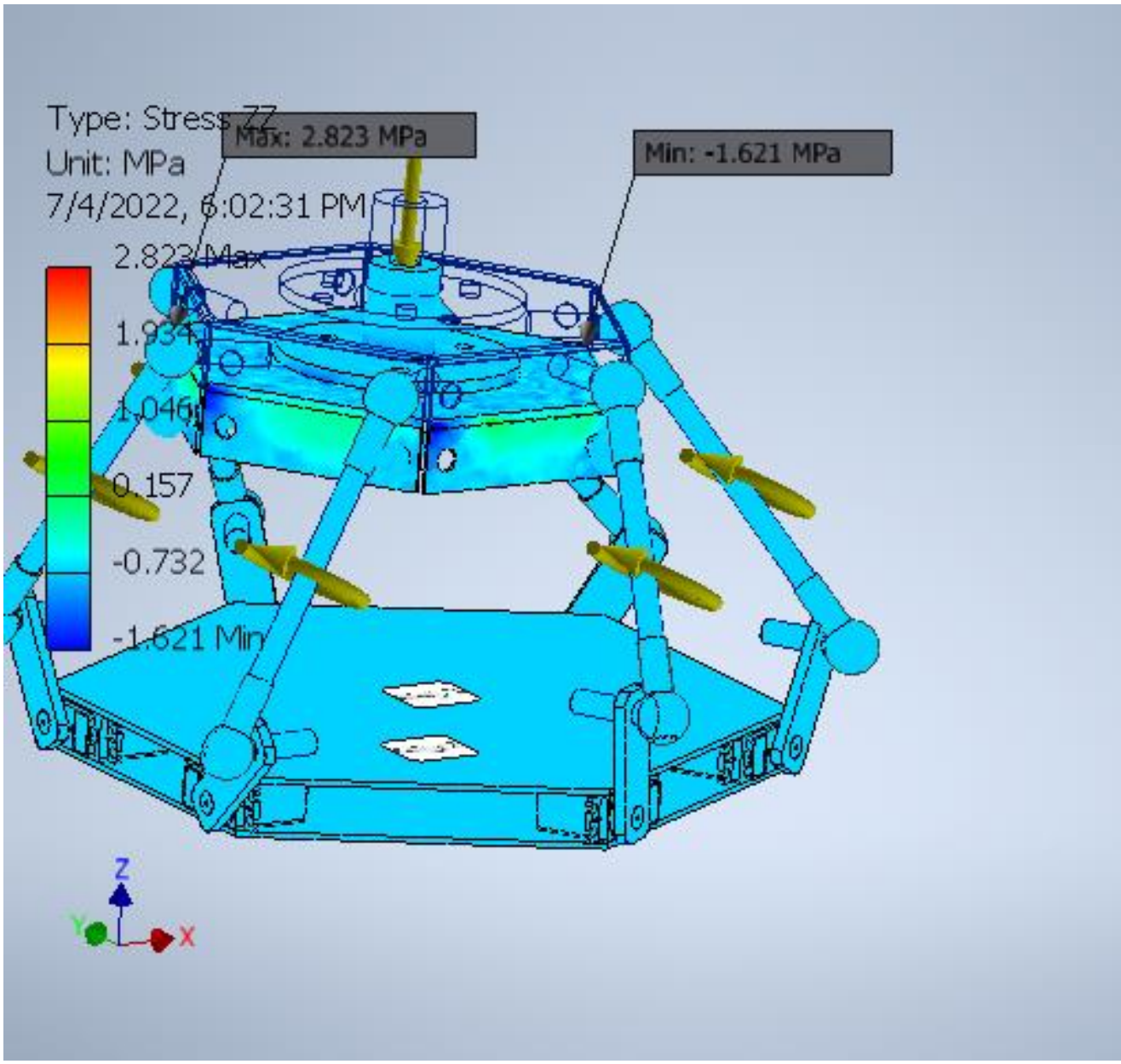
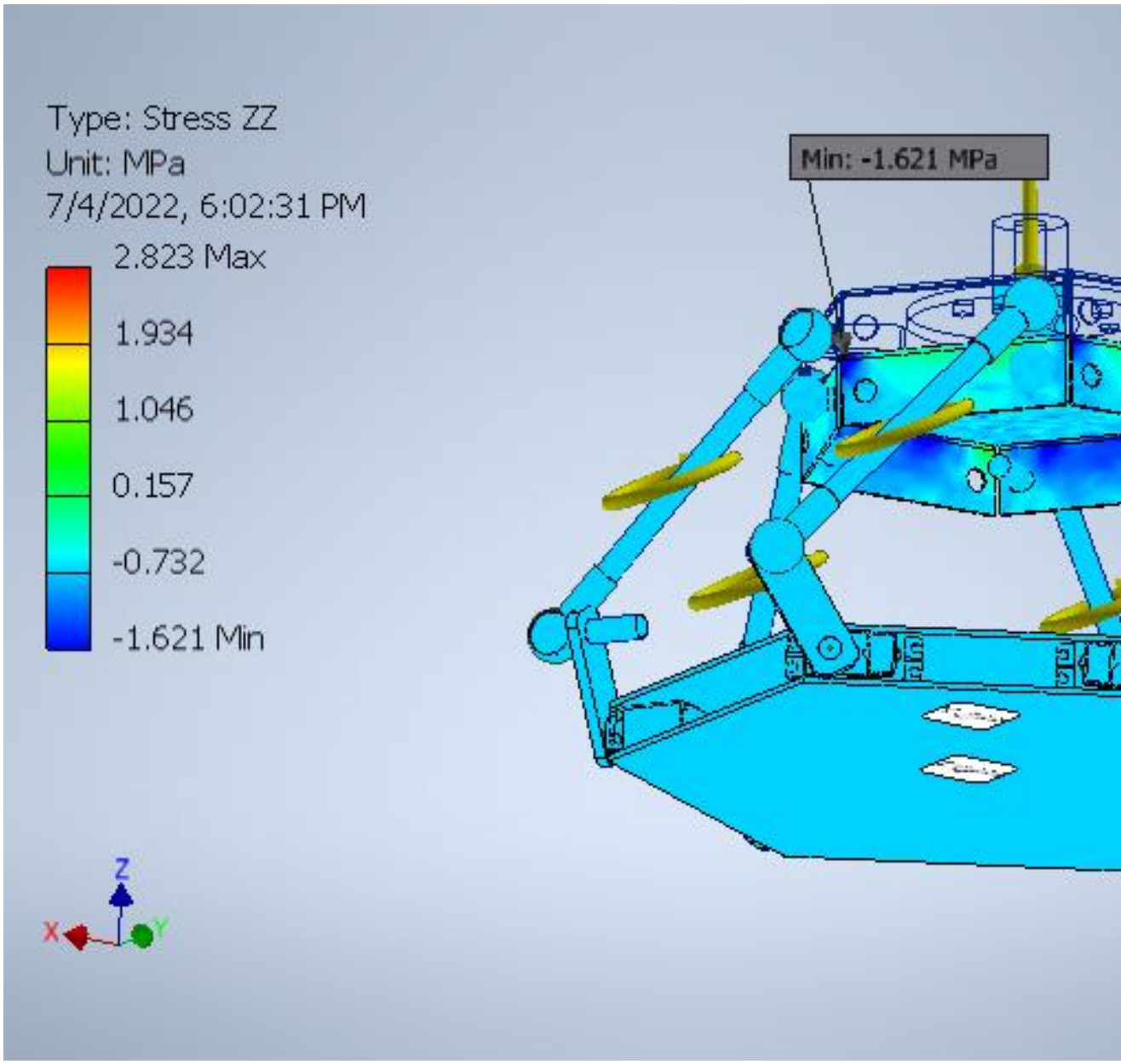
Min: -1.536 MPa
Max: 1.634 MPa
1.634 Max
1
0.366
-0.268
-0.902
-1.536 Min
Z
Y
X

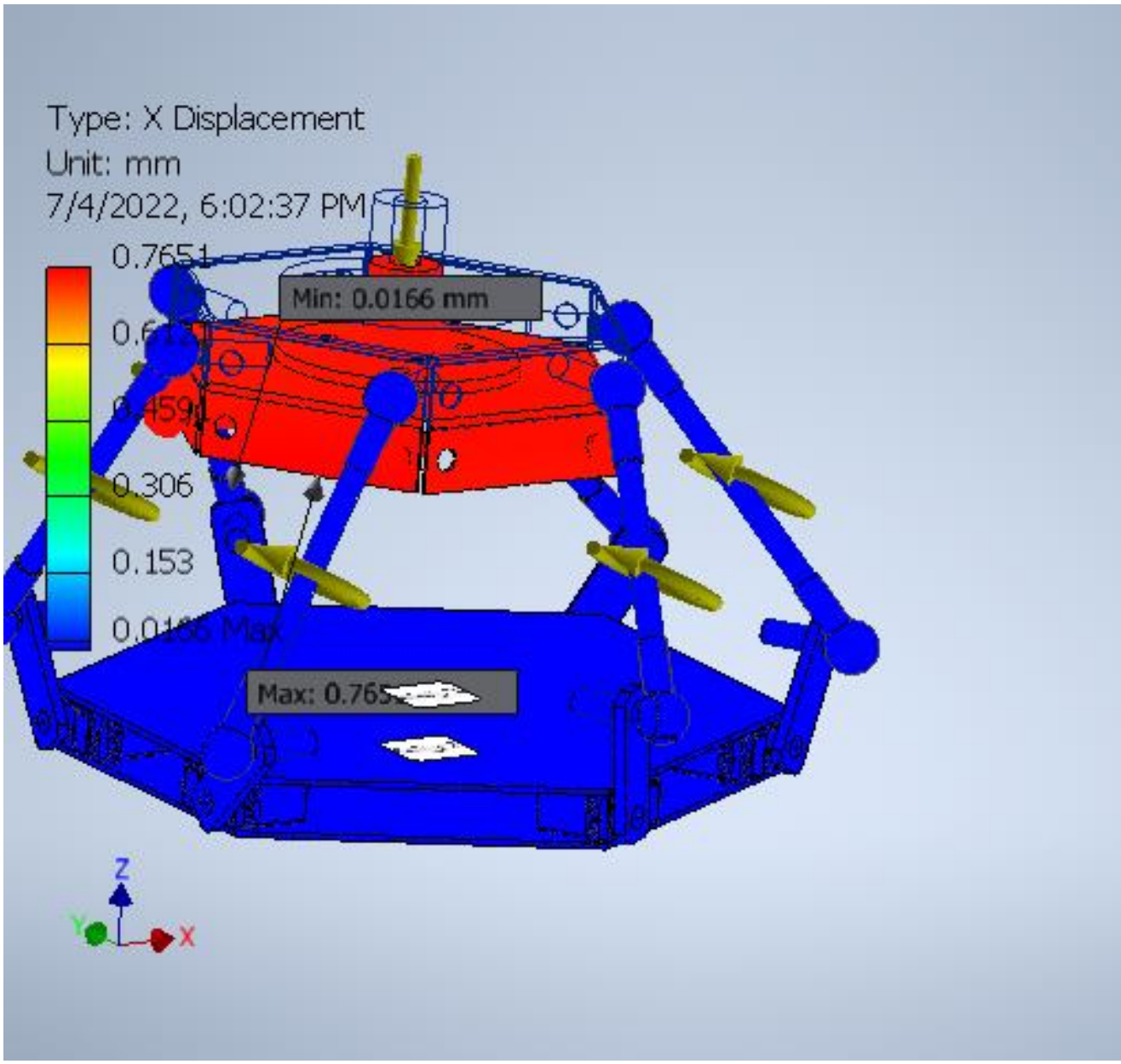

Type: Stress YZ
Unit: MPa
7/4/2022, 6:02:29 PM
1.634 Max
1
0.366
-0.268
-0.902
-1.536 Min
Z
X
Y

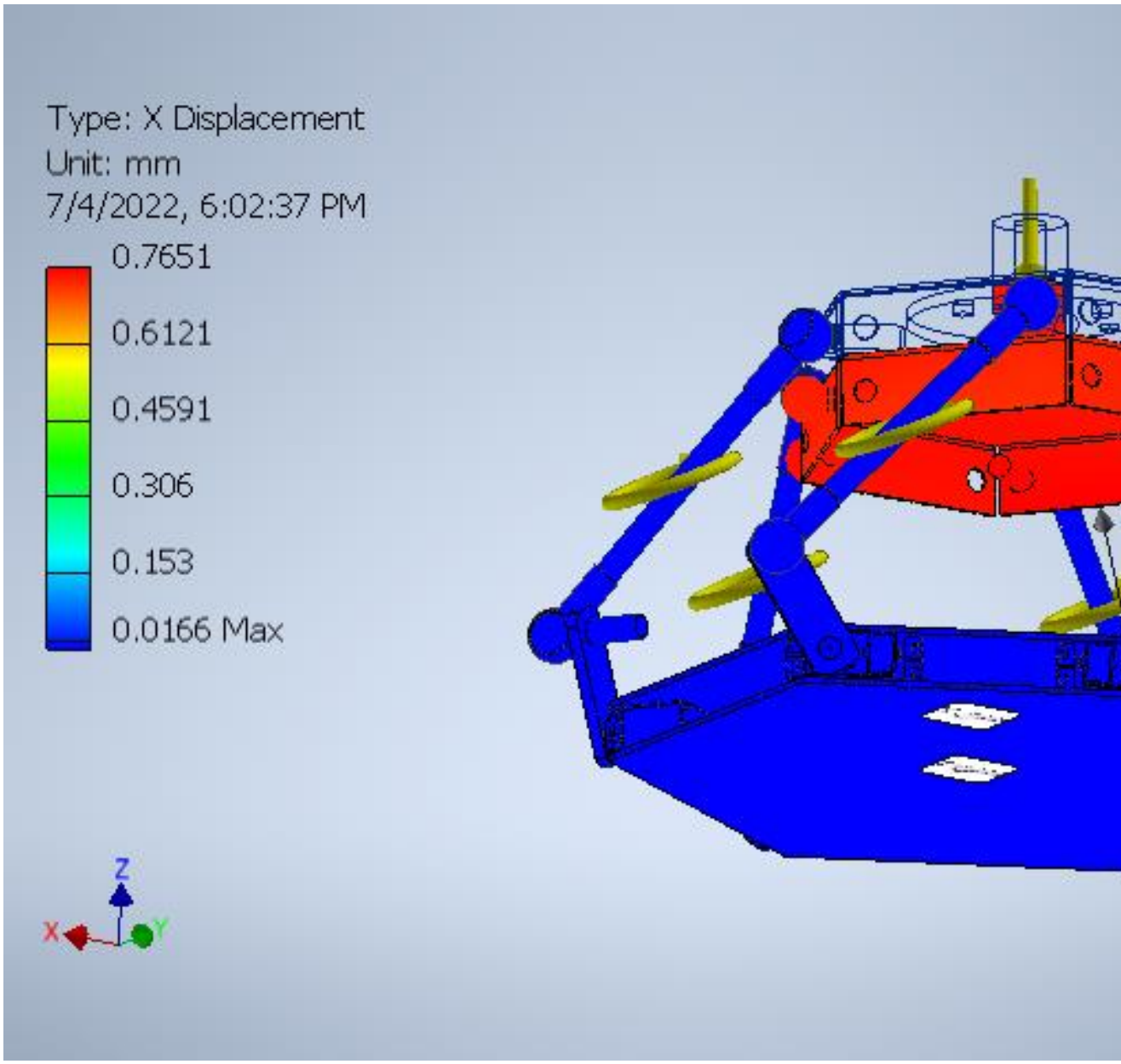
Stress ZZ


Type: Stress ZZ
Unit: MPa
7/4/2022, 6:02:31 PM
Max: 2.823 MPa
Min: -1.621 MPa
2.823 Max
1.934
1.046
0.157
-0.732
-1.621 Min
Z
Y
X

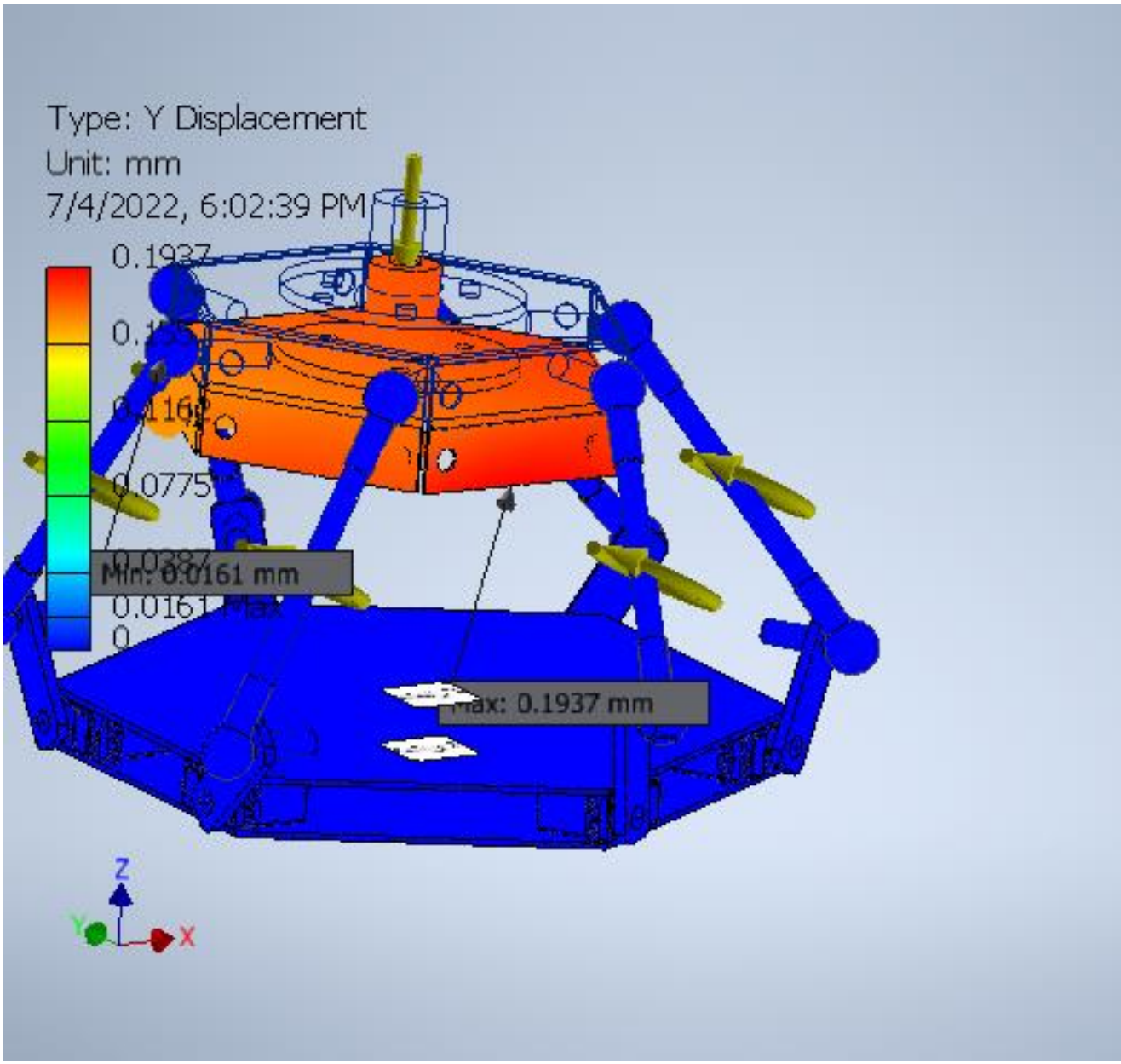


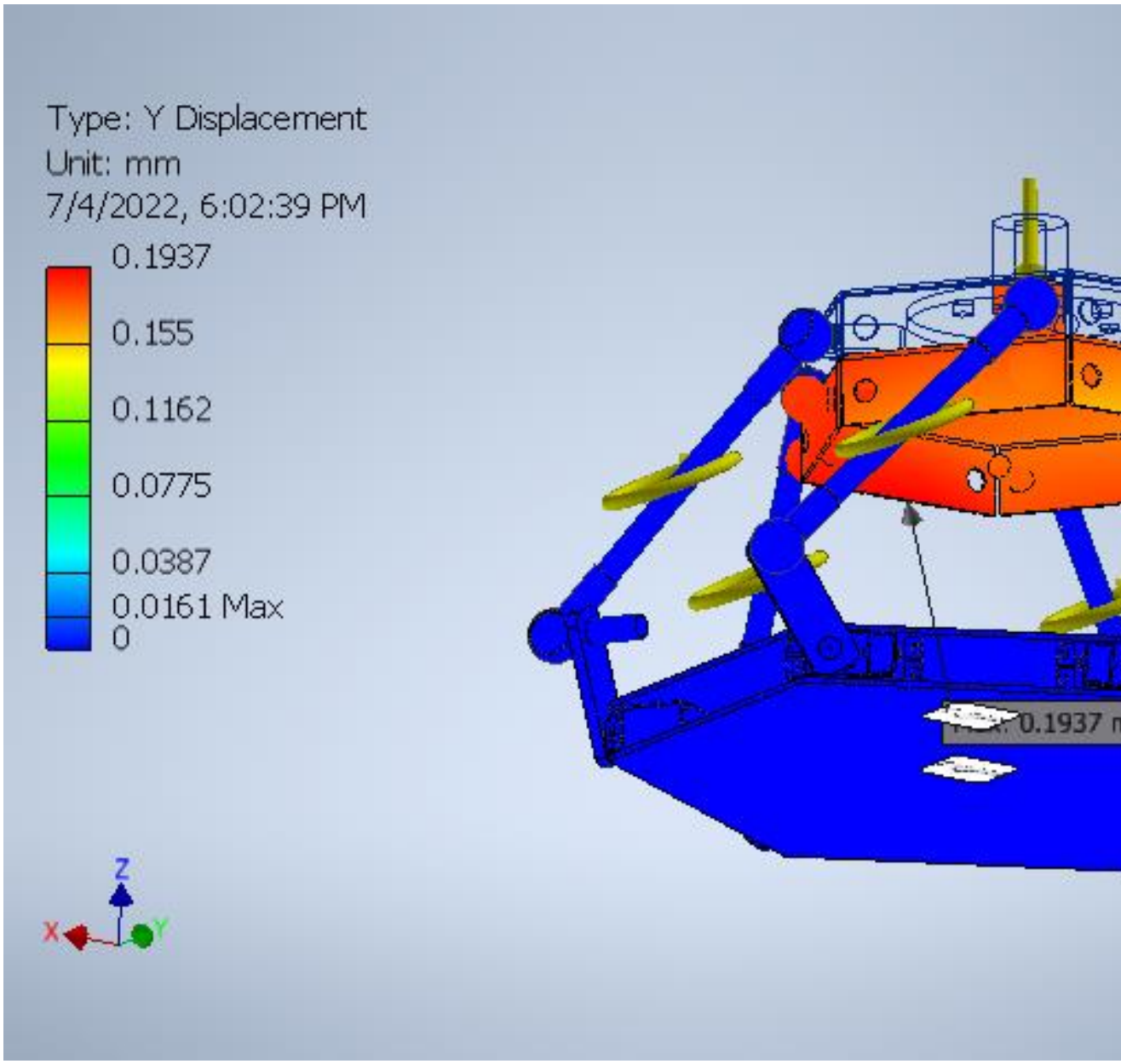
X Displacement


Type: X Displacement
Unit: mm
7/4/2022, 6:02:37 PM
0.7651
0.6119
0.4587
0.306
0.153
0.0166 Min
Min: 0.0166 mm
Max: 0.765
Z
Y
X

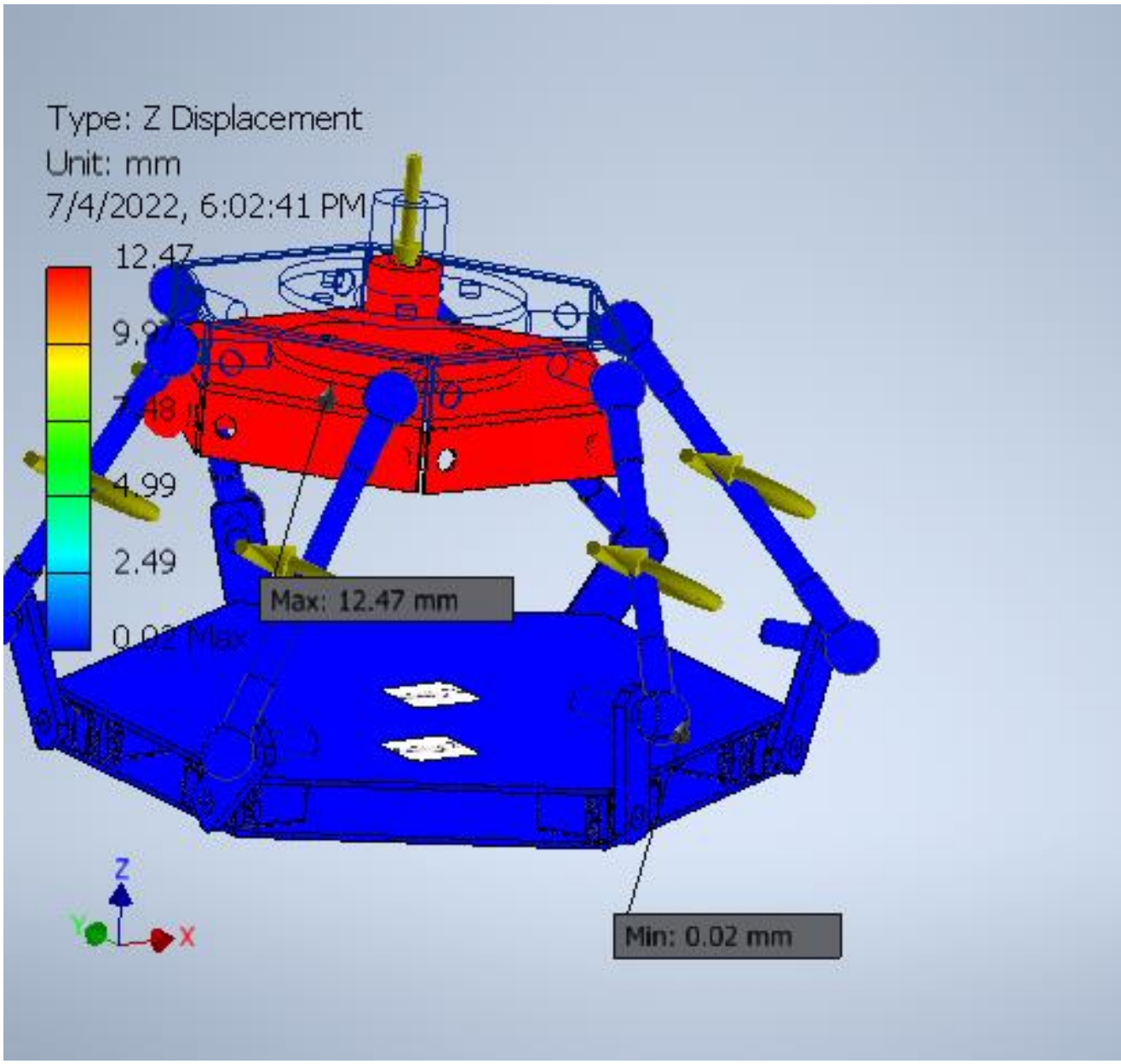


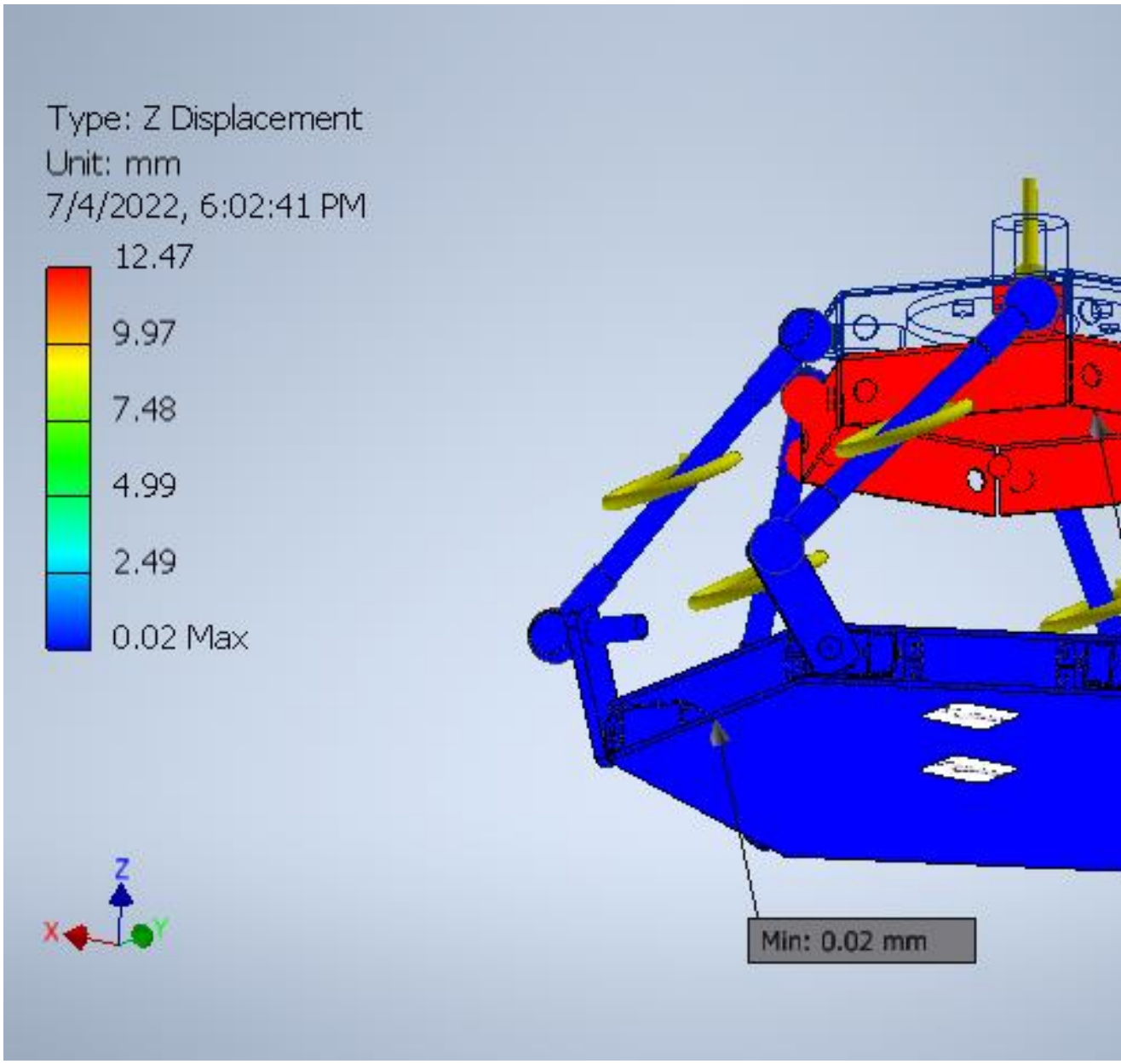
Y Displacement


Type: Y Displacement
Unit: mm
7/4/2022, 6:02:39 PM
0.1937
0.0775
Min: 0.0161 mm
0
Max: 0.1937 mm
Z
Y
X

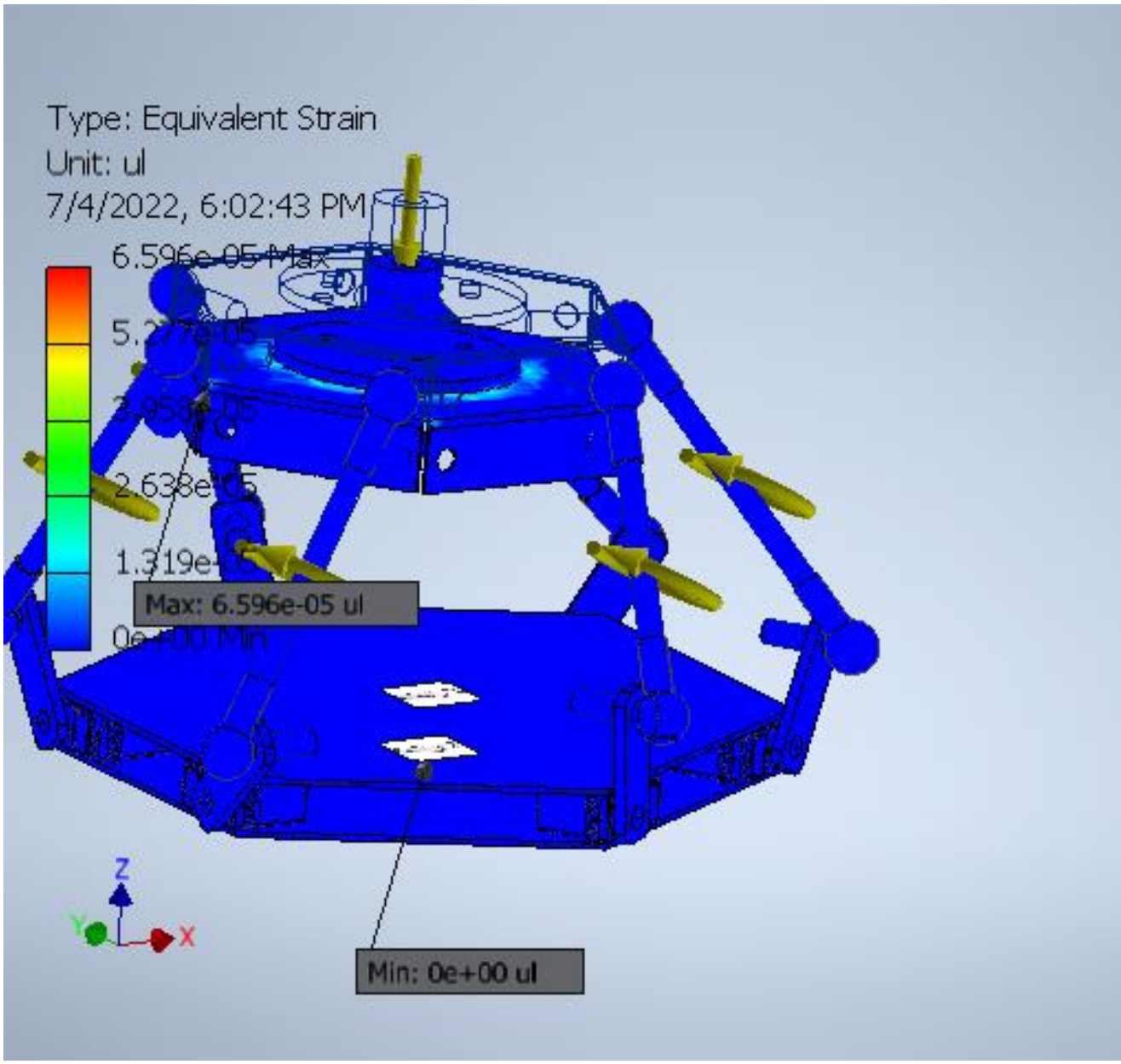


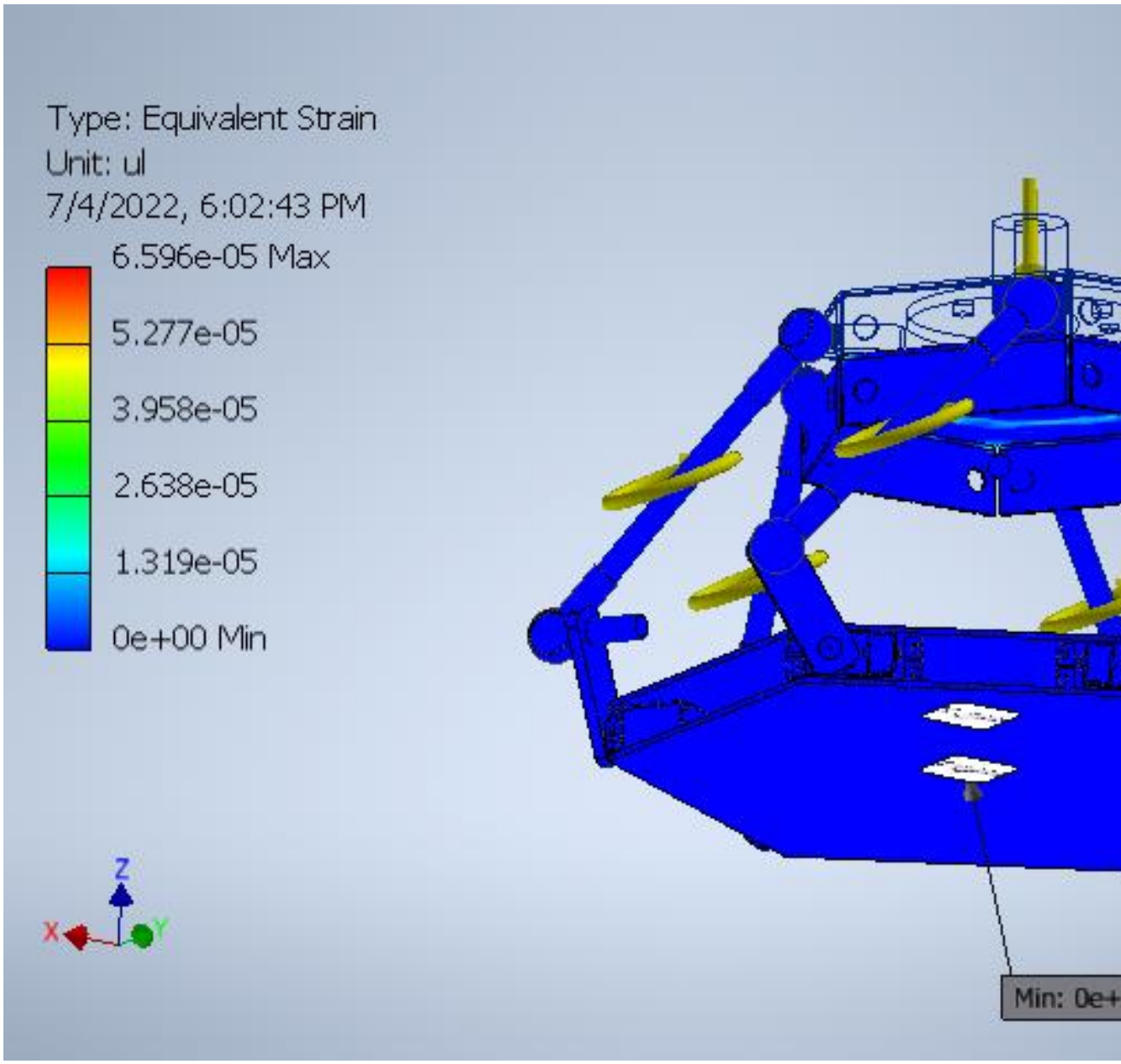
Z Displacement


Type: Z Displacement
Unit: mm
7/4/2022, 6:02:41 PM
12.47
9.9
7.48
4.99
2.49
0.02 Min
Max: 12.47 mm
Min: 0.02 mm
Z
Y
X

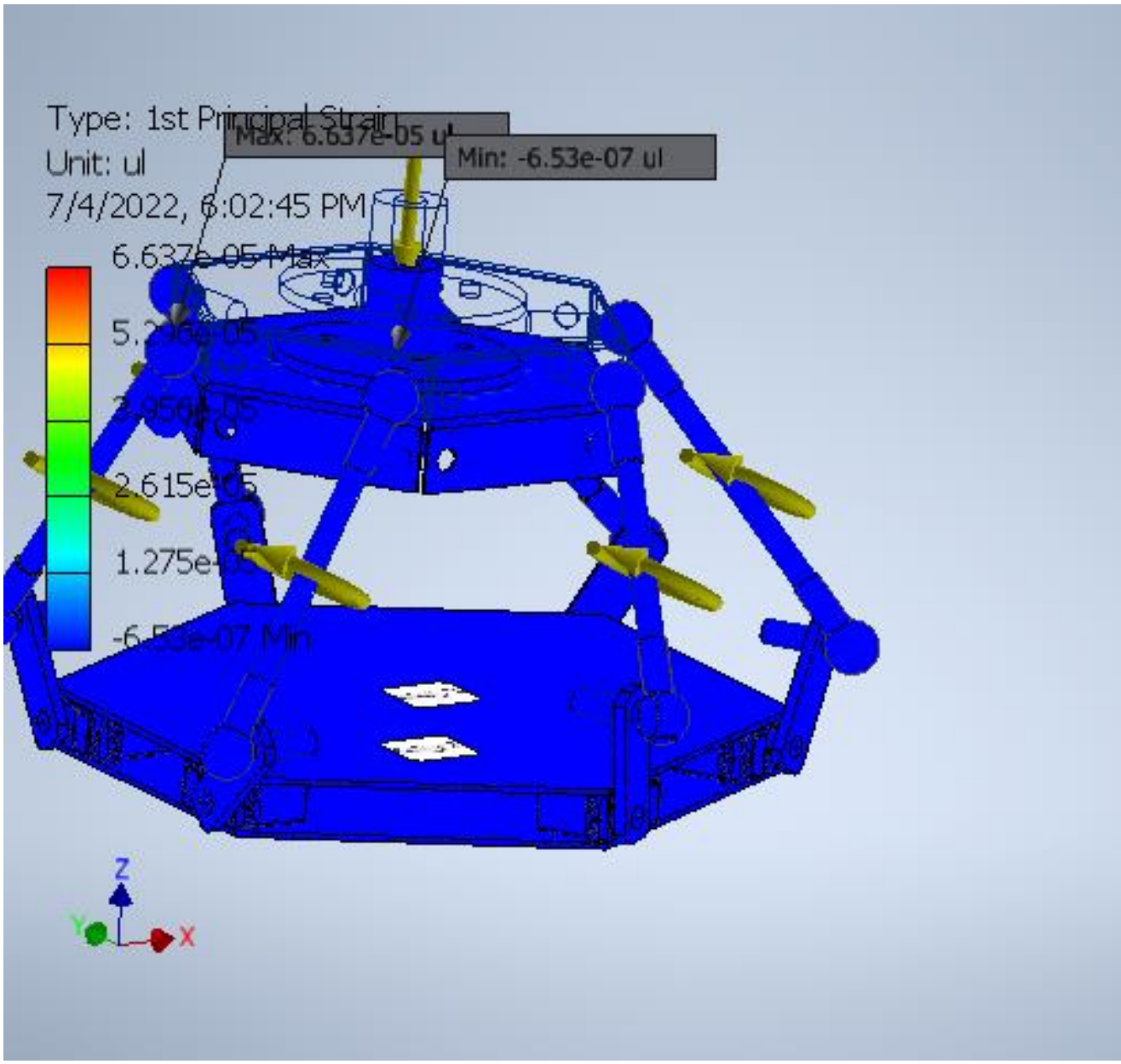


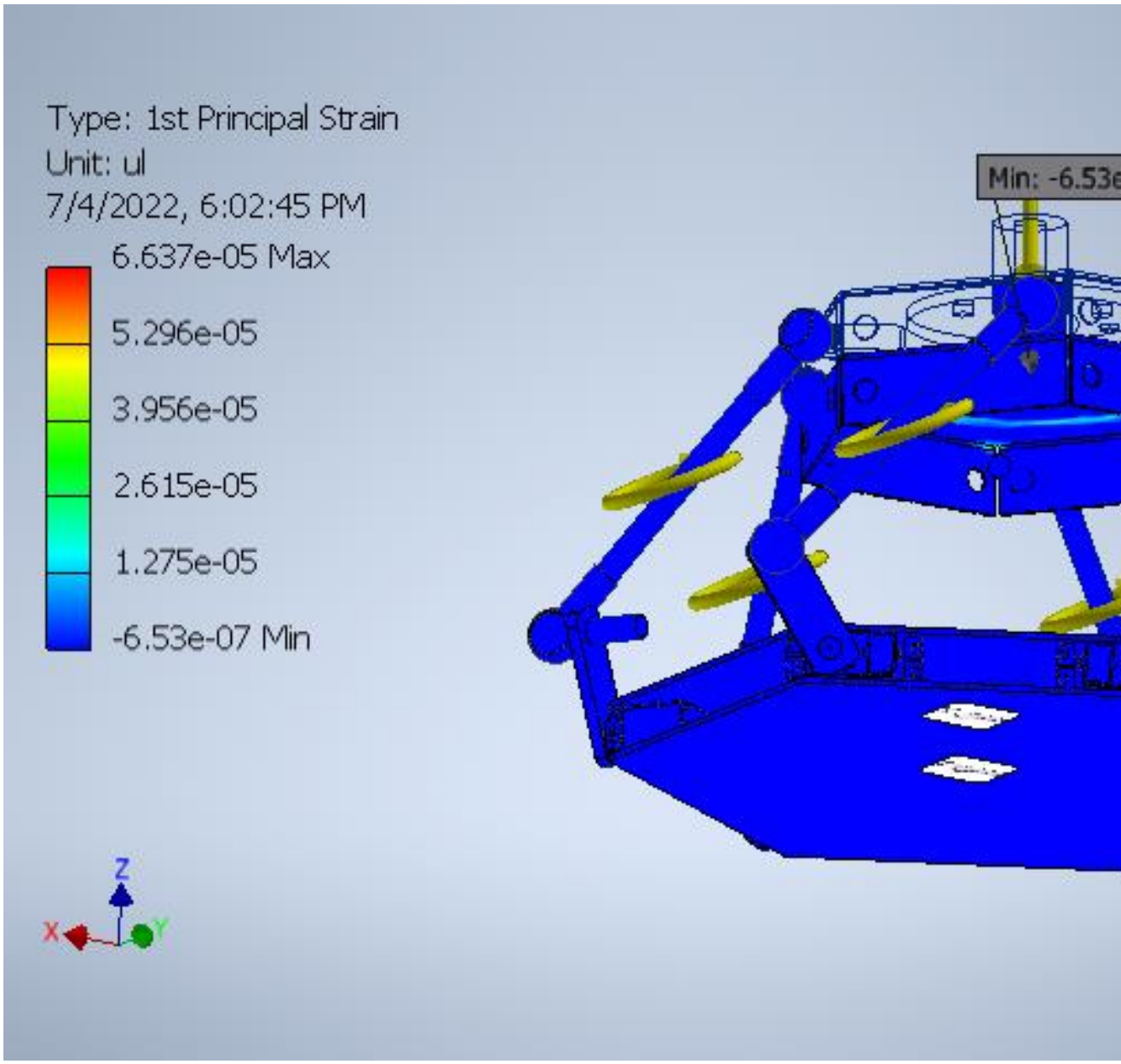
Equivalent Strain


Type: Equivalent Strain
Unit: ul
7/4/2022, 6:02:43 PM
6.596e-05 Max
Max: 6.596e-05 ul
Min: 0e+00 ul
Z
Y
X

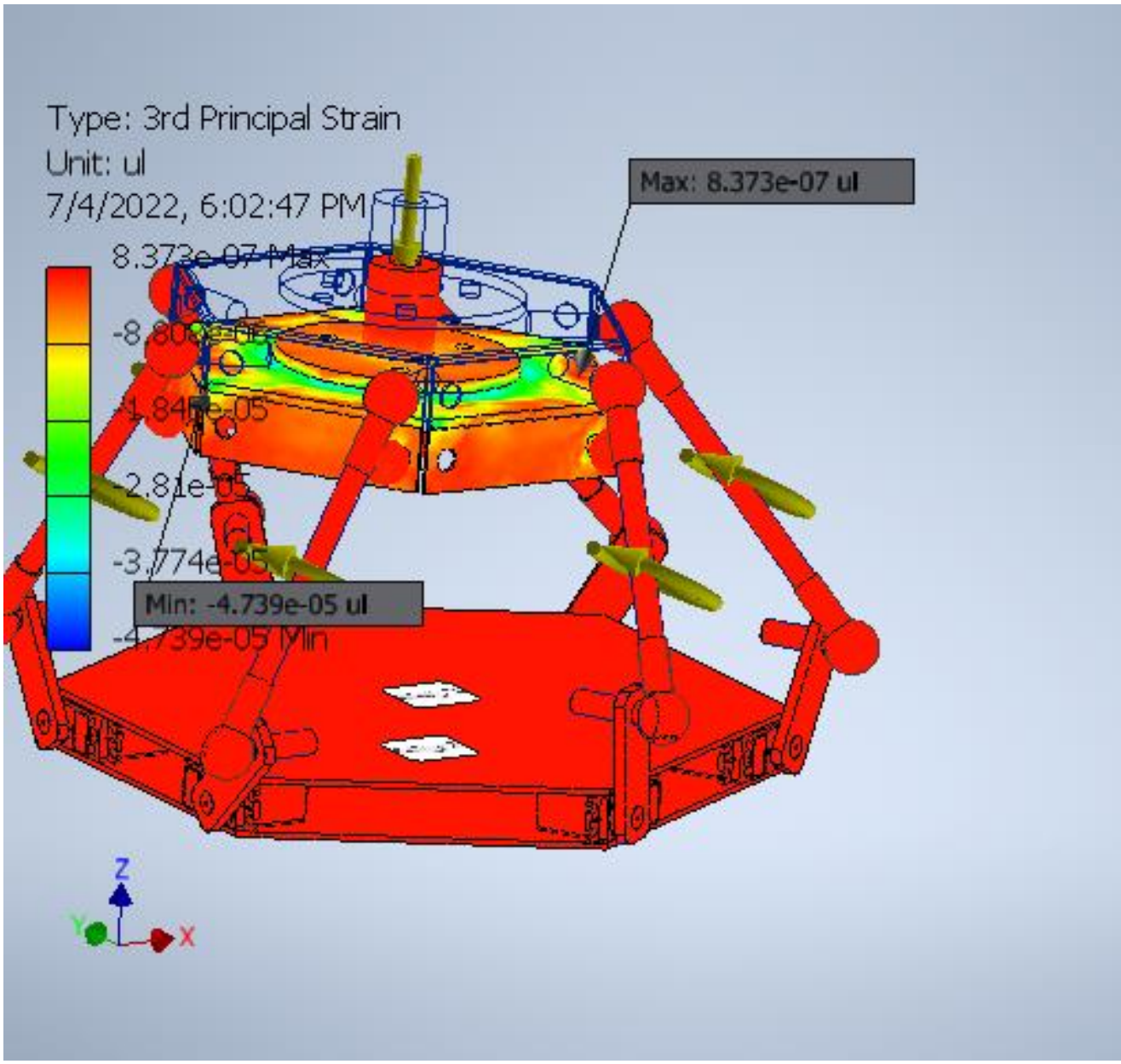


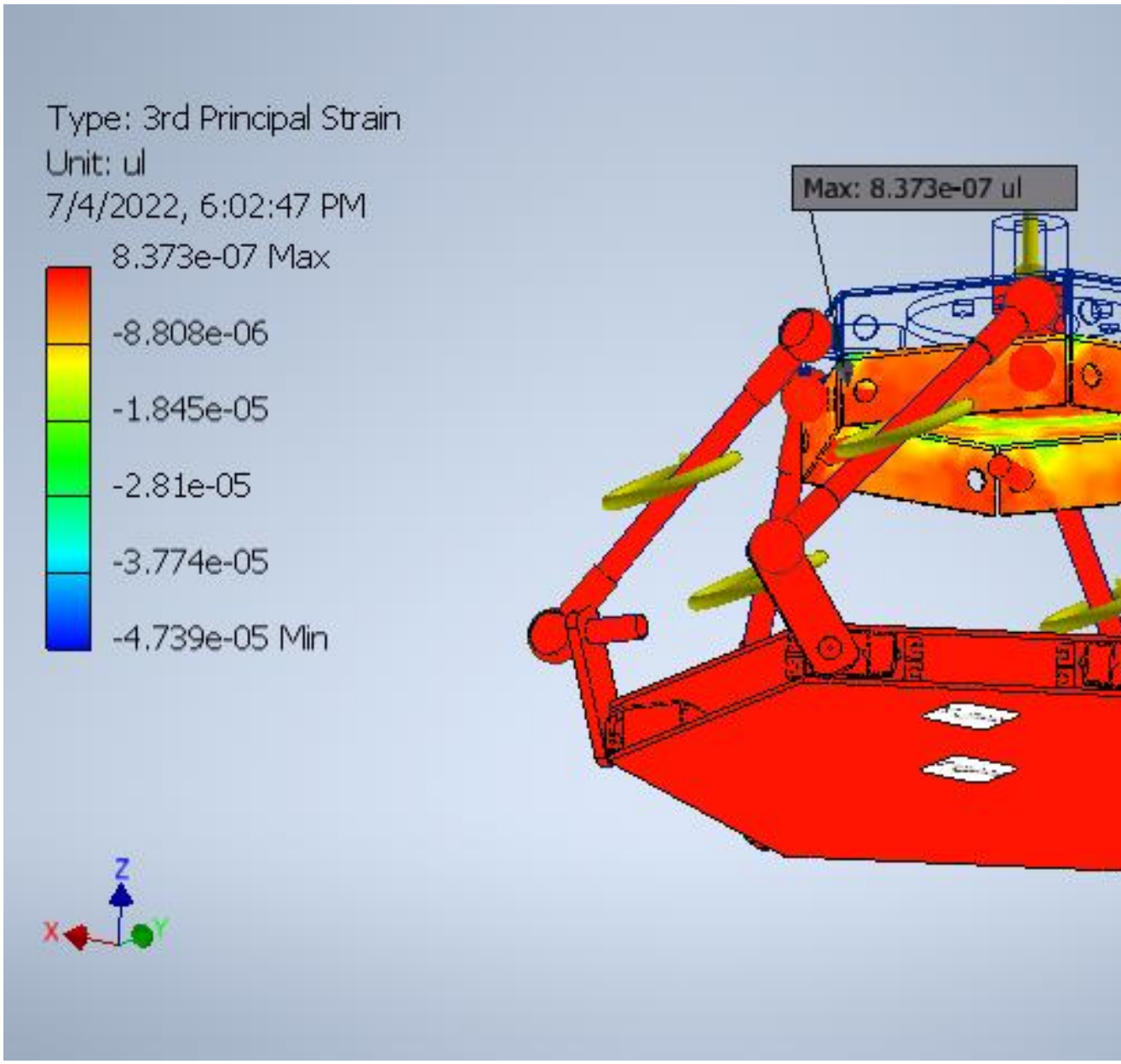
1st Principal Strain


Type: 1st Principal Strain
Unit: ul
7/4/2022, 6:02:45 PM
Max: 6.637e-05 ul
Min: -6.53e-07 ul
6.637e-05 Max
2.615e-05
1.275e-05
-6.53e-07 Min
Z
Y
X

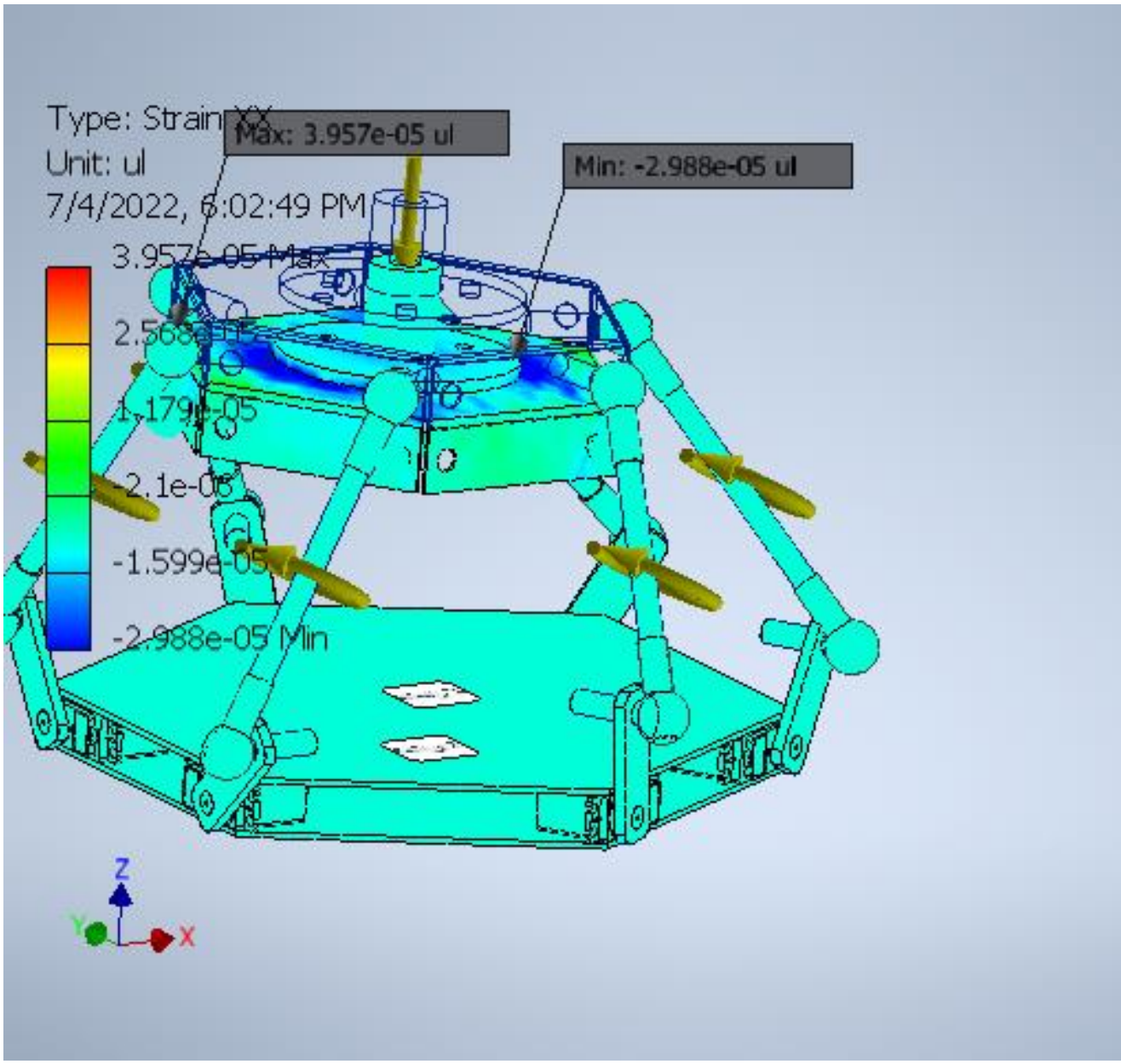


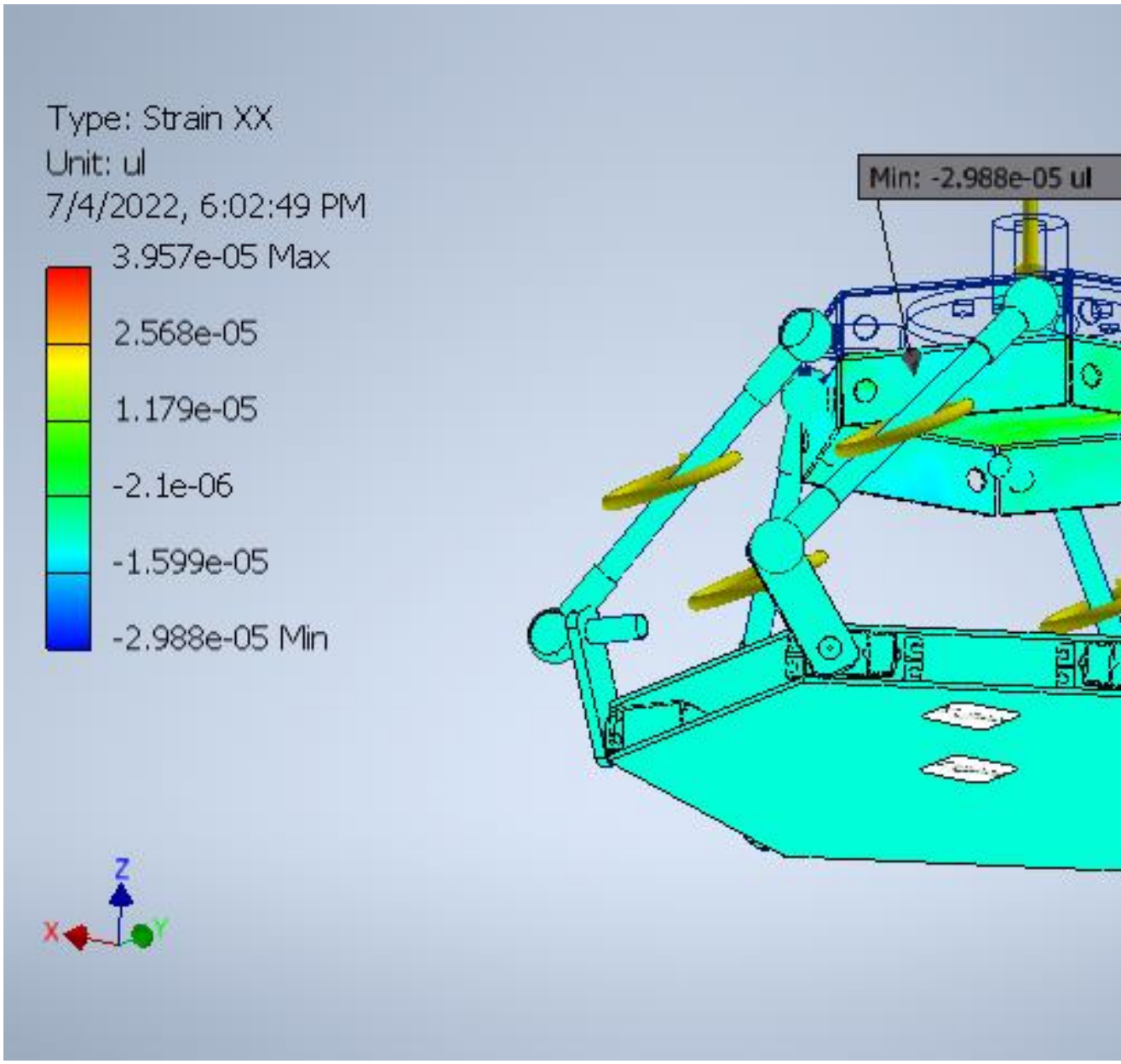
3rd Principal Strain


Type: 3rd Principal Strain
Unit: ul
7/4/2022, 6:02:47 PM
Max: 8.373e-07 ul
Min: -4.739e-05 ul
Z
Y
X

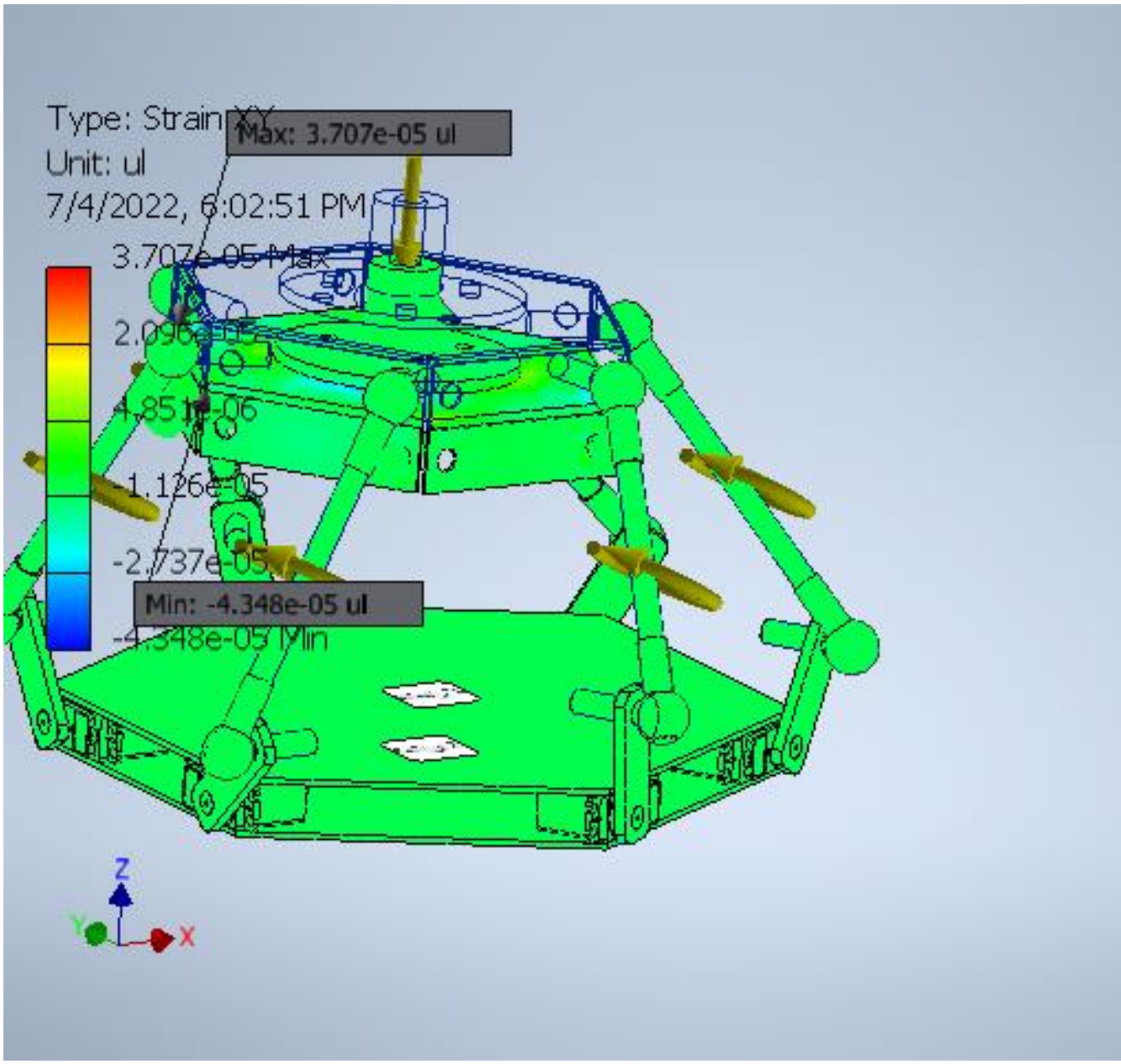

Type: 3rd Principal Strain
Unit: ul
7/4/2022, 6:02:47 PM
8.373e-07 Max
-8.808e-06
-1.845e-05
-2.81e-05
-3.774e-05
-4.739e-05 Min
Max: 8.373e-07 ul
Z
X
Y

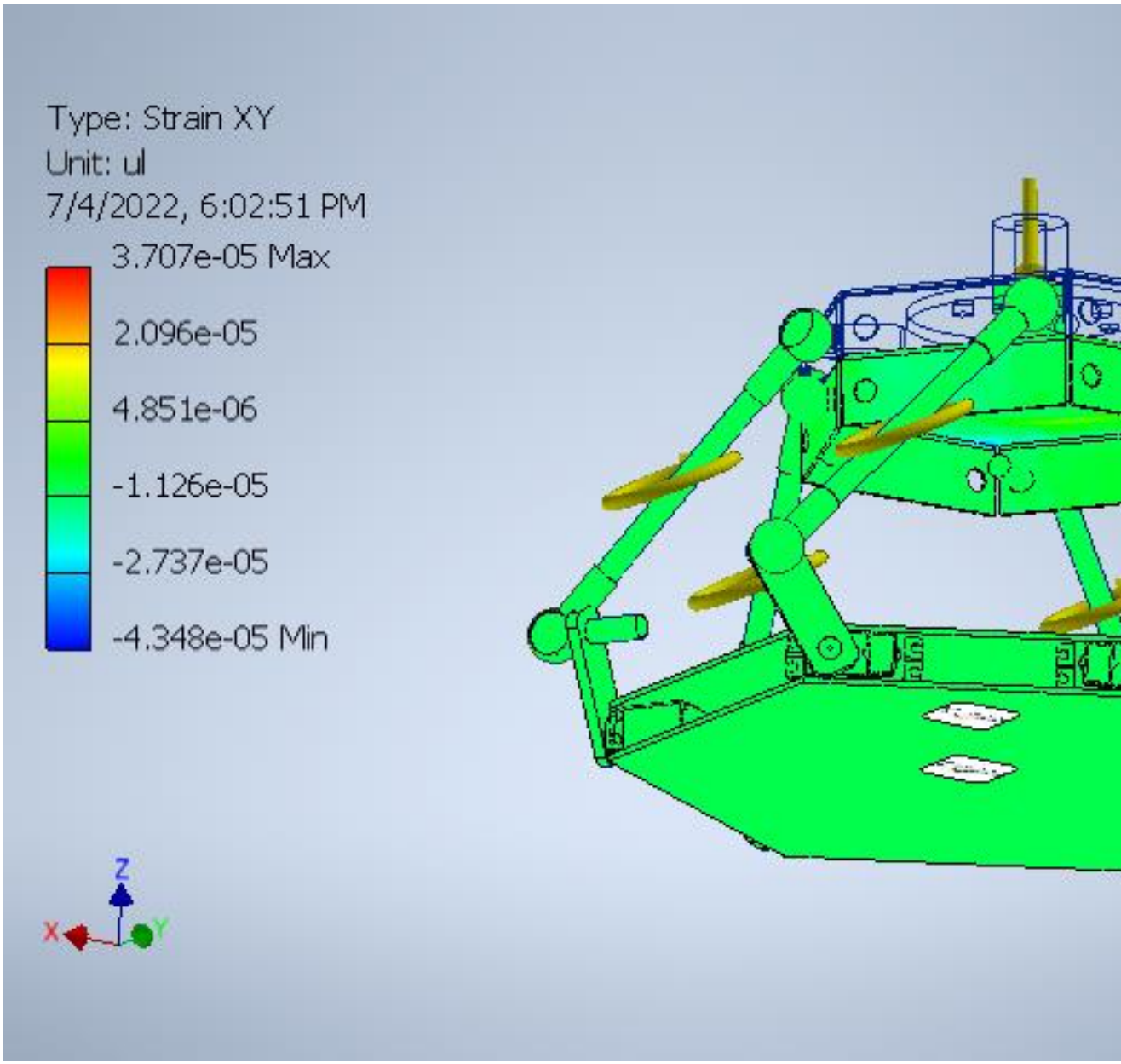
Strain XX


Type: Strain XX
Unit: ul
7/4/2022, 6:02:49 PM
Max: 3.957e-05 ul
Min: -2.988e-05 ul
3.957e-05 Max
2.568e-05
1.179e-05
-2.1e-06
-1.599e-05
-2.988e-05 Min
Z
Y
X

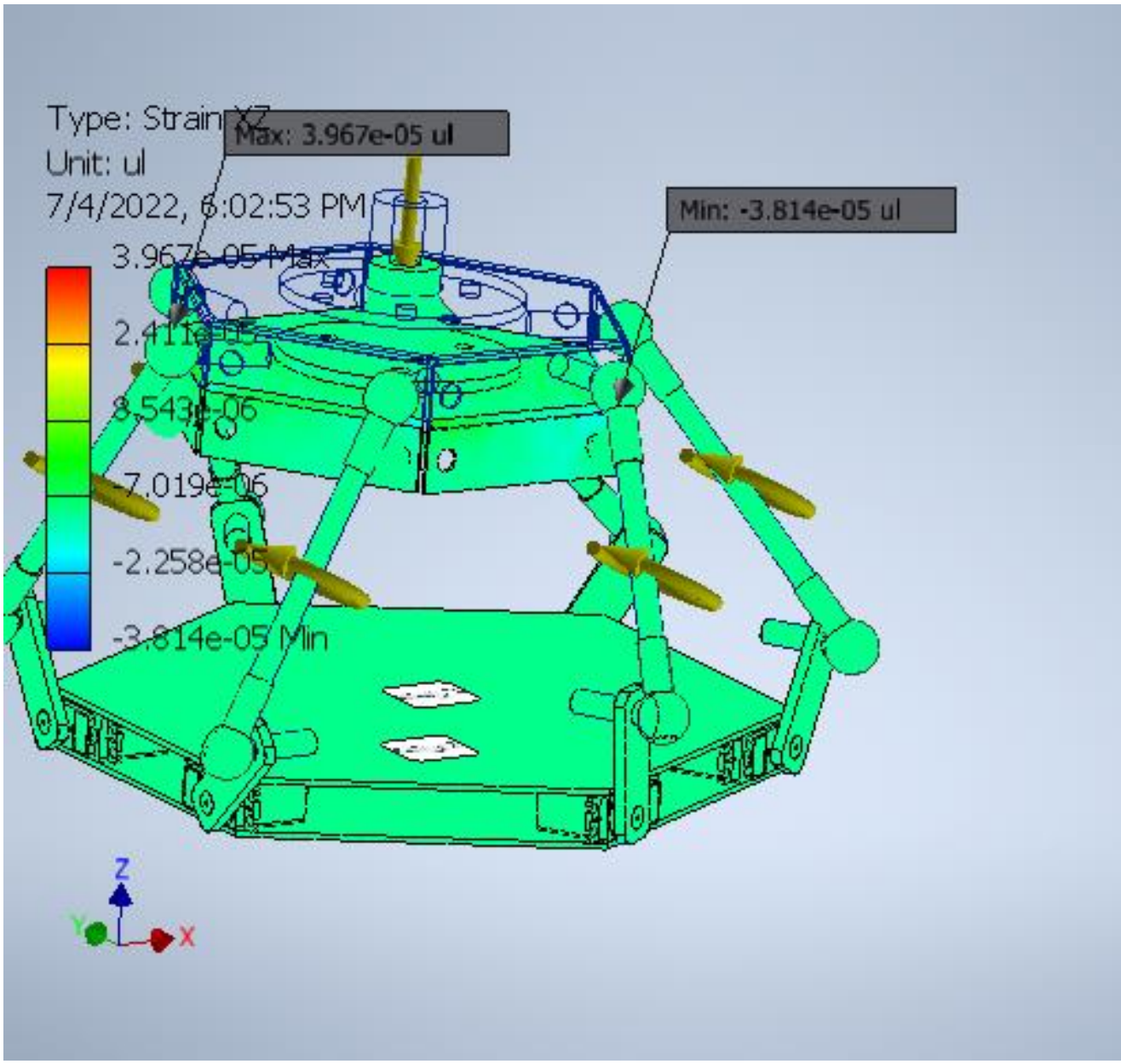

Type: Strain XX
Unit: ul
7/4/2022, 6:02:49 PM
3.957e-05 Max
2.568e-05
1.179e-05
-2.1e-06
-1.599e-05
-2.988e-05 Min
Min: -2.988e-05 ul
Z
X
Y

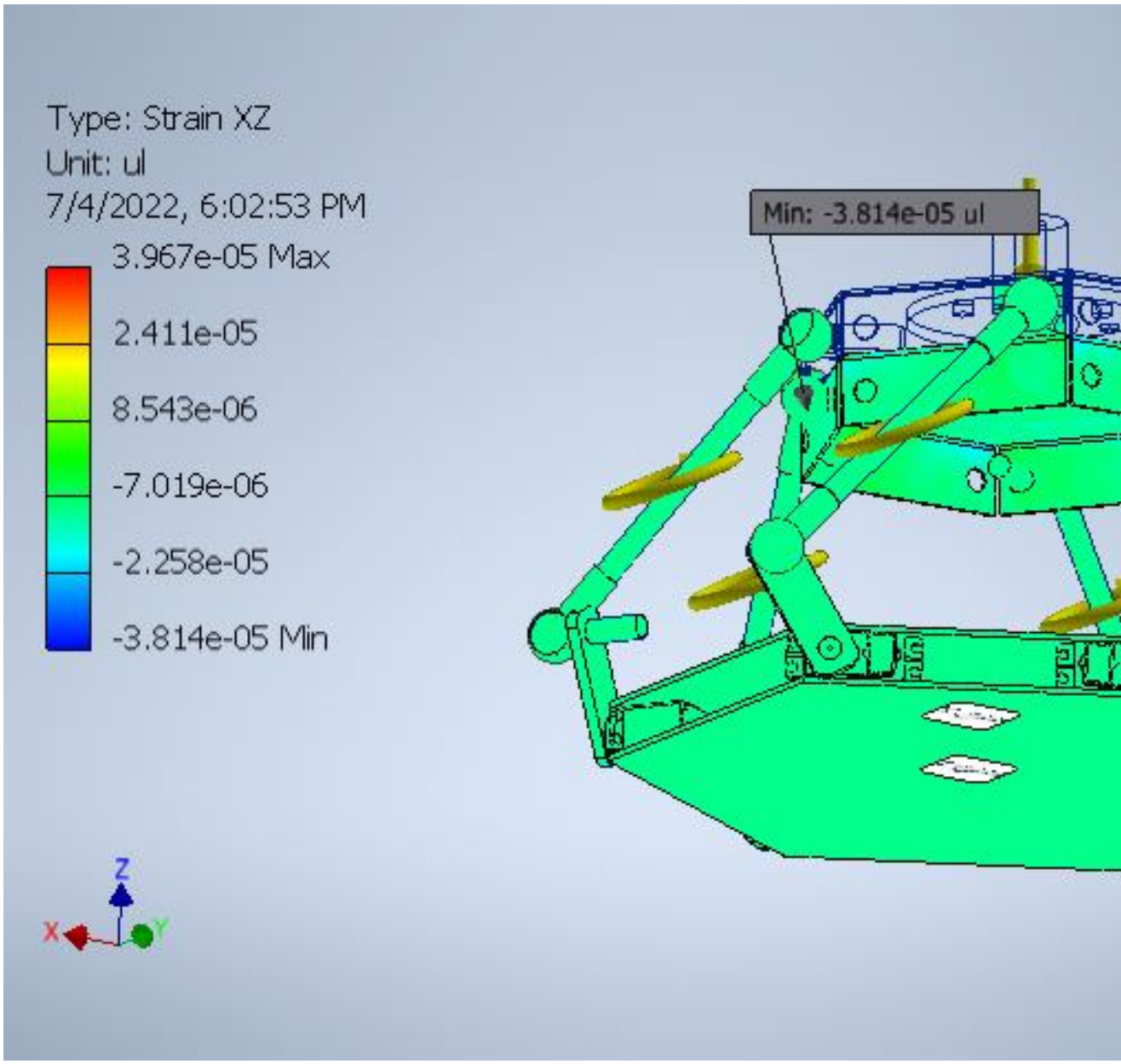
Strain XY


Type: Strain XY
Unit: ul
7/4/2022, 6:02:51 PM
Max: 3.707e-05 ul
3.707e-05 Max
2.096e-05
4.851e-06
-1.126e-05
-2.737e-05
Min: -4.348e-05 ul
-4.348e-05 Min
Z
Y
X

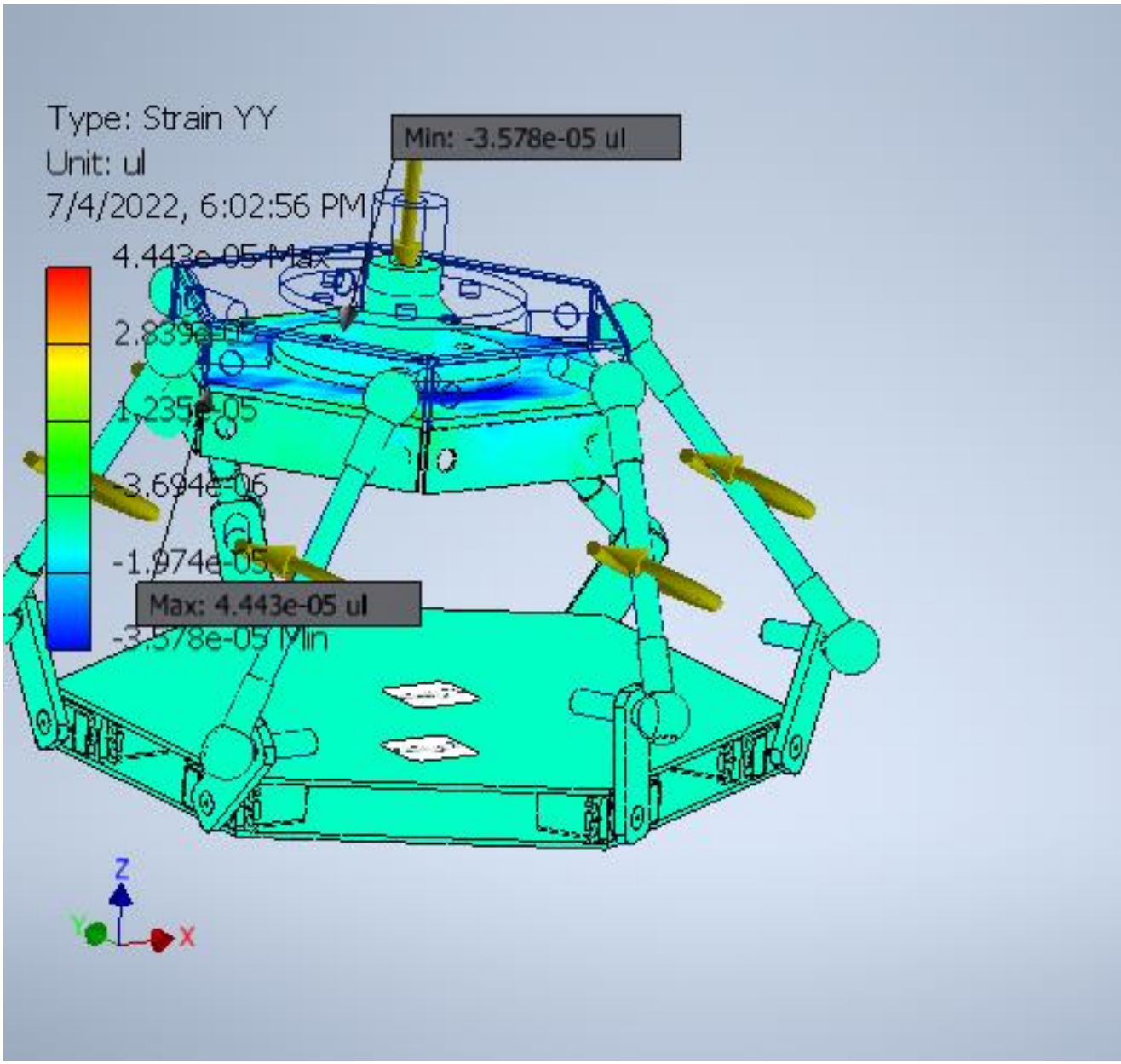

Type: Strain XY
Unit: ul
7/4/2022, 6:02:51 PM
3.707e-05 Max
2.096e-05
4.851e-06
-1.126e-05
-2.737e-05
-4.348e-05 Min
Z
X
Y

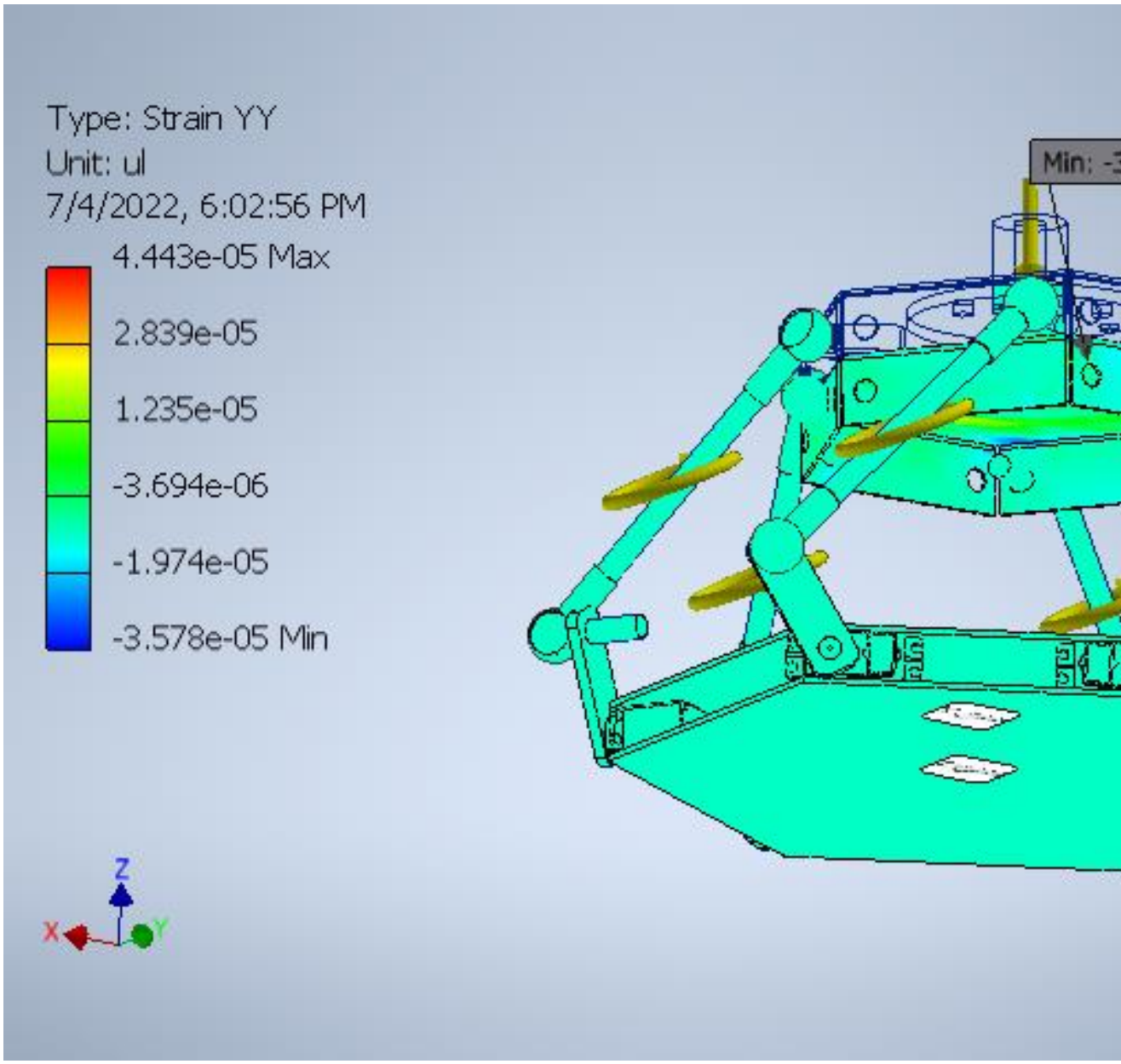
Strain XZ


Type: Strain XZ
Unit: ul
7/4/2022, 6:02:53 PM
Max: 3.967e-05 ul
Min: -3.814e-05 ul
3.967e-05 Max
2.411e-05
8.543e-06
-7.019e-06
-2.258e-05
-3.814e-05 Min
Z
Y
X

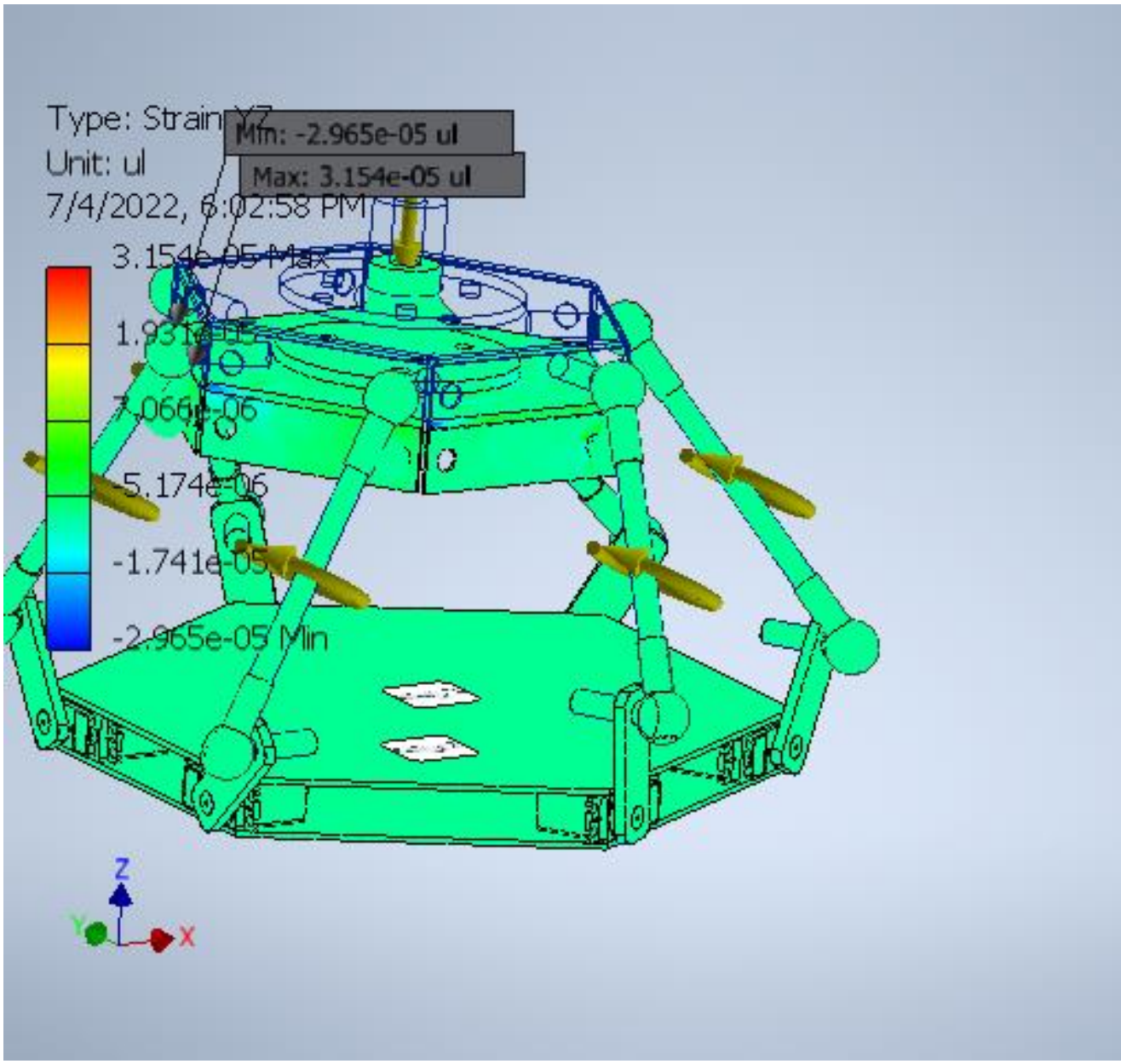

Type: Strain XZ
Unit: ul
7/4/2022, 6:02:53 PM
3.967e-05 Max
2.411e-05
8.543e-06
-7.019e-06
-2.258e-05
-3.814e-05 Min
Min: -3.814e-05 ul
Z
X
Y

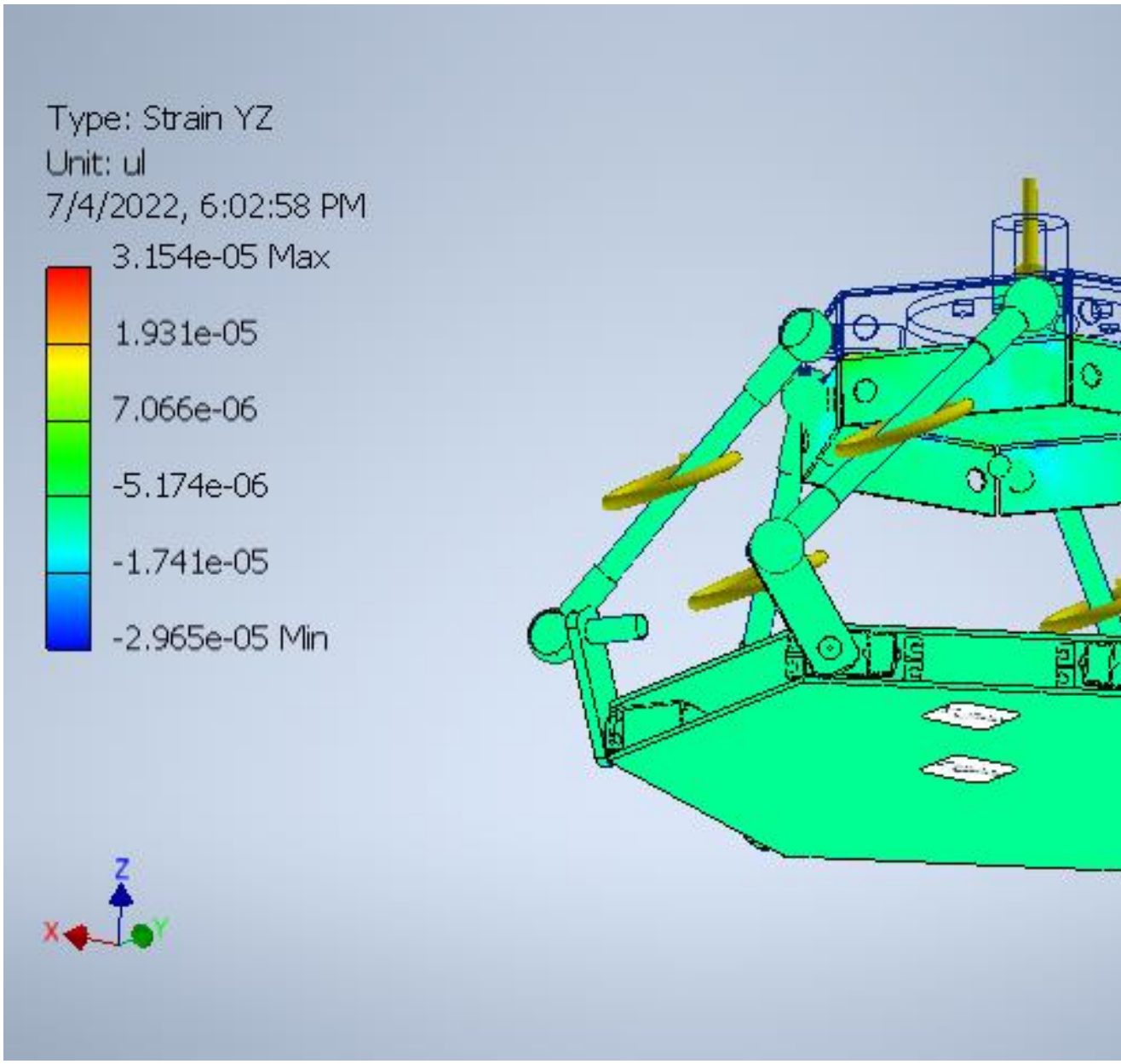
Strain YY


Type: Strain YY
Unit: ul
7/4/2022, 6:02:56 PM
Min: -3.578e-05 ul
4.443e-05 Max
2.839e-05
1.235e-05
-3.694e-06
-1.974e-05
Max: 4.443e-05 ul
-3.578e-05 Min
Z
Y
X

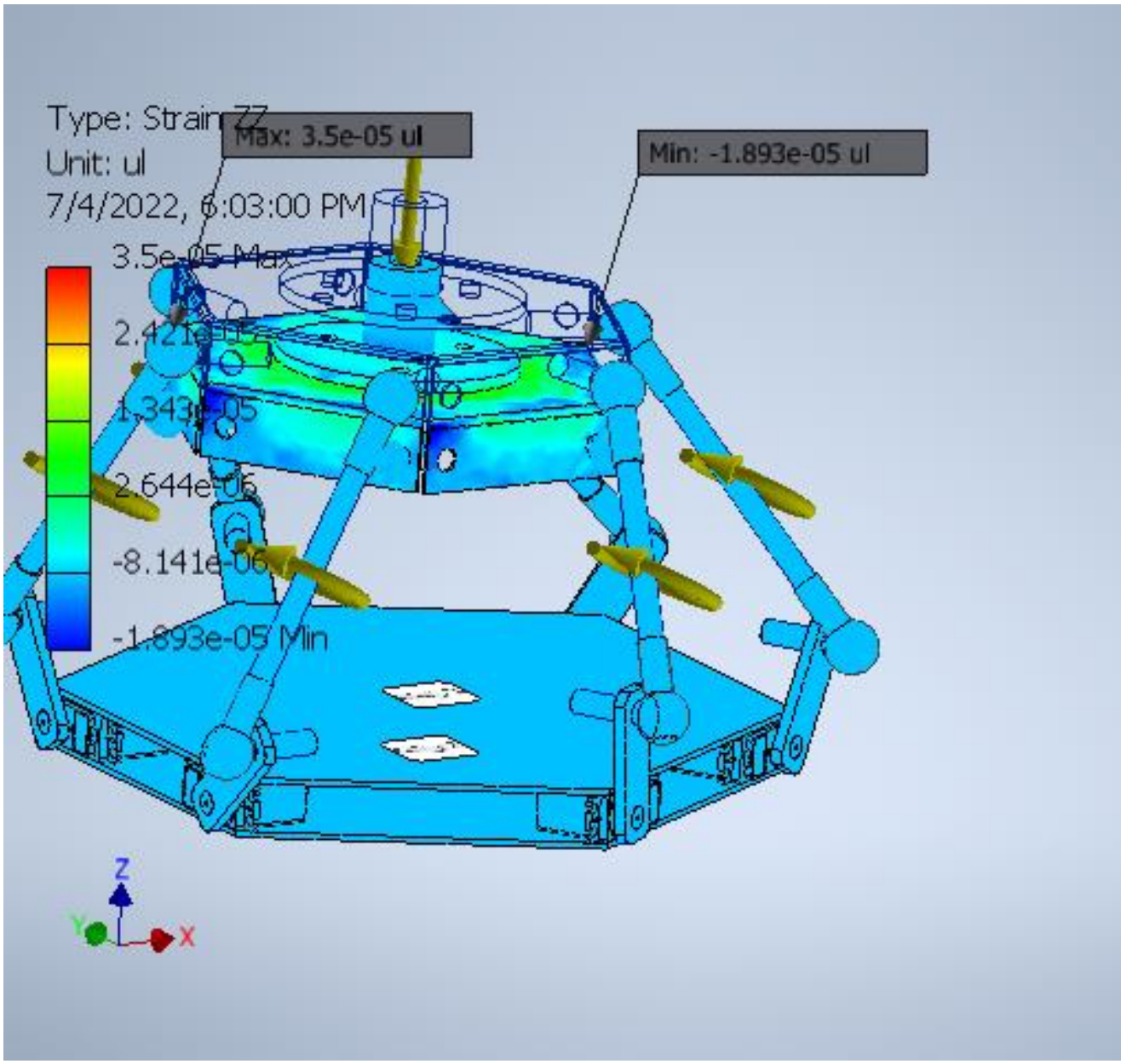

Type: Strain YY
Unit: ul
7/4/2022, 6:02:56 PM
4.443e-05 Max
2.839e-05
1.235e-05
-3.694e-06
-1.974e-05
-3.578e-05 Min
Min:
Z
X
Y

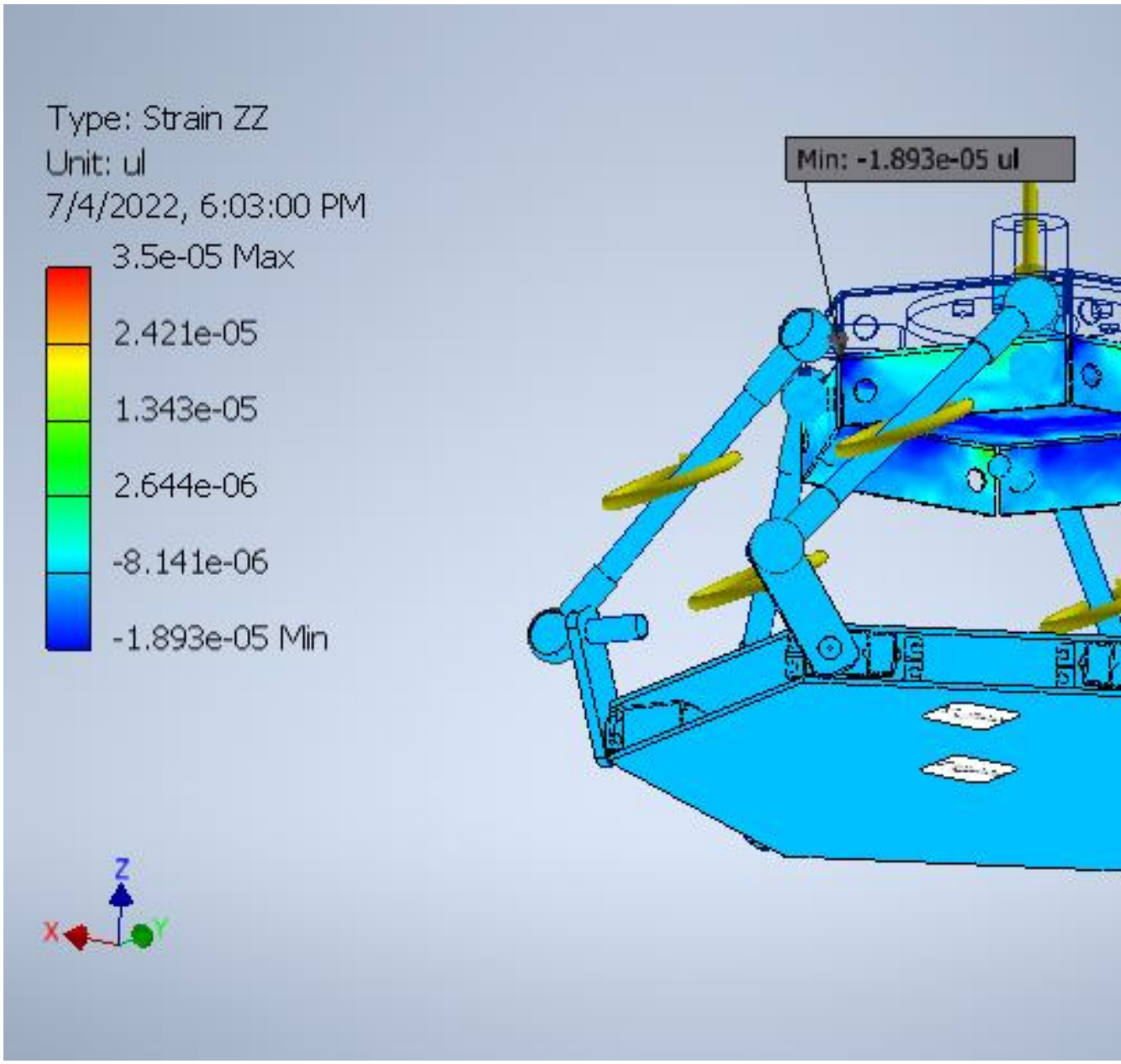
Strain YZ


Type: Strain YZ
Unit: ul
7/4/2022, 6:02:58 PM
Min: -2.965e-05 ul
Max: 3.154e-05 ul
3.154e-05 Max
1.931e-05
7.066e-06
-5.174e-06
-1.741e-05
-2.965e-05 Min
Z
Y
X

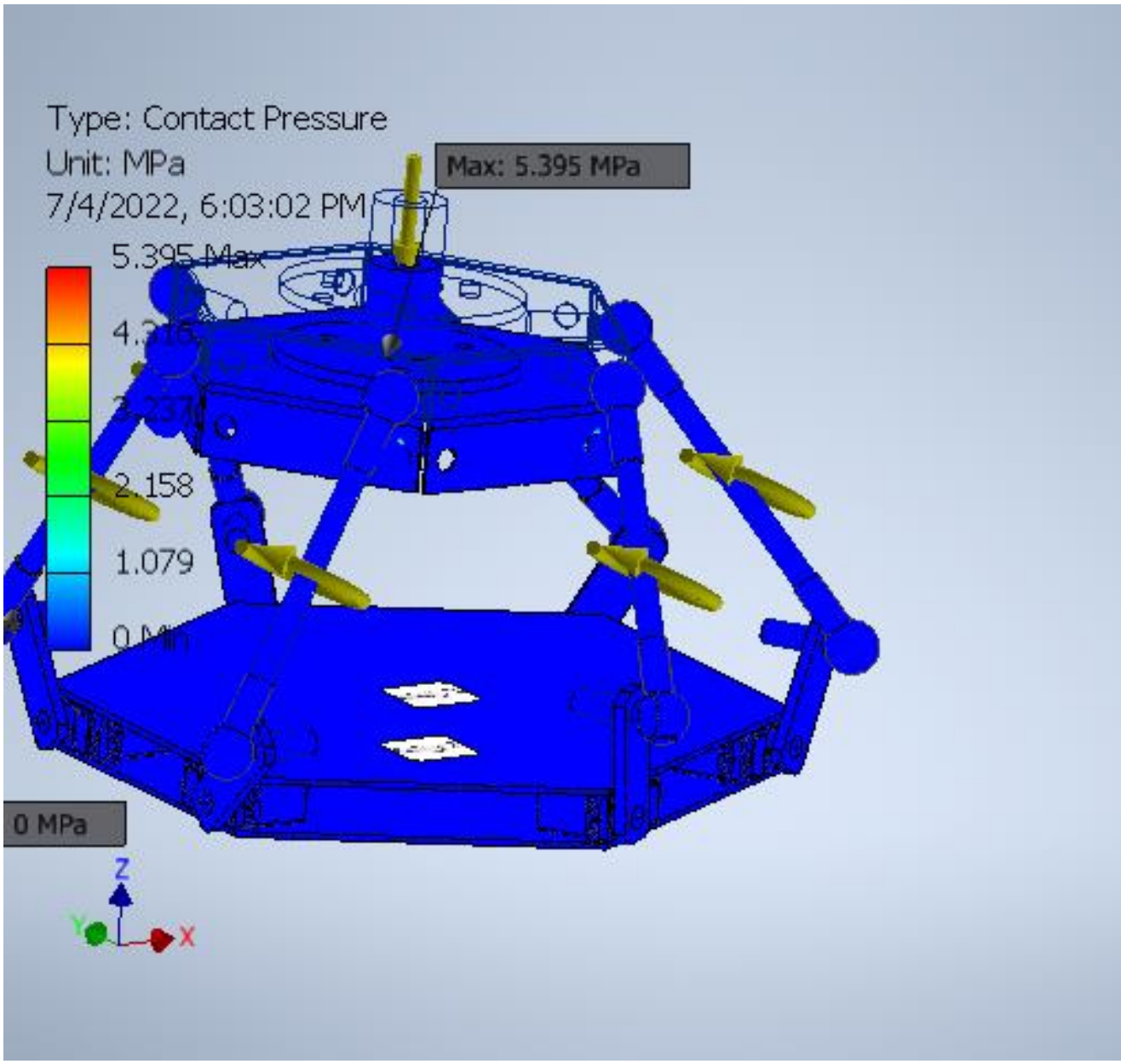

Type: Strain YZ
Unit: ul
7/4/2022, 6:02:58 PM
3.154e-05 Max
1.931e-05
7.066e-06
-5.174e-06
-1.741e-05
-2.965e-05 Min
Z
X
Y

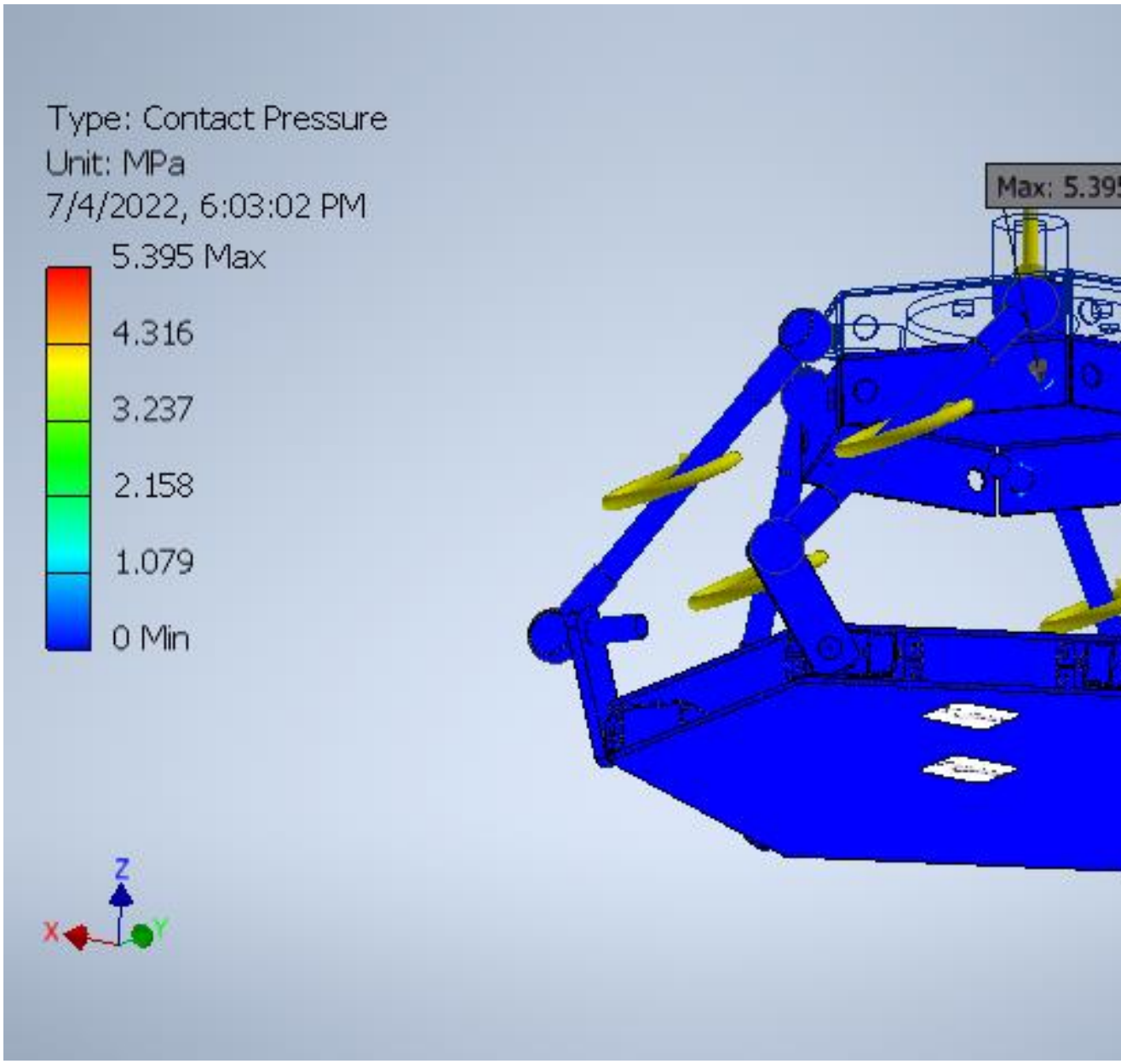
Strain ZZ


Type: Strain ZZ
Unit: ul
7/4/2022, 6:03:00 PM
Max: 3.5e-05 ul
Min: -1.893e-05 ul
3.5e-05 Max
2.421e-05
1.343e-05
2.644e-06
-8.141e-06
-1.893e-05 Min
Z
Y
X

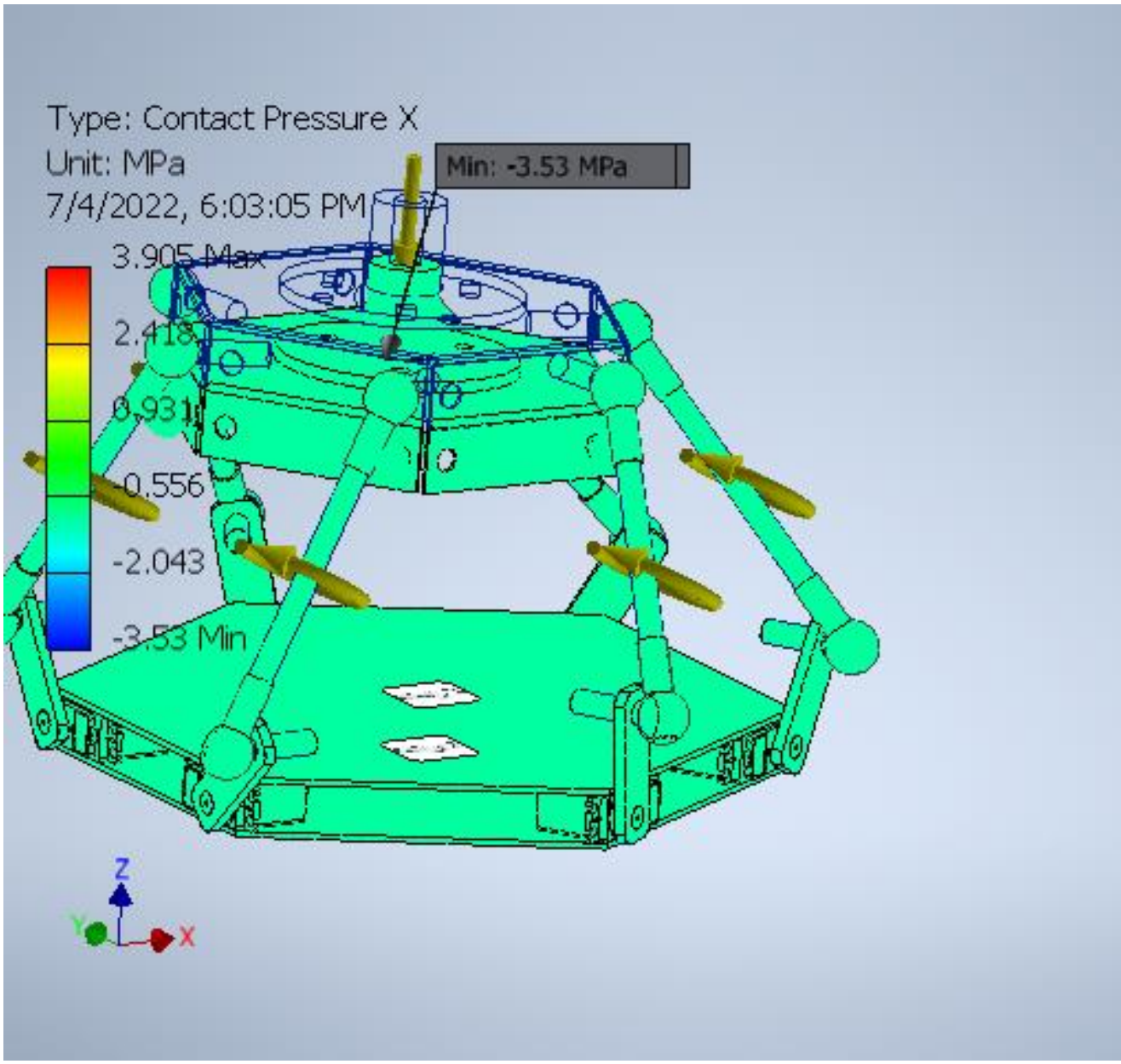


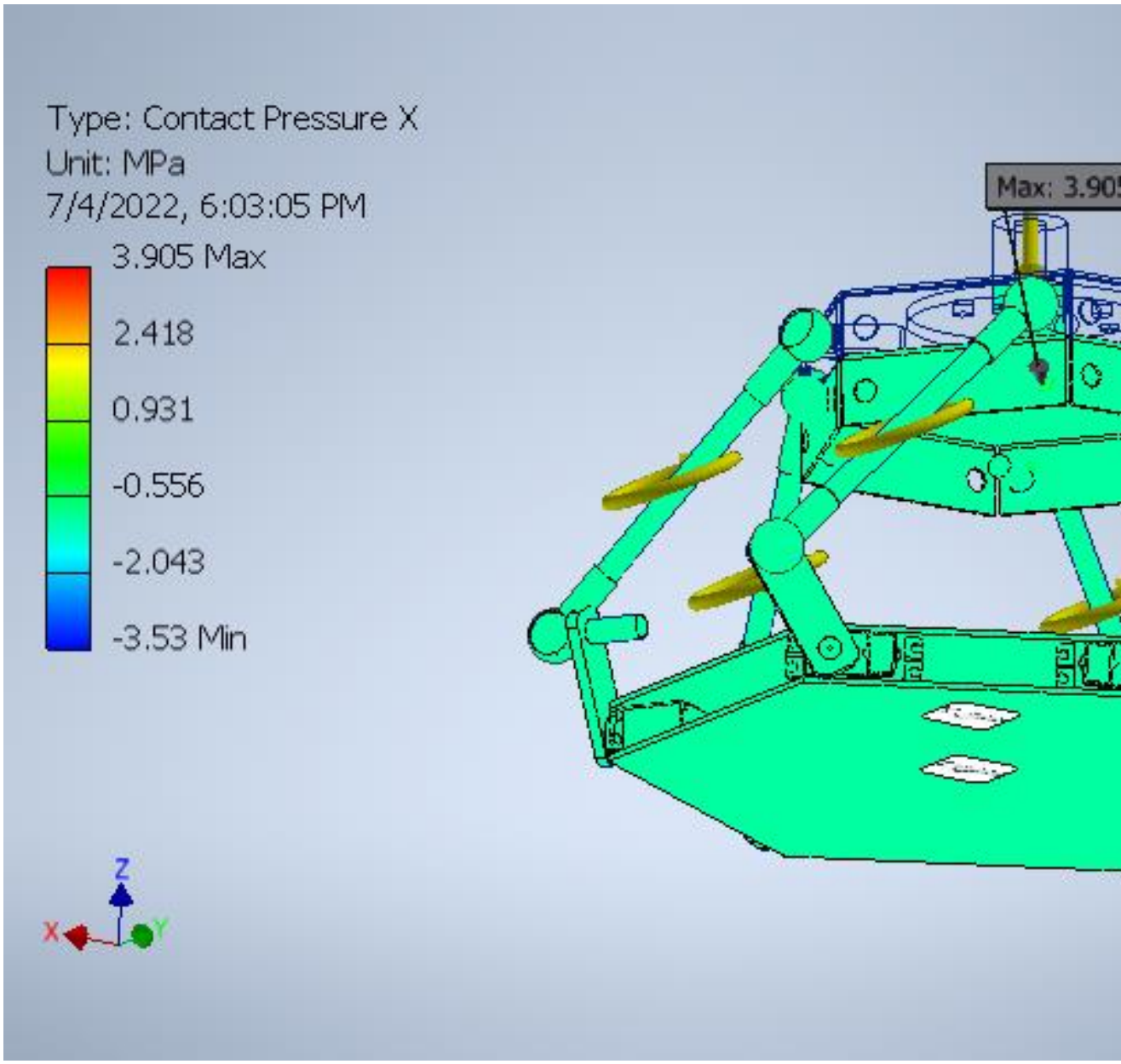
Contact Pressure


Type: Contact Pressure
Unit: MPa
7/4/2022, 6:03:02 PM
Max: 5.395 MPa
5.395 Max
2.158
1.079
0 MPa
Z
Y
X

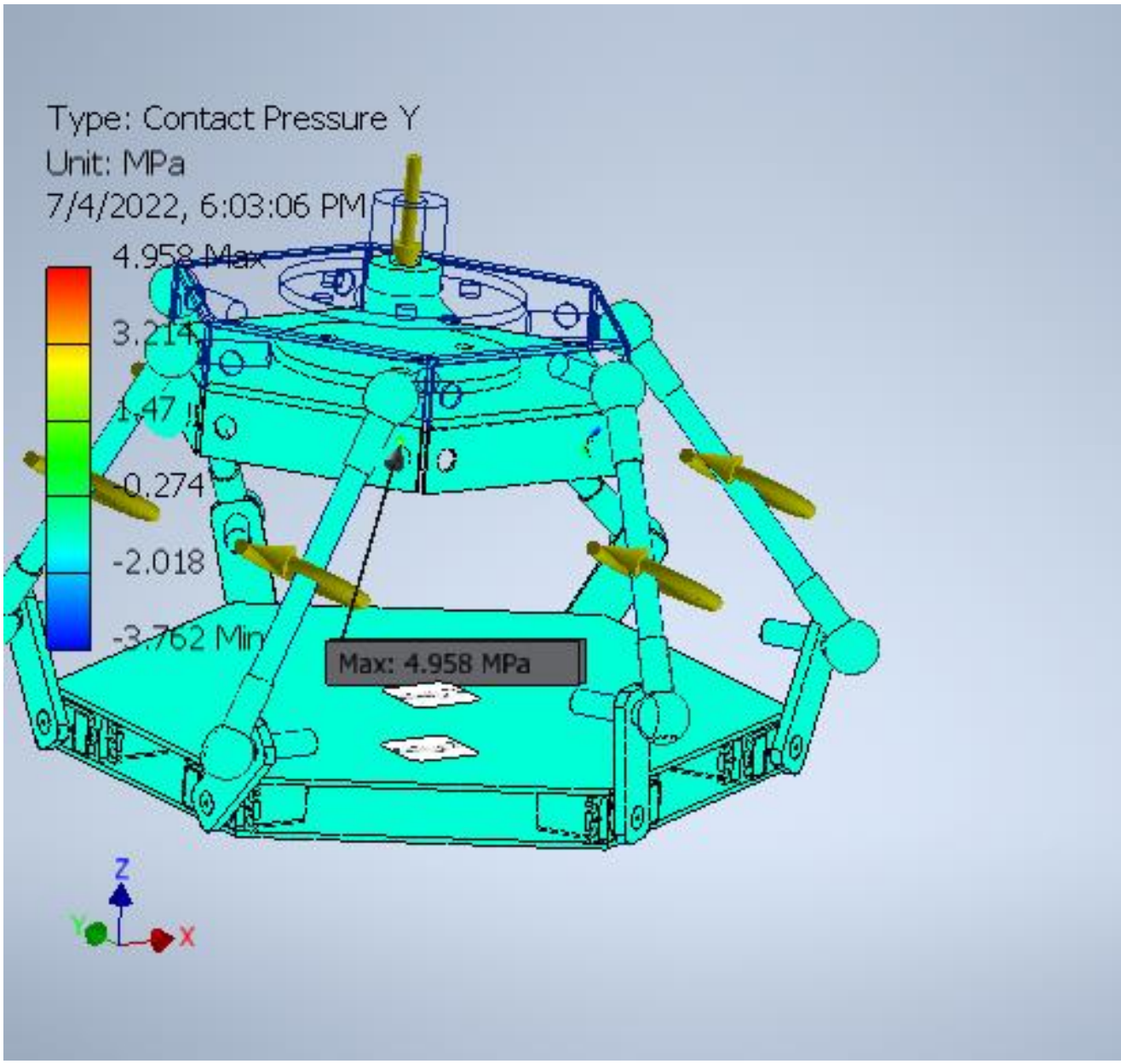


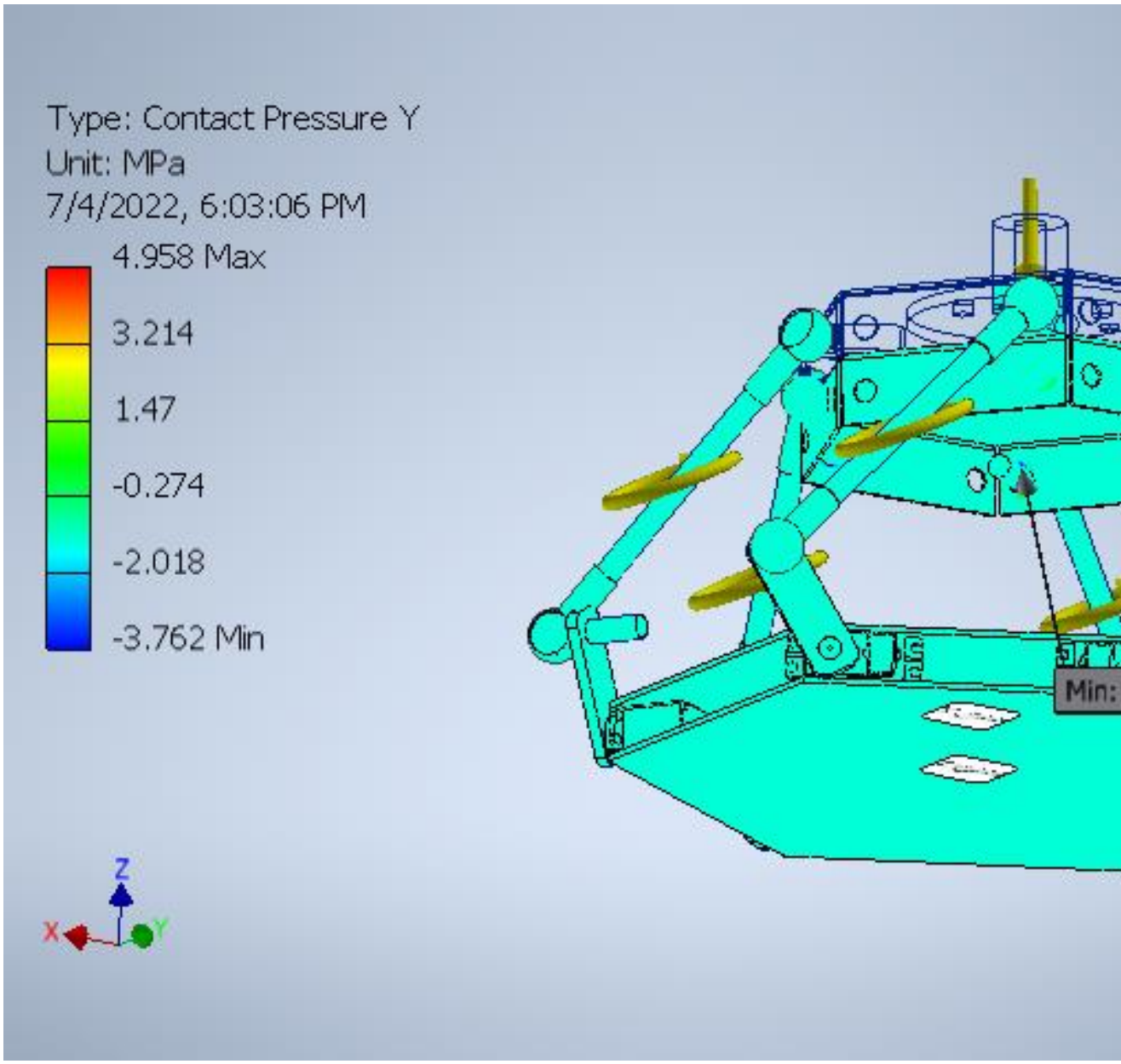
Contact Pressure X


Type: Contact Pressure X
Unit: MPa
7/4/2022, 6:03:05 PM
Min: -3.53 MPa
3.905 Max
2.418
0.931
-0.556
-2.043
-3.53 Min
Z
Y
X

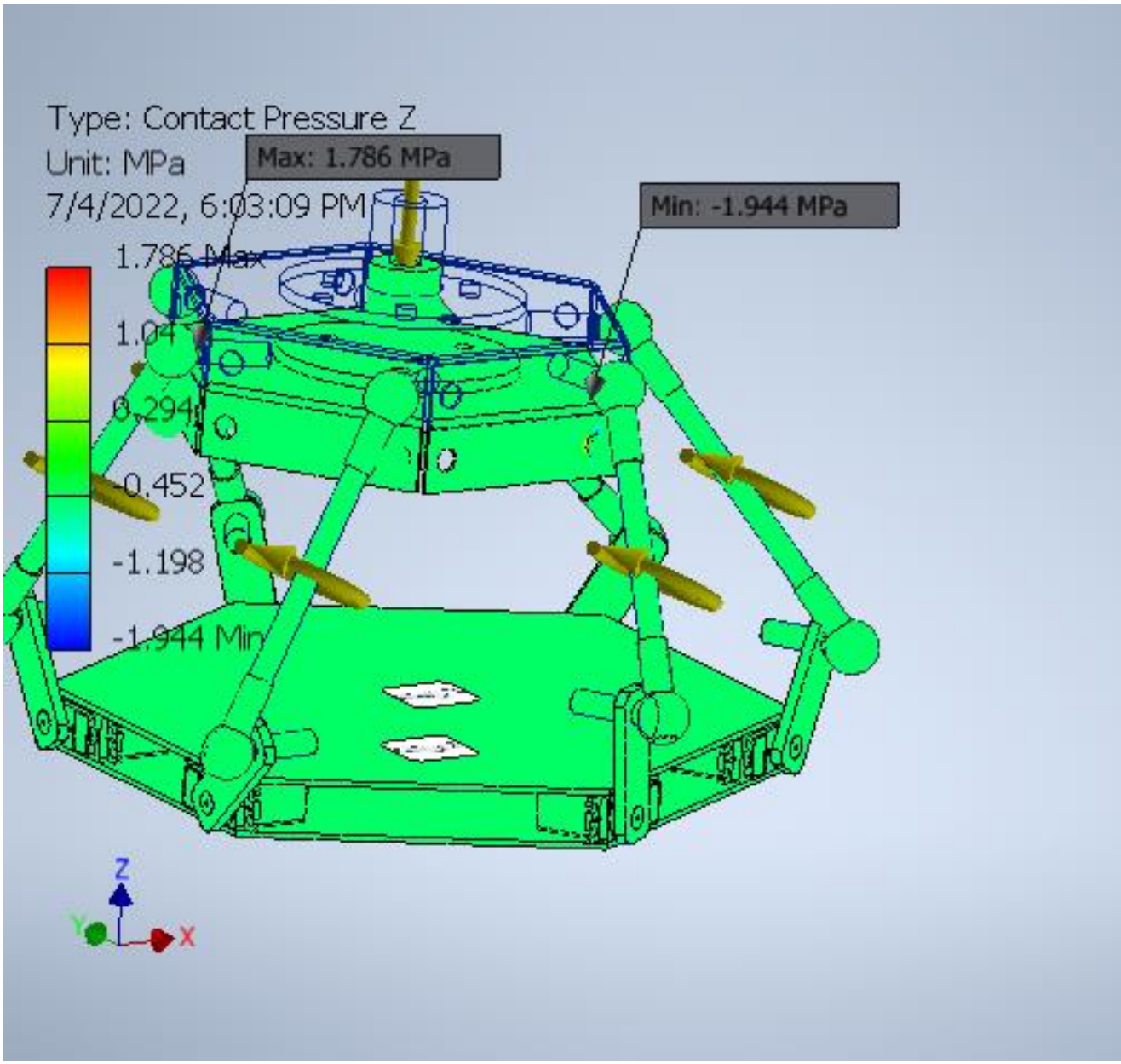


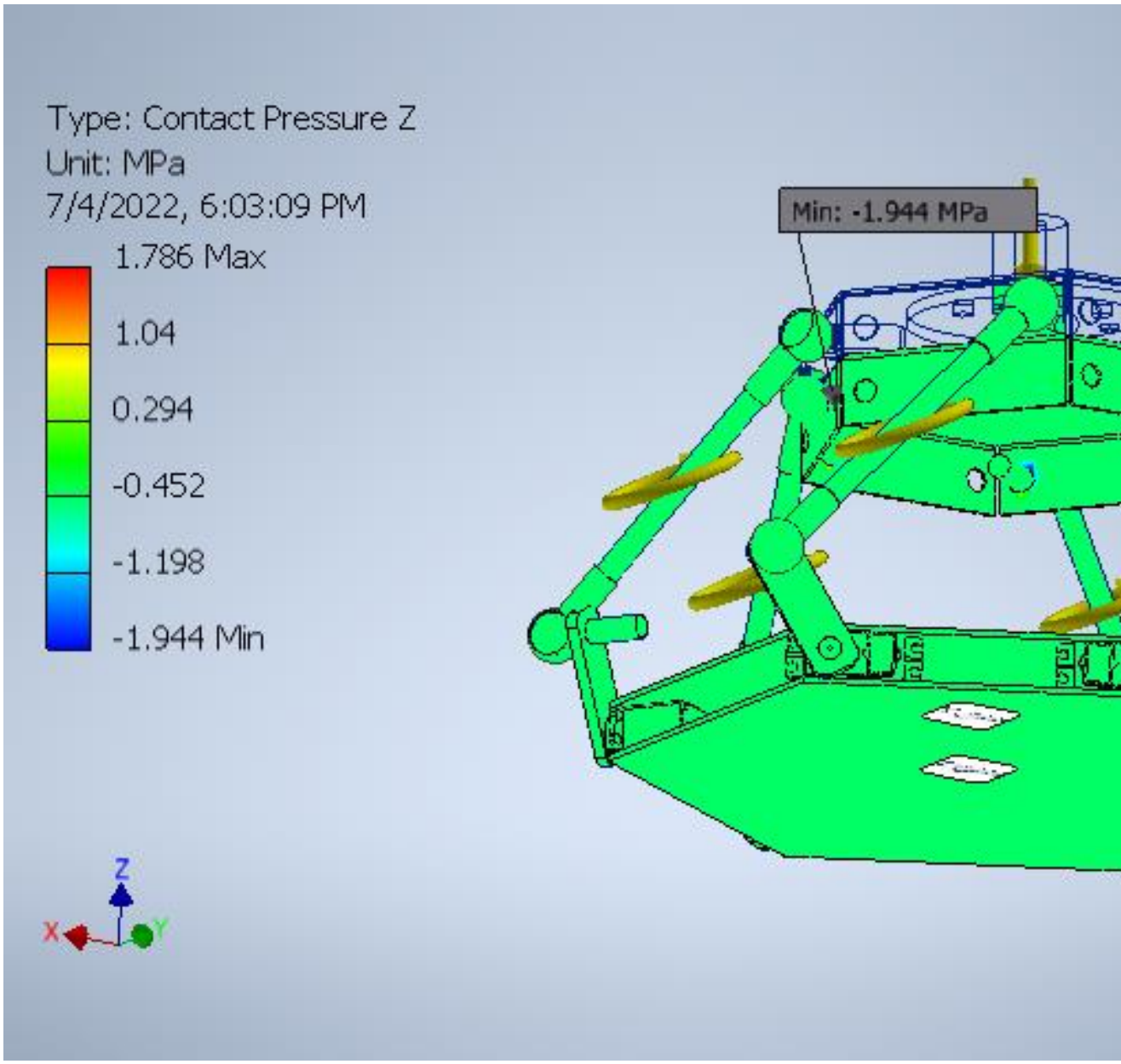
Contact Pressure Y


Type: Contact Pressure Y
Unit: MPa
7/4/2022, 6:03:06 PM
4.958 Max
3.214
1.47
-0.274
-2.018
-3.762 Min
Max: 4.958 MPa
Z
Y
X



Contact Pressure Z


Type: Contact Pressure Z
Unit: MPa
7/4/2022, 6:03:09 PM
Max: 1.786 MPa
Min: -1.944 MPa
1.786 Max
1.094
0.294
-0.452
-1.198
-1.944 Min
Z
Y
X



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