Analysis of a Brake System
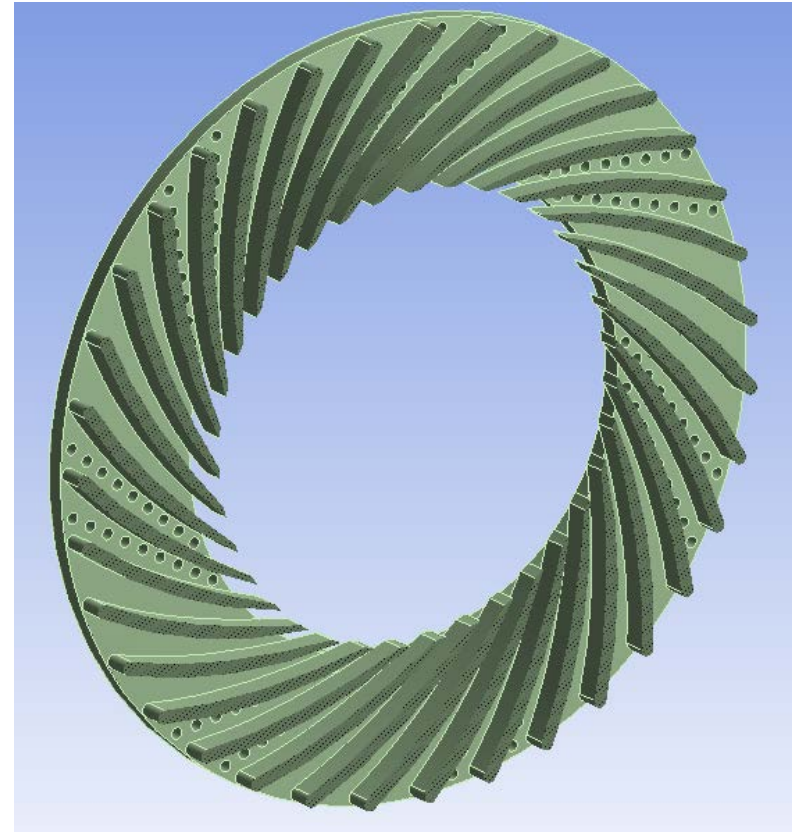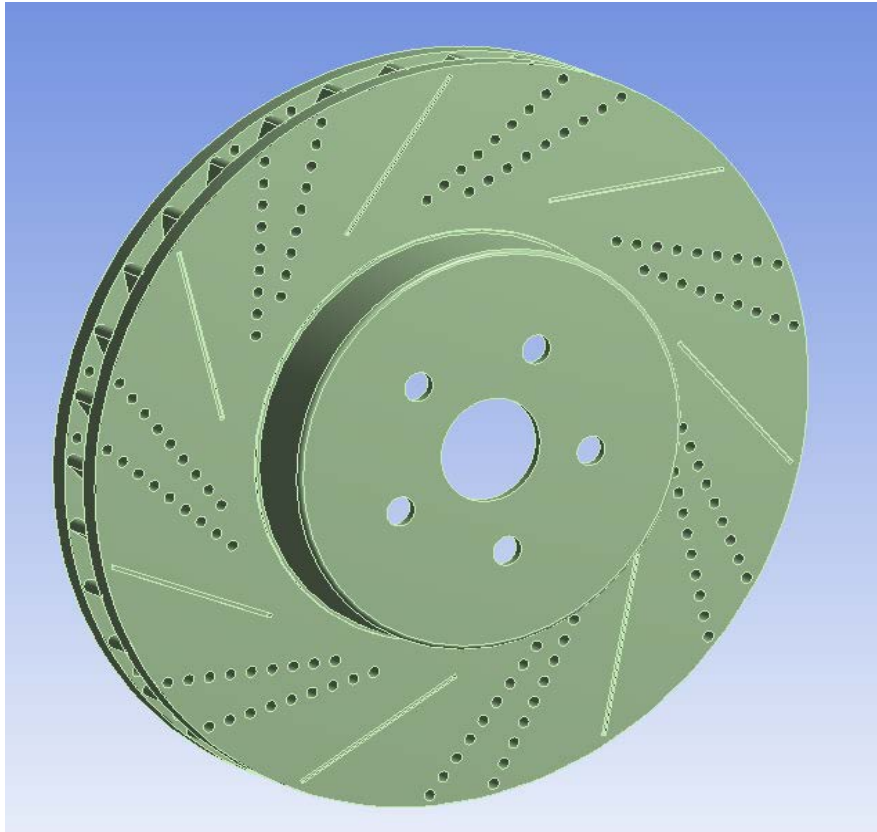
Mike Emerson | FEM Final Project

Overview

- Geometry and Material

- Static Analysis

- Steady State Thermal Analysis

- Modal Analysis

- Conclusions

Geometry and Material

- Geometry is a simplified Brembo automotive brake system

Geometry and Material

- Material is Structural Steel with the following properties:

Material Properties - Structural Steel		
Density	7850	kg m^-3
Young's Modulus	2.0 E+11	Pa
Poisson's Ratio	0.3	
Thermal Expansion Coefficient	1.20E-05	C^-1
Zero-Thermal-Strain Reference Temperature	22	C

Static Analysis – Boundary Conditions

- 100 Nm moment applied as well as fixed supports at bolt holes
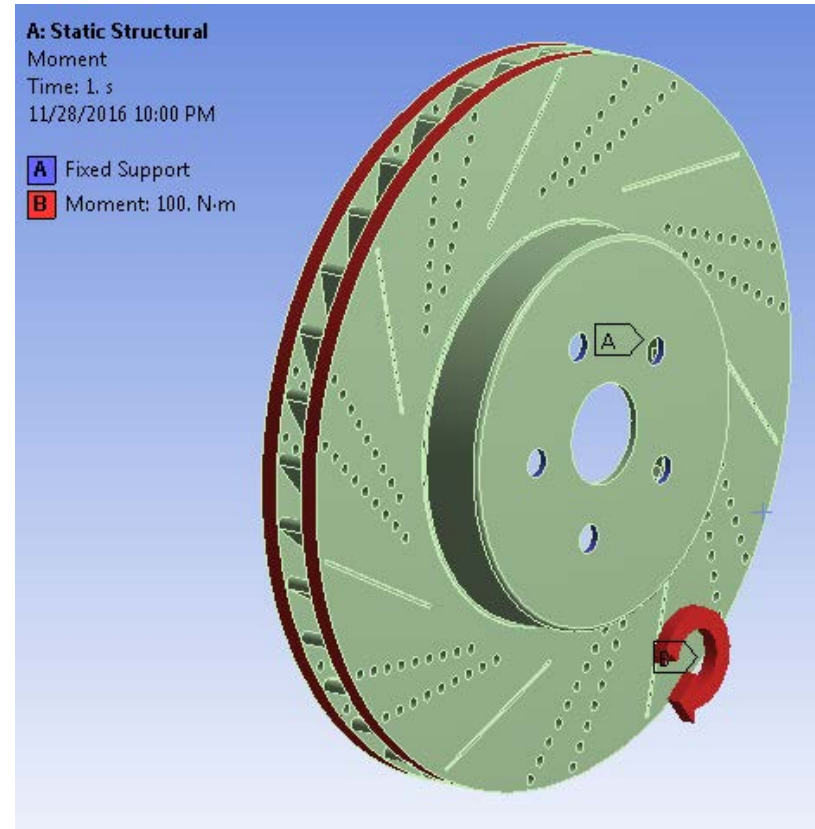
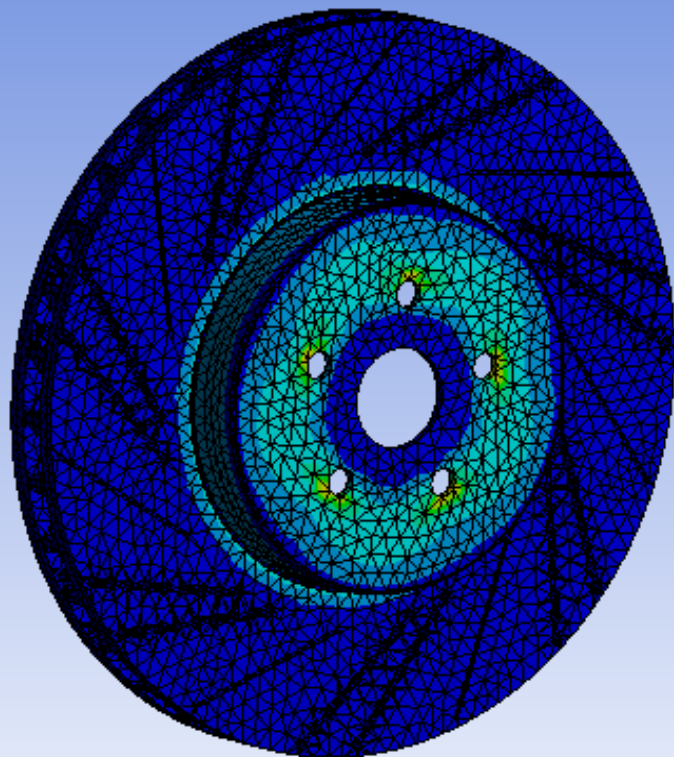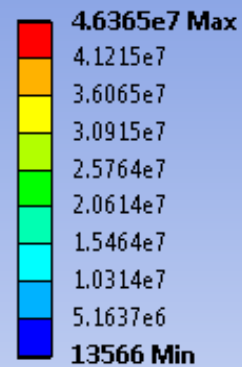# Static Analysis – Results

A: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
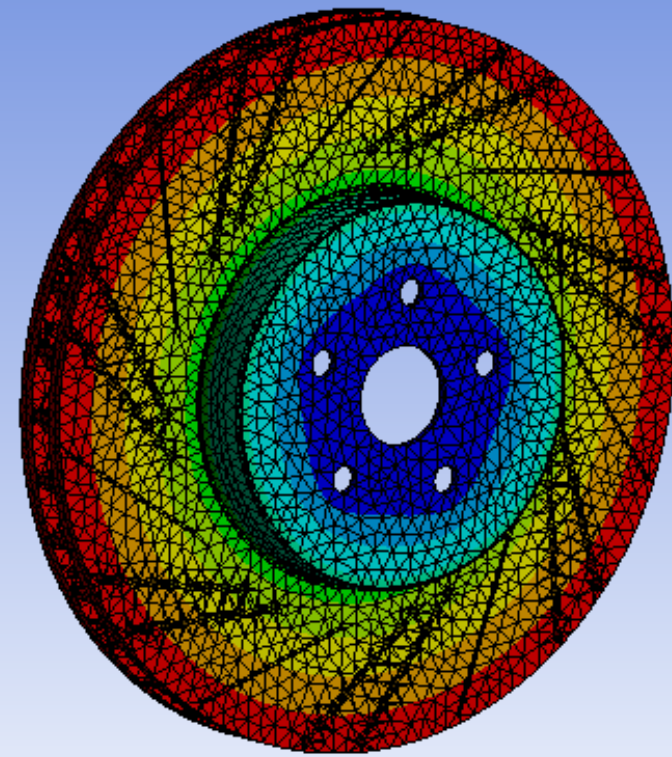Unit: Pa
Time: 1
11/28/2016 10:05 PM

- 4.6365e7 Max
- 4.1215e7
- 3.6065e7
- 3.0915e7
- 2.5764e7
- 2.0614e7
- 1.5464e7
- 1.0314e7
- 5.1637e6
- 13566 Min

A: Static Structural
Total Deformation
Type: Total Deformation
Unit: m
Time: 1
11/28/2016 10:06 PM

- 7.6186e-6 Max
- 6.7721e-6
- 5.9256e-6
- 5.0791e-6
- 4.2326e-6
- 3.3861e-6
- 2.5395e-6
- 1.693e-6
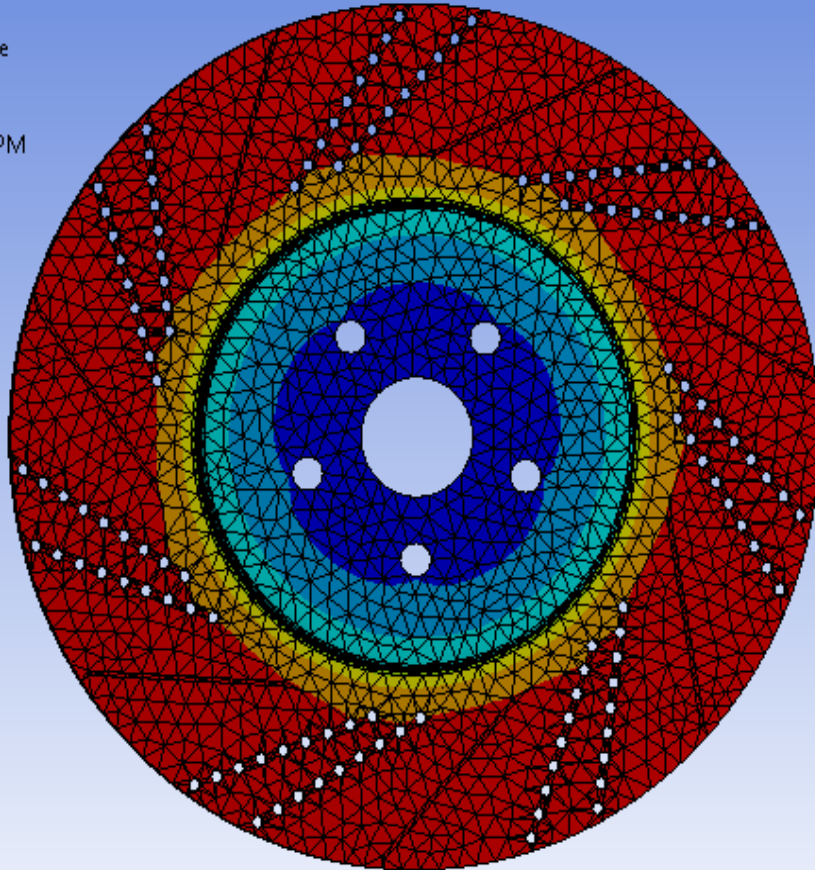- 8.4652e-7
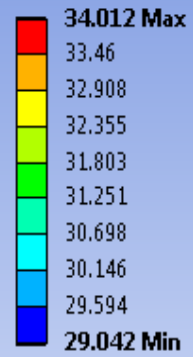- 0 Min
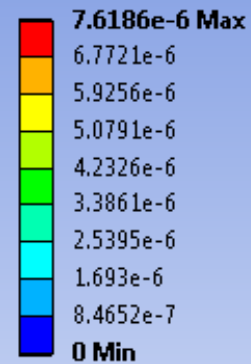
c Structu
x Von Mi
4.6
4.9
5.3

Steady State Thermal – Temperature Results

- Fixed at bolt holes, uniform heat flux on rotor faces, convection on all others

- Heat Flux = 1000 W/m^2

- Convective film coefficient of 30 W/(C*m^2)

- Ambient Temperature of 22 C

Steady State Thermal – Temperature Results

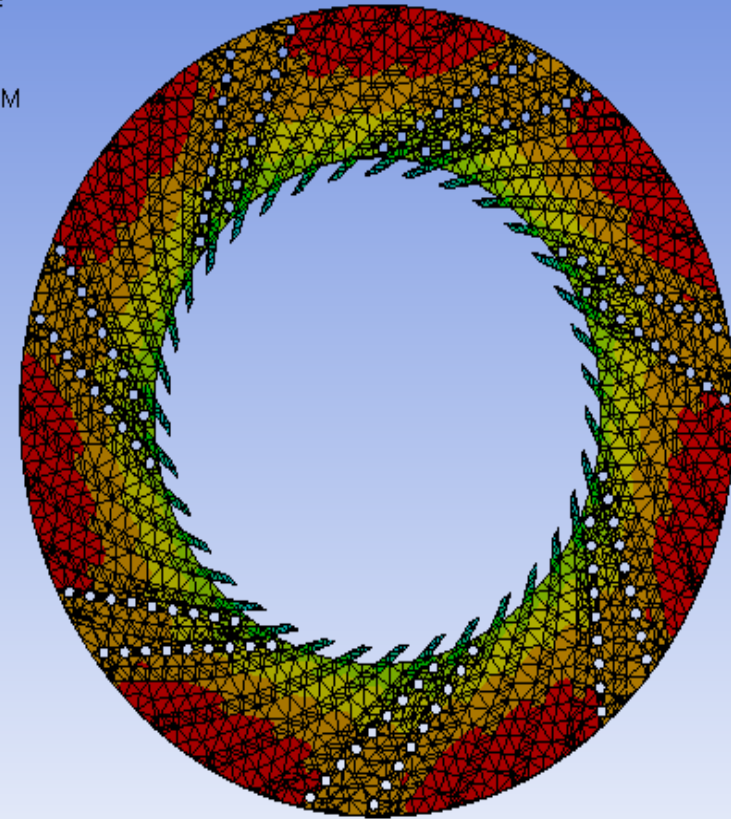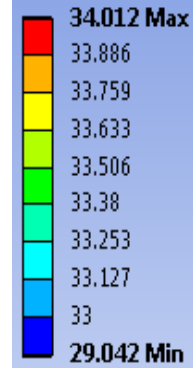# Steady State Thermal – Thermal Stress Results
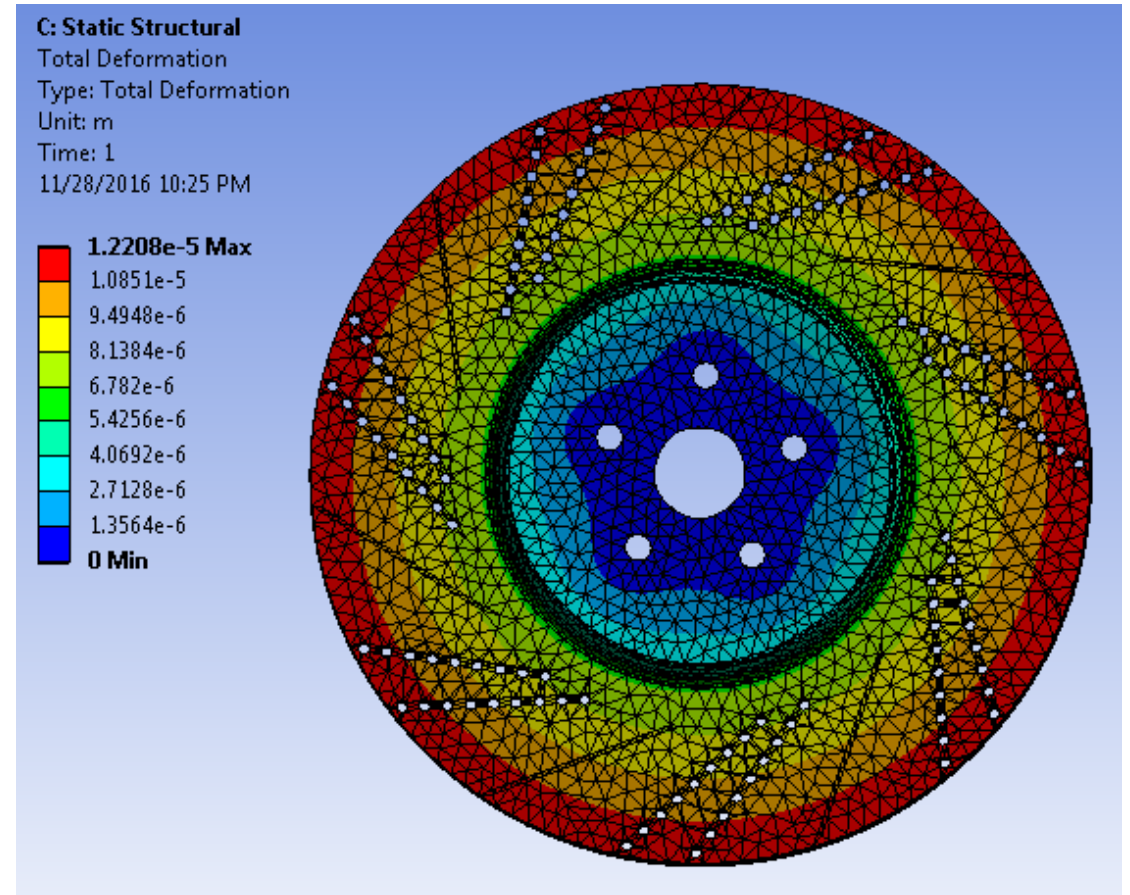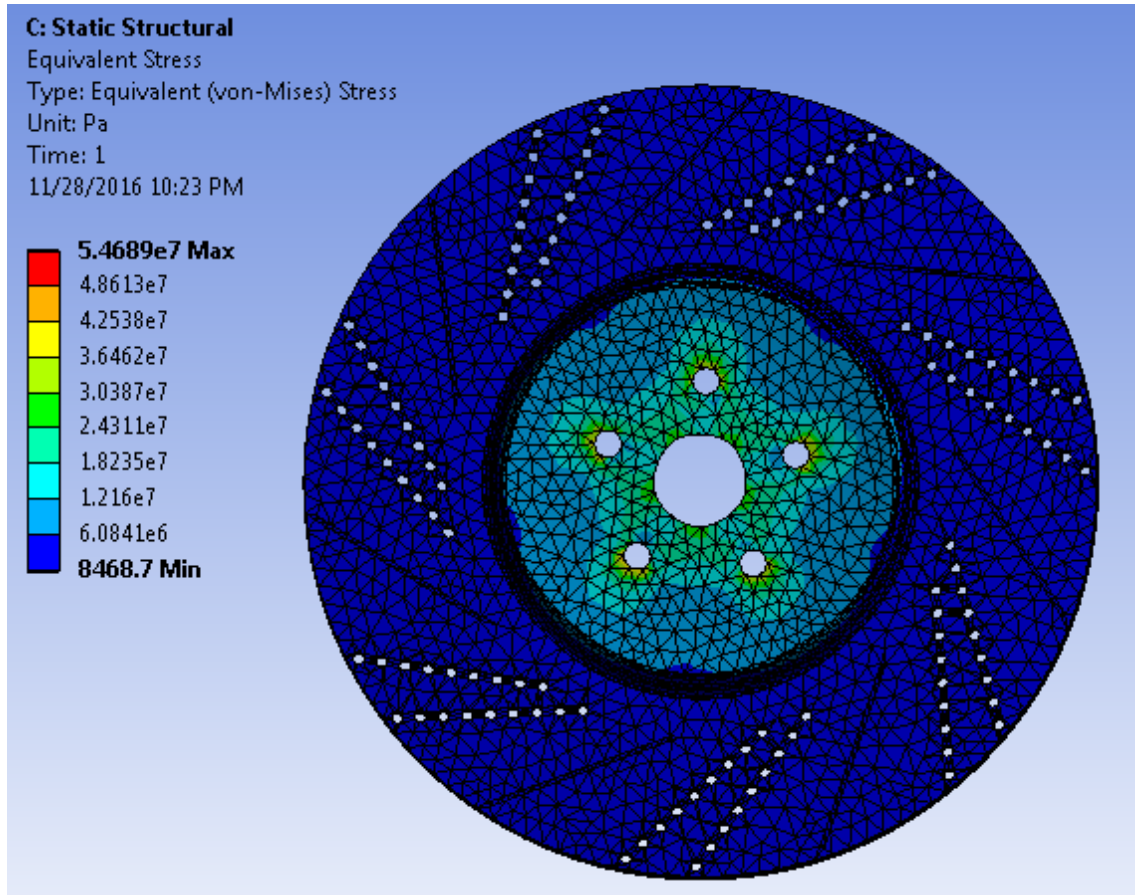
Modal Analysis - Results

- Mode shapes as well as modal frequencies were analyzed

- Fixed support on bolt holes

- First 6 modes were analyzed

- Modes 1 and 2 as well as 5 and 6 are repeated

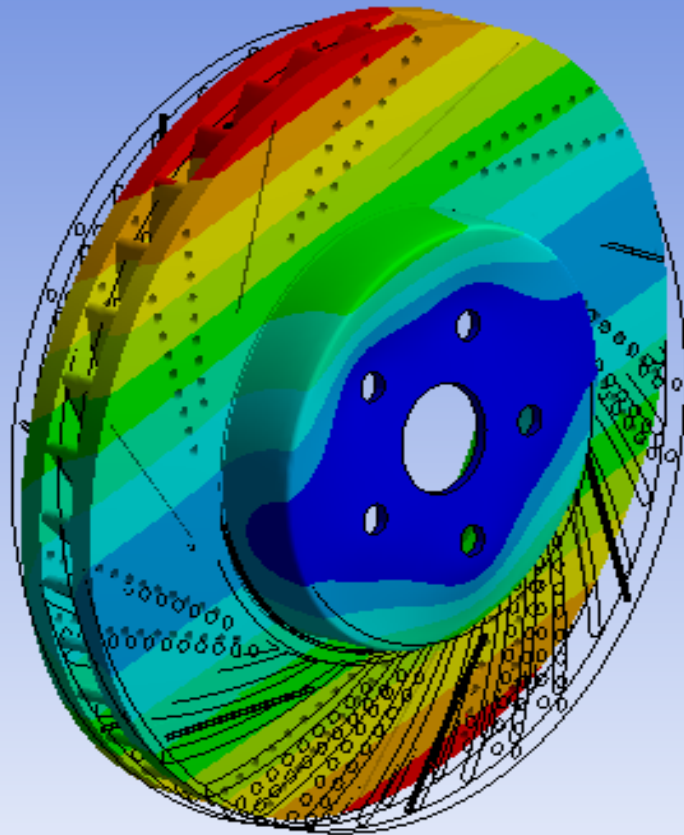| Mode	Freq (Hz)
1	387.26
2	387.9
3	795.52
4	2142.4
5	2161.2
6	2161.9

Modal Analysis - Results

D: Modal
Total Deformation
Type: Total Deformation
Frequency: 387.26 Hz
Unit: m
11/28/2016 10:31 PM

1.4732 Max
1.3095
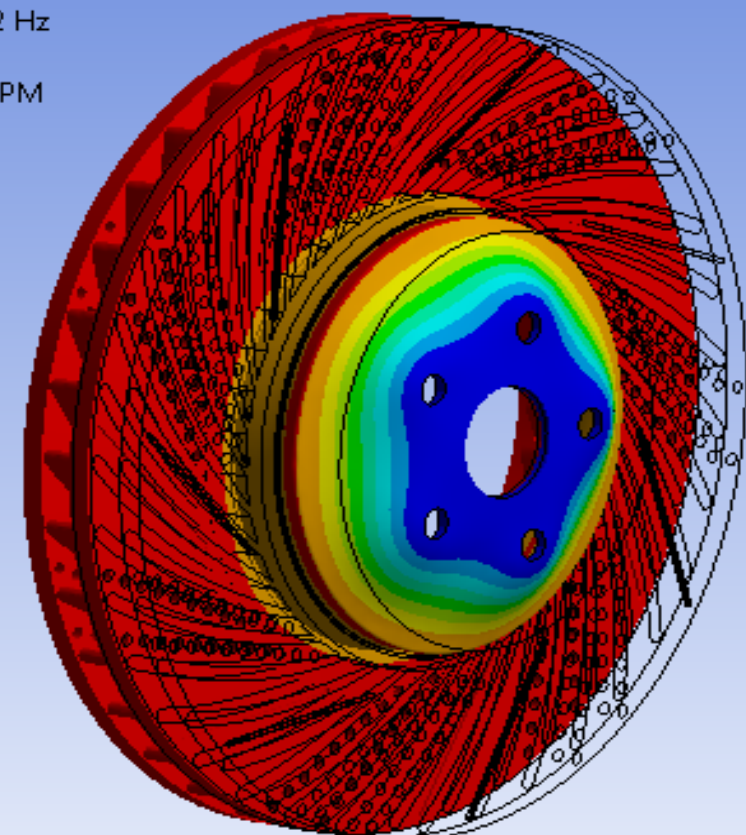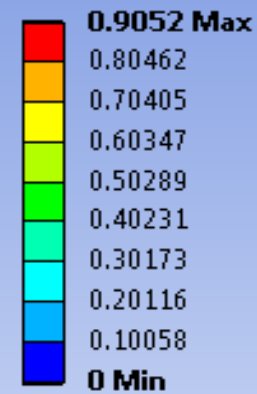1.1458
0.98213
0.81844
0.65475
0.49106
0.32738
0.16369
0 Min
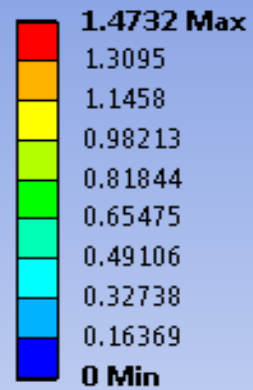
D: Modal
Total Deformation 3
Type: Total Deformation
Frequency: 795.52 Hz
Unit: m
11/28/2016 10:32 PM

0.9052 Max
0.80462
0.70405
0.60347
0.50289
0.40231
0.30173
0.20116
0.10058
0 Min

Modal Analysis - Results

D: Modal
Total Deformation 4
Type: Total Deformation
Frequency: 2142.4 Hz
Unit: m
11/28/2016 10:34 PM

1.0829 Max
0.96254
0.84223
0.72191
0.60159
0.48127
0.36095
0.24064
0.12032
0 Min

D: Modal
Total Deformation 5
Type: Total Deformation
Frequency: 2161.2 Hz
Unit: m
11/28/2016 10:35 PM

1.7642 Max
1.5682
1.3722
1.1762
0.98013
0.7841
0.58808
0.39205
0.19603
0 Min