Aircraft Nacelle Seal Compression Testing and Simulation

Meet the Sponsors

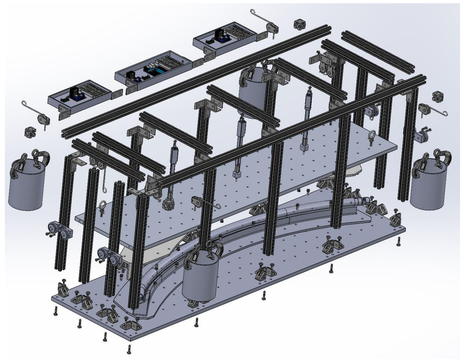
Collins Aerospace, an RTX business, is a leader in designing and manufacturing advanced aerospace and defense hardware.

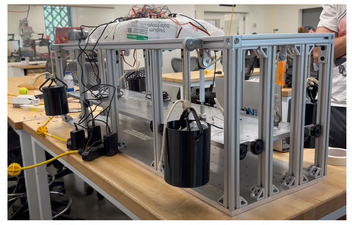
Project Overview

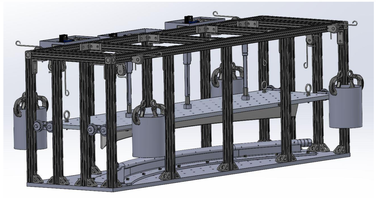
Problem:
The complex and large geometry of nacelle seals makes it difficult to determine stiffness of the seal as a system with traditional compression methods such as tensile testers. Previously, seals have been cut into smaller sections and tested with a flat compressor. This has been shown to not accurately represent the system's stiffness as a whole.

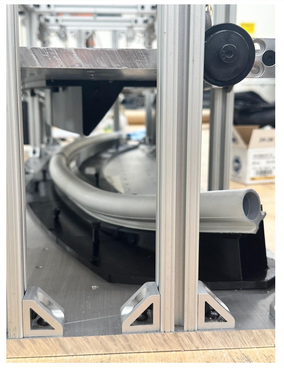
Solution:
Utilize custom 3D printed curved surfaces that accommodates complex seal geometry. Apply controlled compression load onto seal with linear actuators and measure force and deformation data via three load cells and potentiometers. Using the data gathered, the experimental seal stiffness can be calculated. After the experimental stiffness is determined, an ANSYS model was created and correlated against the data. The ANSYS model was solved in various ways including an ACP model with fiber layers and solving it as a solid body in order to determine which FEA method yielded the best correlation to the experimental data to provide an accurate model.

CAD and Final Design

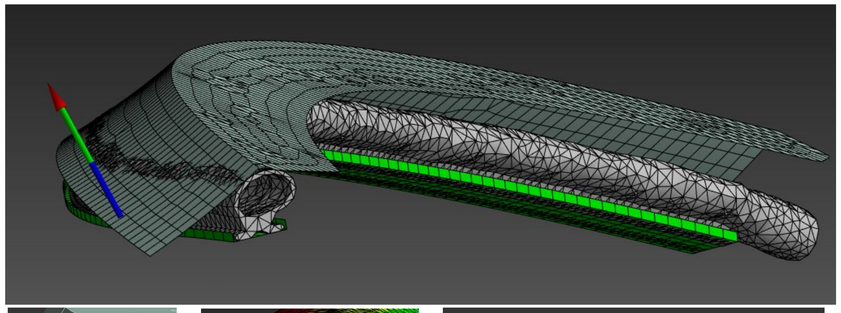


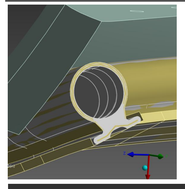


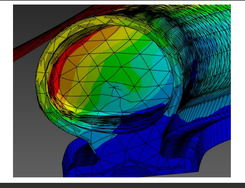


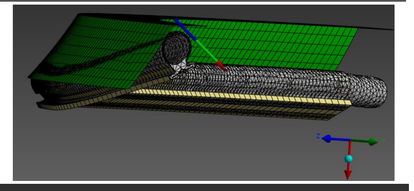


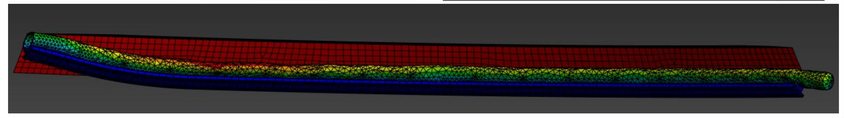
FEA Compression Analysis











Testing and Simulation Methods

Testing Method: Nacelle seal sections were compressed in the test rig to 60% compression and force data was acquired via load cells using Arduino. Deformation data was acquired via the actuators internal potentiometers. Trigonometry was used to determine displacement deformation and normal force vectors since force was applied to the seal on an angle. Resulting system stiffness of seal was approximately 2 lbs/in from force data at 60% compression.
ANSYS Model: An ACP model was created to replicate the fiber layers in the seal and ANSYS Static Structural was used to replicate testing conditions of applied compression on the seal. The ANSYS model was validated from experimental data and the fiber layers' material properties were iterated until the reaction forces correlated with the load cell reaction force. The solid model based on RTV88's material properties resulted in a seal stiffness of about 3 lbs/in, which was calculated from the reaction forces.

Meet the Team

Connor Carrasquilla

Nick Anderson

Matthew Simon

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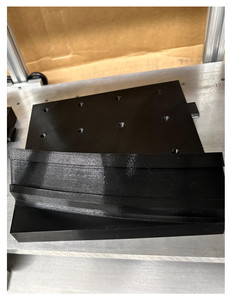
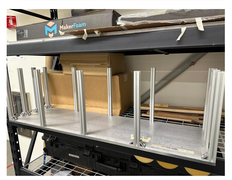
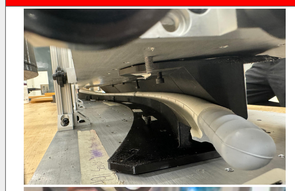
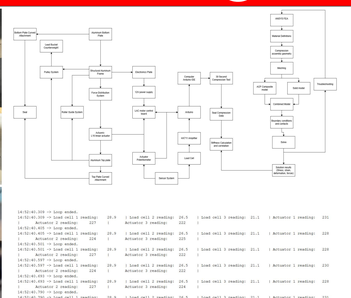
Manufacturing

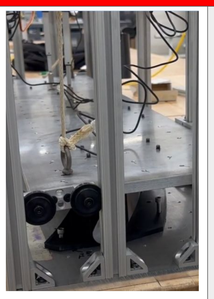




Testing







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