3D Transonic Flow Over a Wing

Created using ANSYS 16.1

Learning Goals

In this tutorial you will learn to

1. Perform a 3D transonic turbulent CFD Simulation
2. Create a three dimensional mesh using techniques to strategically refine the mesh
3. Obtain iterative convergence by using recommended solver settings
4. Visualize 3D flow characteristics to gain physical insights
5. Verify and validate simulation results by comparing with experimental data and NASA CFD results

Problem Specification

We modeled our simulation after the simulation done by NASA using WIND and we try to reproduce their results here. It is from there we have obtained the experimental data for comparison purposes. It is linked here: NASA Onera M6 Validation.

Flow over the Onera M6 wing is transonic and compressible. The wing flow experiences supersonic conditions, a shock and boundary layer separation. There is no wing twist, with all chords being in the same plane. Therefore, the angle of attack is simply the angle between the free stream and the chord line. There is no side-slip in the simulation. The flow conditions are given below:

<table>
<thead>
<tr>
<th>Mach</th>
<th>Reynolds Number</th>
<th>Angle of Attack (degrees)</th>
<th>Angle of Side-slip (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.8395</td>
<td>11.72E6</td>
<td>3.06</td>
<td>0</td>
</tr>
</tbody>
</table>

Our wing geometry will be a scaled down version matching the geometry from NASA rather than the experiment available on the linked page. The half span dimension is 1 ft and from there we were able to calculate a scaling factor for the entire wing. More about the geometry creation can be found on the exercises page.

The table below describes some key geometries, the leading and trailing edge angles are measured from the vertical.

<table>
<thead>
<tr>
<th>Span (ft)</th>
<th>Taper Ratio</th>
<th>Mean Aerodynamic Chord (ft)</th>
<th>Leading Edge Angle (degrees)</th>
<th>Trailing Edge Angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.562</td>
<td>.5400</td>
<td>30</td>
<td>15.8</td>
</tr>
</tbody>
</table>
Go to Step 1: Pre-Analysis & Start-Up

Go to all FLUENT Learning Modules