Transient vs Steady vs Psuedo

Transient - Good for unsteady flows, flows that change with time; for our purposes, great for finding information around stall conditions and simulating propellers

Steady - Great for flows that do not change with time\

Pseudo - Adds an artificial time derivative to Steady simulations, a shortcut to simulating unsteady flows; the artificial time step is based on physical properties of the flow and determined automatically by Ansys, providing a great alternative to Transient simulations.

P-V Coupling Algorithms

Piso - Good for Transient Flows
Piso uses a simplified iteration loop, attempting to correct the flow instead of generating new pressure fields for each iteration.

Simple - Good for Steady State Flows
Simple generates a brand new pressure field for every iteration.

Coupled - Typically requires fewer iterations than segregated solvers, but each iteration is slower, and the memory requirements are greater. If Simple or Piso do not converge, it is recommended to try a coupled solver to achieve convergence.

Turbulence Models

Spalart-Almaras - Simplest model available, designed for Aerospace applications, first introduced in 1994, Recommended for first runs of new designs, slightly underpredicts flow separation.

K-epsilon - A widely used model first introduced in 1973, solves two equations to get turbulent kinetic energy, then calculates eddy viscosity from these values. K-epsilon underpredicts flow separation due to overprediction of wall shear stress, Sensitive to freestream turbulence at the inlet. Very good at predicting lift and drag when the flow is turbulent but not separated.

K-Omega - Although initially proposed in 1942, it was further developed as part of a wave of models introduced in the 80s and 90s that attempted to address issues with the K-epsilon model. While it does predict boundary layer separation much better than K-epsilon, it is extremely sensitive to freestream turbulence.

K-Omega-SST - Introduced in 1994, blends the K-Omega and K-Epsilon models near walls and includes a near-wall viscosity limiter to attempt to better predict separation. Gives better separation predictions than K-Omega and K-Epsilon. Typically used for Aerodynamics and turbomachinery at high Reynolds numbers.

GEKO - This one is really cool, developed by Ansys and released in 2022, this turbulence model is based on the classic K-Omega model. The model has been modified to allow the user to tune the model to their specific case using five independent tuning variables; it allows for blending of the K-Omega and K-Epsilon models using any ratio the user desires. It is the most adaptable model on this list and the one I will primarily use for SAE Aero simulations. The user guide for this model found here describes what all the control variables do.

Transition SST - Based on the K-Omega-SST model and initially introduced in 2003, the Transition SST Model attempts to model laminar to turbulent transition within the boundary layer and prevents incorrect omega to epsilon transition sometimes found in the laminar portion of the boundary layer. Used to model Aerodynamics and turbomachinery at Re within the order 10^5. Mesh MUST have Y+ less than 1. Gamma=1 at inlet

Useful Settings

Curvature Correction - should always be used as it increases the accuracy of wing tip vortex simulations, takes extra CPU time

Corner Correction - useful for any object with sharp corners if a fine mesh is used, doesn’t decrease the accuracy of other flows but will take extra CPU time and not improve accuracy if the mesh is not very fine.