



# STAR-CCM+

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- Grid generation
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# What is STAR-CCM+



- Parallelized flow solver
- 2D/3D viscous/inviscid compressible flow problems
- Unstructured grid
- Finite volume technique
- Integrated software environment - from grid generation to post-processing



# Surface or geometric import



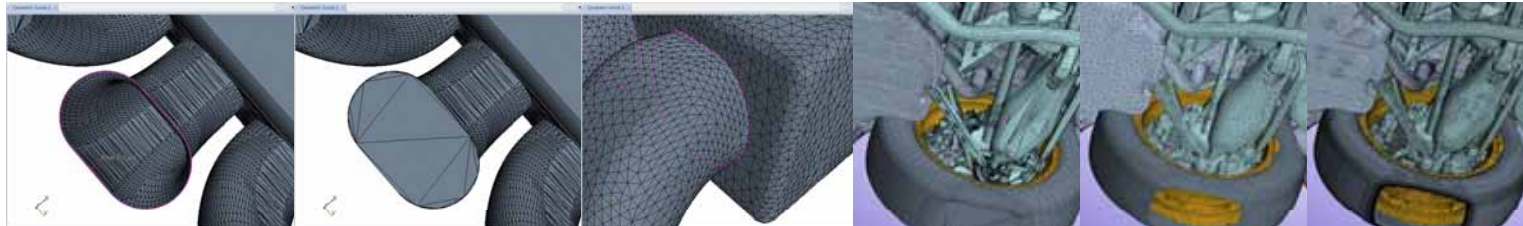
- Import surface grid or geometry from
  - .dbs - pro-STAR surface database mesh file
  - .inp - pro-STAR cell/vertex shell input file
  - .nas - NASTRAN shell file
  - .pat - PATRAN shell file
  - .stl - Stereolithography file
  - .igs/.iges - Initial Graphics Exchange Specification file
  - .stp/.step - Standardized Exchange of Product file
  - .x\_t/.x\_b - Parasolid Transmit file



# Surface meshing



- Tools to help prepare the starting surface geometry
  - Surface remesher
  - Surface wrapper
  - Hole filler, including non-simple holes
  - Edge zipper
  - Automatic and hand based feature curve extraction and editing



# Volume meshing



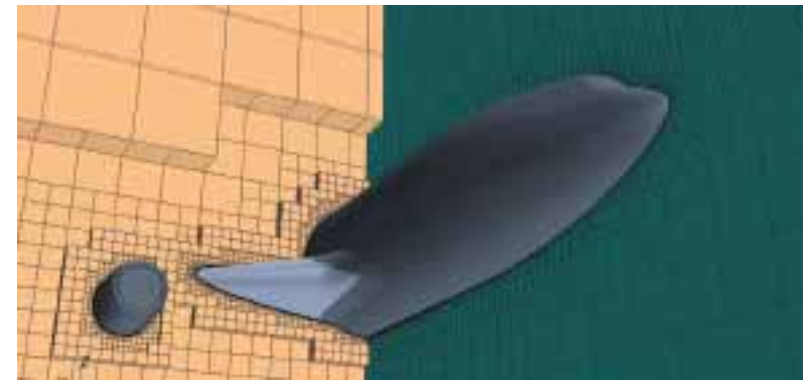
- Three types of meshing models
  - tetrahedral - tetrahedral cell shape based core mesh
  - polyhedral - arbitrary polyhedral cell shape based core mesh
  - trimmed - trimmed hexahedral cell shape based core mesh
  
- Boundary layer meshing using a prism layer
  
- Fine tune mesh generation with:
  - Volume sources
  - Local and global parameter setting



# Volume meshing



## ➤ Types of meshing models



# Mesh manipulation



- Transform - scale, translate and rotate
- Split and combine boundaries and regions, including automated
- interface definition for closed semi-manifold surfaces
- Create, delete and fuse interfaces
- Fuse internal boundaries
- Convert a three-dimensional mesh to two-dimensional
- Create cell sets





# Import mesh



- Import from:
  - pro-STAR
  - Gridgen
  - Fluent
  - Gambit
  - STAR-CD
  - ICEM



# Physical models



- Motion
  - Moving reference frames, rotational and translational
  - Frozen rotor (multiple reference frame) model
- Flow and energy
  - Inviscid, laminar and turbulent flow regimes
  - Gas, liquid, solid and porous media modeling
  - Total energy formulation
  - Conjugate heat transfer
  - Free-surface and Volume of Fluid (VOF)
  - Cavitation
  - Radiator type heat exchanger
  - Fan curve adjusted momentum source fan



# Physical models - turbulence



- Reynolds-Averaged Navier-Stokes
  - Spallart-Allmaras
  - K-Epsilon
  - K-Omega
- Large Eddy Simulation
- Detached Eddy Simulation
- Wall Treatments
  - Low  $y^+$
  - High  $y^+$
  - All  $y^+$
- Prescriptive boundary layer transition



# Boundary conditions



- Wall
- Pressure outlet
- Mass flow inlet
- Stagnation inlet
- Velocity inlet
- FreeStream
- Symmetry
- Axis
- Interface



# Solver



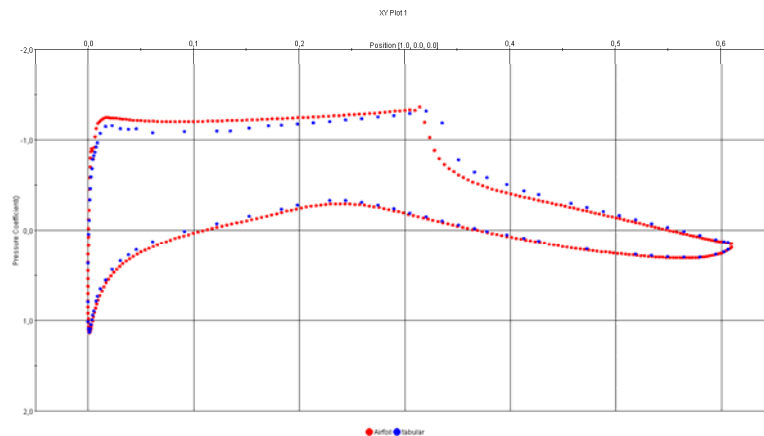
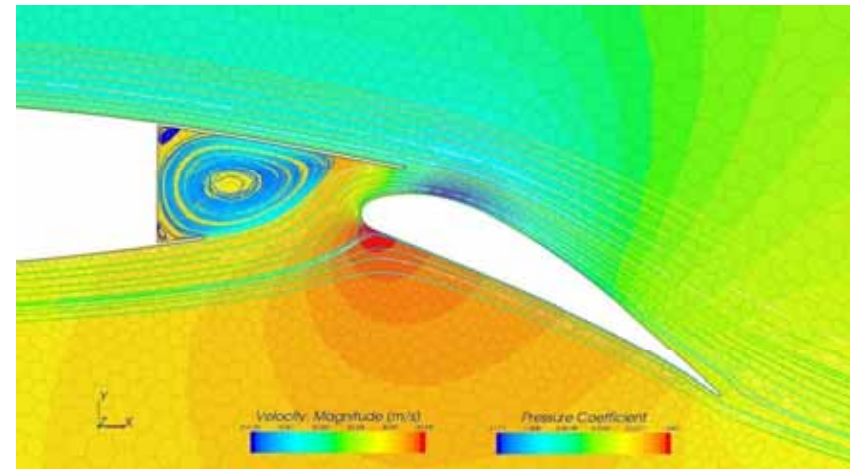
- Coupled flow
  - implicit
  - explicit
- Coupled energy
- Segregated flow



# Post-processing



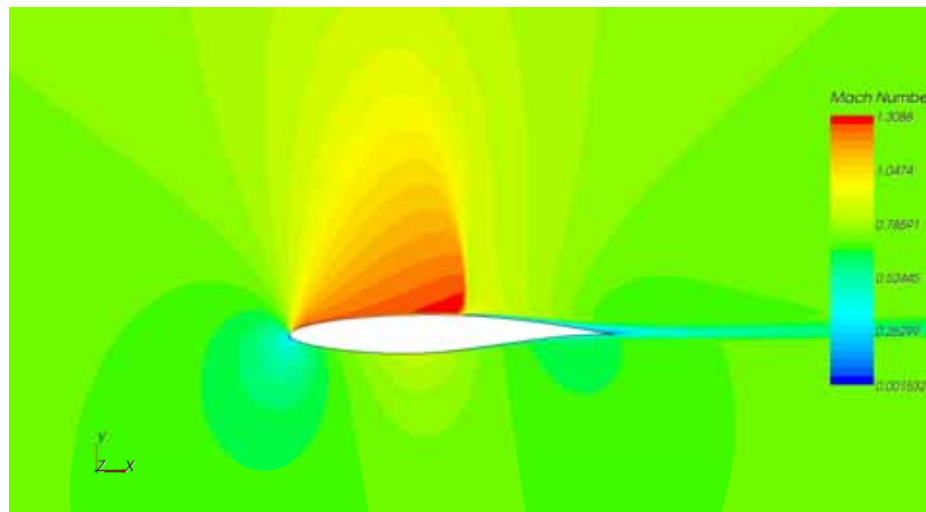
- On-line visualization
  - Scalar scene
  - Vector scene
  - XY plot
  - Streamline
- Export results to TECPLOT



# Examples



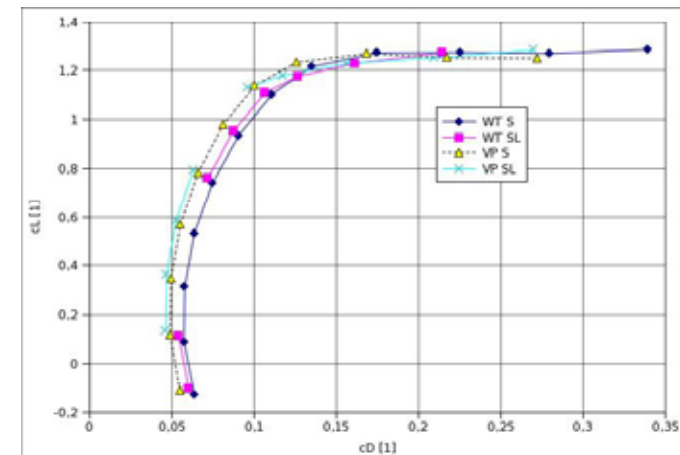
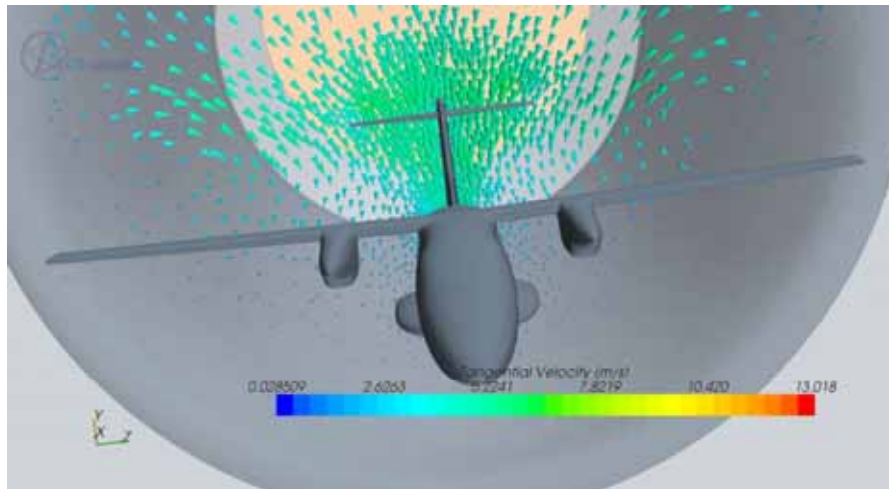
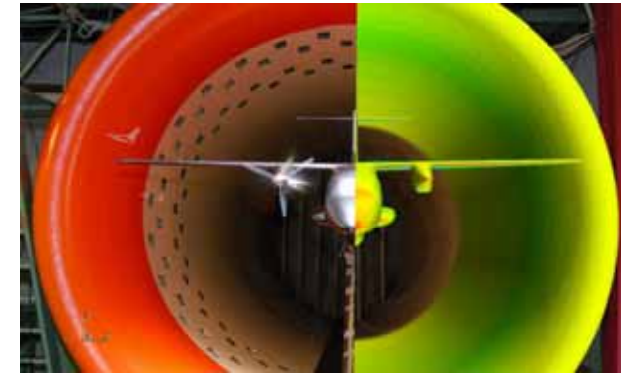
- 2D airfoil RAE 2822
  - several types of meshes
  - imported mesh from ICEM



# Examples



- 3D case: Small commercial aircraft
  - Wind tunnel correction
  - Different configuration
  - Drag difference to wind tunnel test ~10%

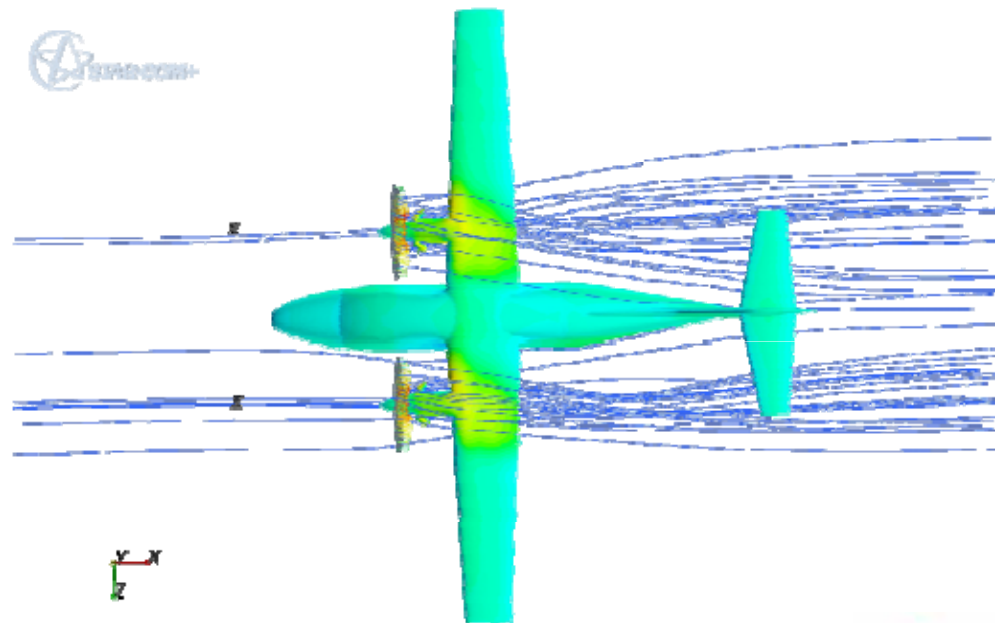




# Examples



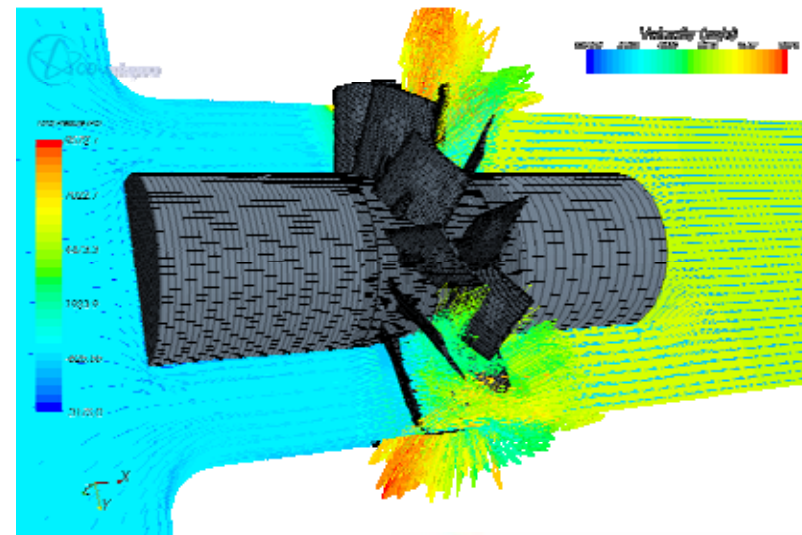
- 3D case: Small commercial aircraft
  - Propeller effect
  - Fan solver



# Examples



- 3D case: Axial fan / Turbomachinery
  - Axial fan with contra-rotary blades
  - Full scale model
  - Approximately 1'500'000 cells
  - Calculation of fan curve



# Conclusion



- Universal code limited generally by number of licenses
- Sometimes problems with physical memory requirement occurred
- Some problems with automated meshing
- Is able to be used for solving problems usually occurred in aerospace





Thank you for your attention  
Questions?

