CFD Capabilities in AES

CFD ANALYSIS SOFTWARE & AREA OF EXPERTISE IN AES

Modeling Software

- ✓ PRO E
- ✓ UNIGRAPHICS
- ✓ MECHANICAL DESKTOP

Meshing Software

- ✓ ICEM HEXA
- ✓ ICEM TETRA
- ✓ GAMBIT

CFD Analysis Software

- ✓ CFX
- ✓ FLUENT

Hardware

- ✓ Parallel Intel 64 bit processors
- ✓ Parallel Quad core Xeon 64 bit Processors

Area of Expertise

- ✓ Gas Turbine Engine & Components
- ✓ Steam Turbine & Components
- ✓ Micro Turbine
- ✓ Automotive Application
- ✓ Industrial Application
- ✓ Pumps

COMPUTATIONAL FLUID DYNAMICS-TECHNICAL CAPABILITIES

- CFD Modeling
- Meshing : Hexa, Tetra & Hybrid Mesh Capabilities

  Unstructured meshes (hexahedral, tetrahedral)
  Tetrahedral meshes with prism layer extrusion
  Discontinuous/hybrid meshing
  Local mesh refinement
- Pre-processing

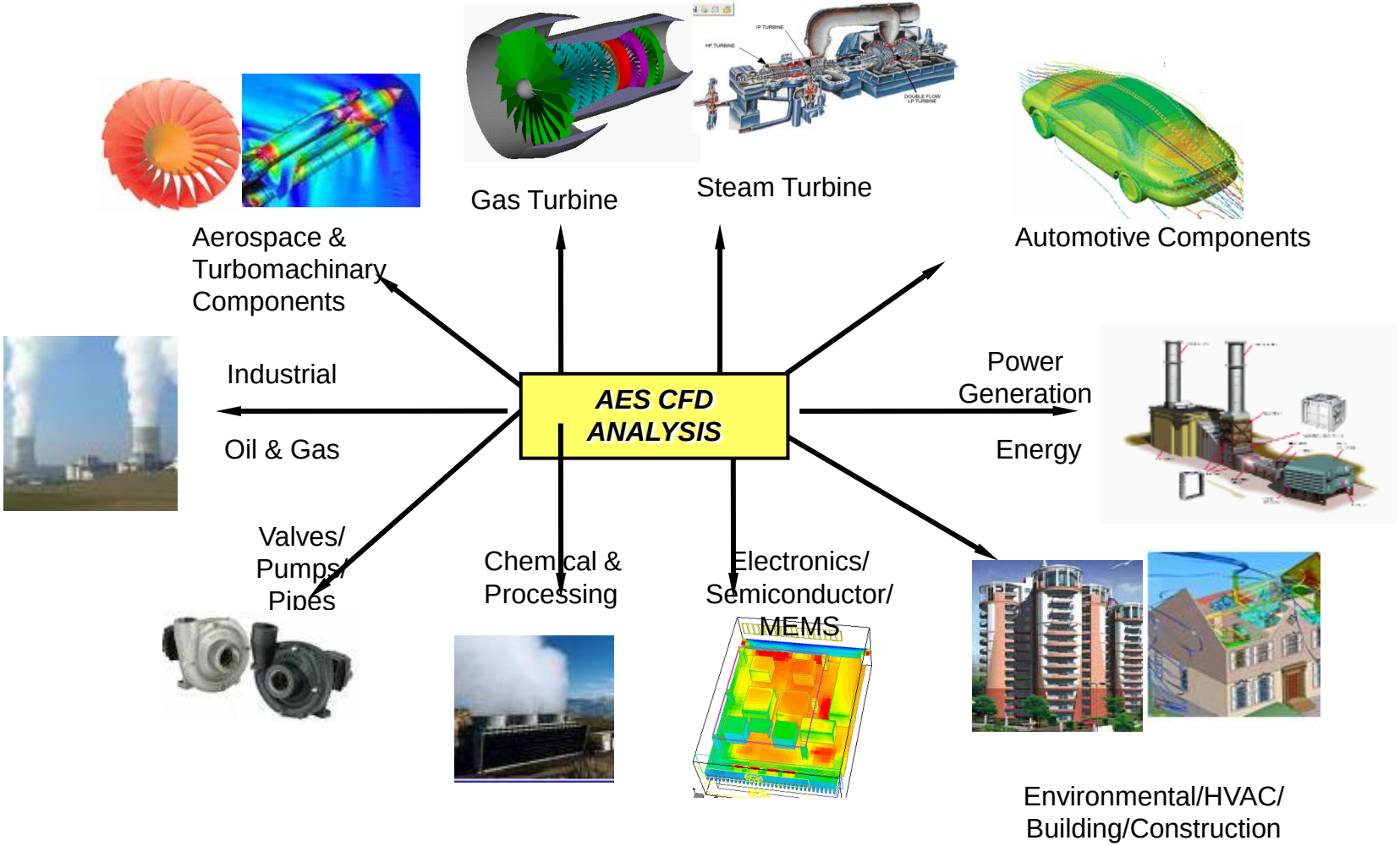
  Definition of thermodynamics models, properties and boundary conditions
- CFD Analysis
- Post Processing

  Display of vectors, contours & etc
  Particle tracking
  Animation
  Data conversion for structural analysis
  Data manipulation functions
- Parallel Computing

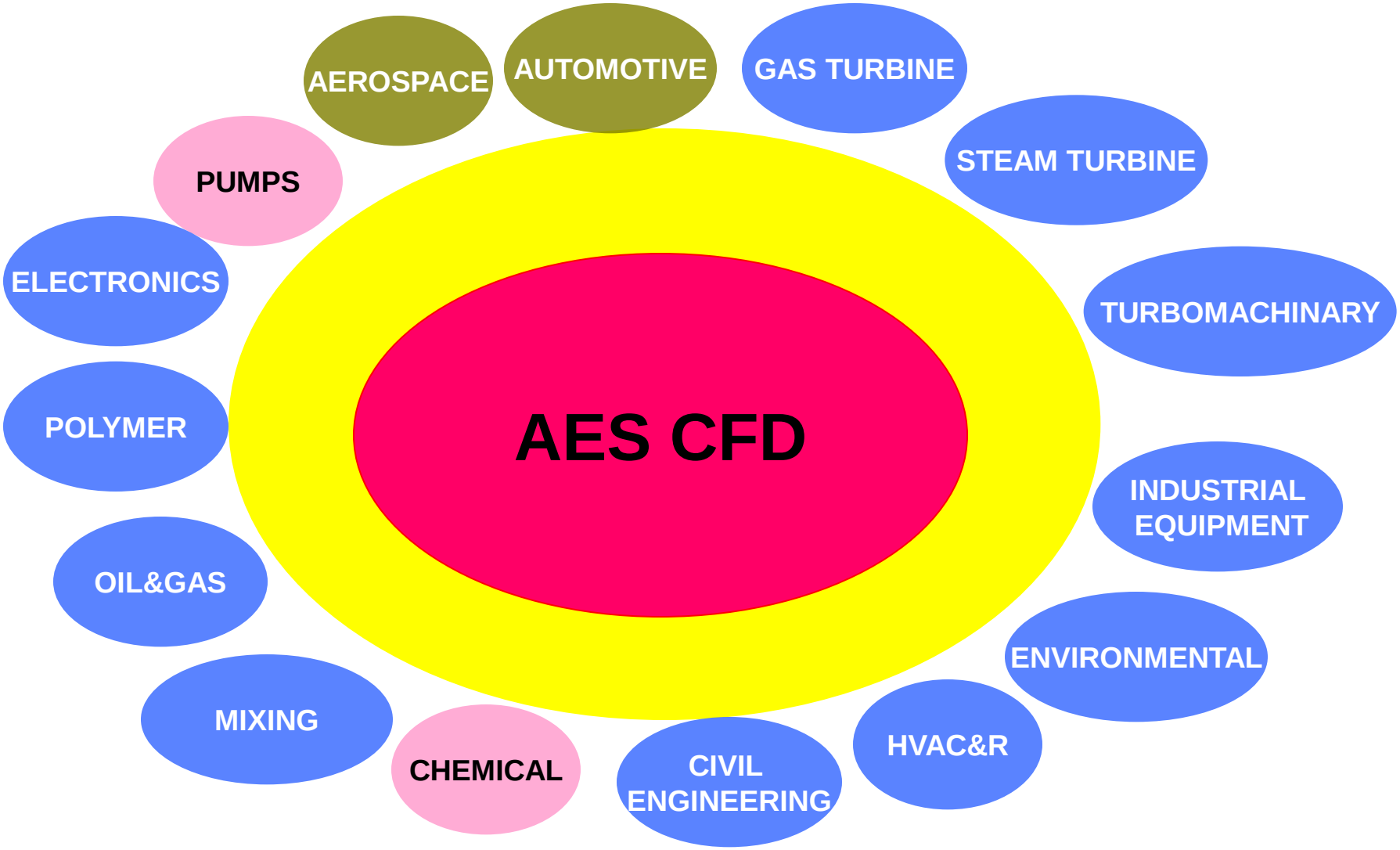
CFD- PHYSICAL MODELING CAPABILITIES

- Steady & Transient Flows
- Flow Distribution (Laminar & Turbulent) using Different Turbulent Methods.
- Incompressible and Compressible Flow
- Newtonian & Non-Newtonian Fluids
- Swirling & Rotating Flows
- Conjugate Thermal Analysis
- Forced & Natural Convection Heat Transfer
- Flow Through Porous Media
- Rotating Frames of Reference
- Multiple Frames of Reference
- Multiple Species Transport
- Free Surfaces by VOF Method
- Deformable Meshes
- Lagrangian Particle Tracking
- Thermal and Solar Radiation
- Multi-component & Multi Phase Flow- Mixing, Flashing, Evaporation
- Reacting and Combusting Species
- Fluid Structure Interaction (Including Deforming Grid)
- Cavitation

CFD CAPABILITY AREA



AES CFD CAPABILITIES



1. Gas Turbine
2. Steam Turbine
3. Micro Turbine
4. Compressor
5. Pumps
6. Turbomachinary components for Different Industries i.e Automotives, Aerospace

Major Areas in Turbomachinary CFD Analysis

AES is capable of provide a wide range of CFD solutions in Turbomachinary :

- flow conditions ranging from subsonic to supersonic
- to solve the wide range of specialized problems encountered in the turbo-machinary industry.
- provide the accuracy, turnaround time, and unique capabilities to improve the productivity of the design process.

Major Areas

- Gas Turbine
- Steam Turbine
- Micro Turbine
- Compressor
- Pumps
- Rotating components for Different Industries i.e Automotives, Aerospace
- Fans & Blower

Key Applications

- External Aerodynamics
- Internal Flows
- Thermal Management
- Tank Sloshing
- VOF
- Multi-phase & Species
- Heat Exchangers
- Fluid Structure Interaction (FSI)
- Combustion
- Erosion Modeling
- Mixing

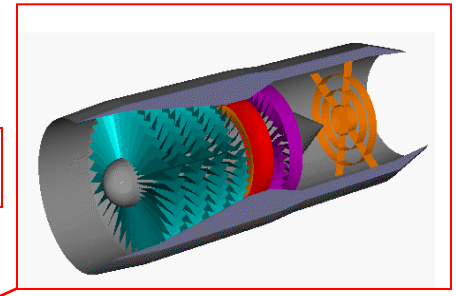
CFD Analysis : Gas Turbine Components

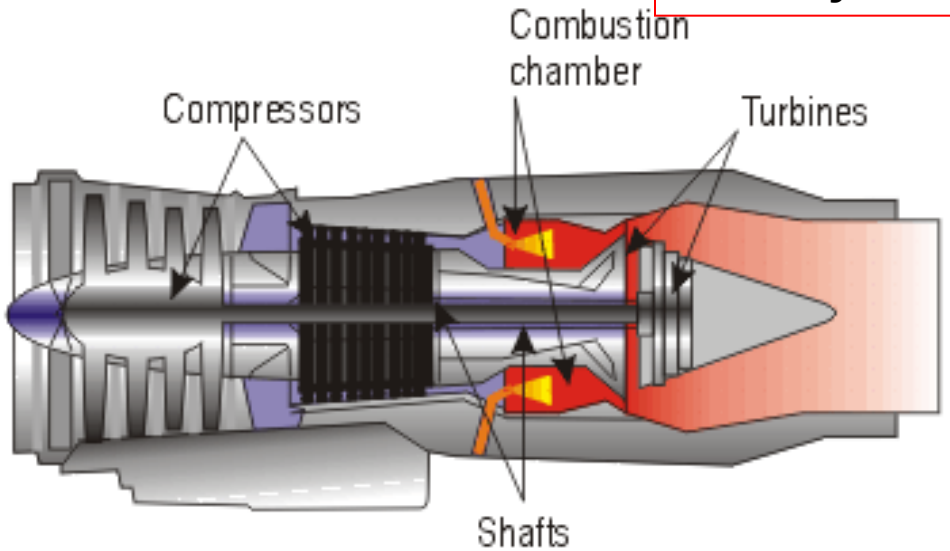
Fan

Compressor

Secondary Flow System

Turbine





Exhaust System

Conjugate Heat Transfer Analysis

Inlet System

Diffuser

Combustion Chamber

After Burner

Major Areas in Gas Turbine : AES Capabilities

AES is capable of provide a wide range of CFD solutions in Gas Turbine :

- Flow conditions ranging from subsonic to supersonic
- To solve the wide range of specialized problems encountered in different altitude operating condition.

Major Areas

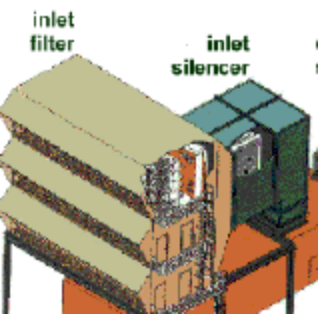
- Air Intake System
- Fans
- Compressor
- Anti Icing System
- Fuel System
- Diffuser
- Combustion Chamber
- Turbine
- Thrust Reverser
- After Burner
- Secondary Air Flow
- Exhaust System

Key Applications

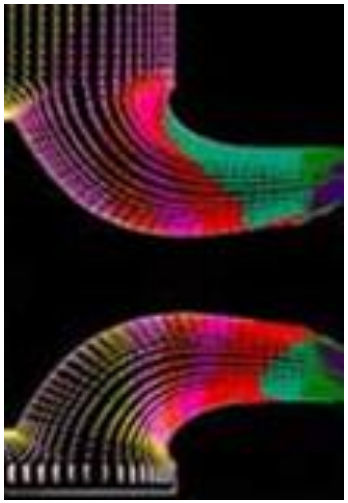
- CFD Fluid Modeling
- Internal & External Flows
- Fluid & Thermal Management of the Components
- Single Stage & Multistage Analysis
- Combustion with Multi-Species Analysis
- Conjugate Heat Transfer Analysis
- Fluid Structure Interaction (FSI)
- Secondary flow & Cavity system
- Aero thermo design Support

Gas Turbine Capabilities – Inlet System

Gas Turbine Inlet & Intake System for Industrial as well as the aircraft engines

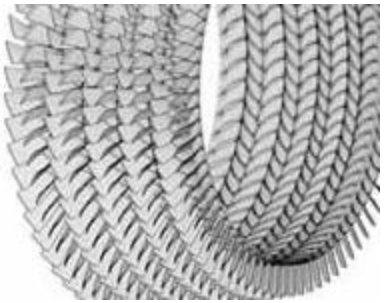


- To validate the pressure and temperature at the inlet system with experimental data
- To compare the pressure loss at different stages of inlet system with variation in the geometrical configurations
- Validate the Fluid parameters distribution i.e Flow distribution, Temperature & pressure distribution
- High jet mixing flow analysis.
- Porous media modeling for Industrial Gas Turbine.
- Optimisation of Flow path and design of Inlet System.
- Fan CFD Analysis

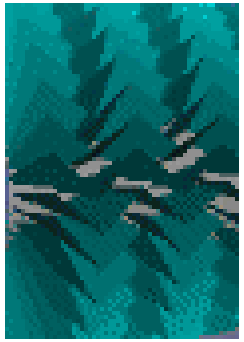


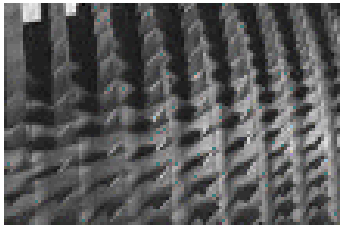
Gas Turbine Capabilities – Compressor

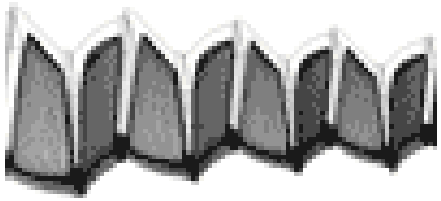
Capability and experience in wide variety of Fan, Axial and Centrifugal Compressor of Gas turbine

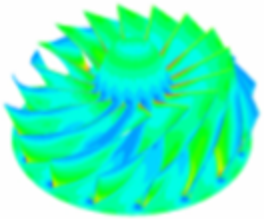


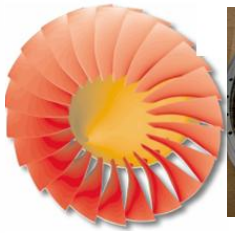
- Steady & Unsteady Performance Prediction
- Validation of the performance of compressor with experimental data.
- Analysis Compressor Inlet Plenums
- Axial and Centrifugal Compressor Stator & Rotor Analysis
- Single/Multi Stage Axial/Centrifugal Compressor.
- Prediction of blade loading, flow angle, efficiency, etc.
- Combined Return Channel & Impeller model using MFR
- Design and Analysis of compressor Discharge Volute
- Radial diffuser and axial diffuser analysis of Centrifugal Compressor
- Rotor Blade Tip Clearance
- Frozen Rotor interface (between stator & rotor)
- Prediction Fan /Compressor Performance curves, the effect of inlet or exit geometry and off design conditions.

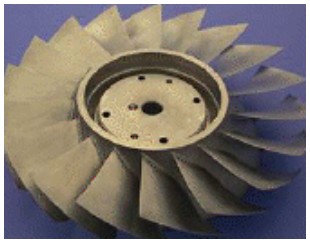




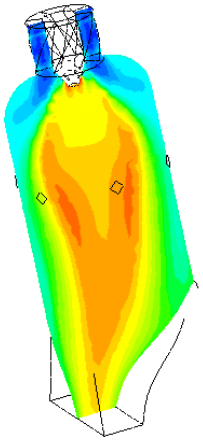






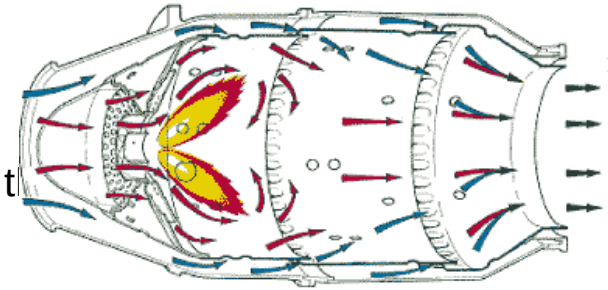


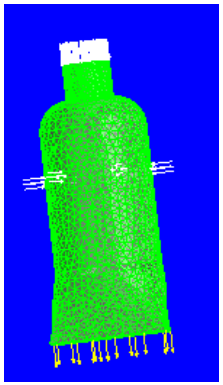
Gas Turbine Capabilities – Combustion Chamber

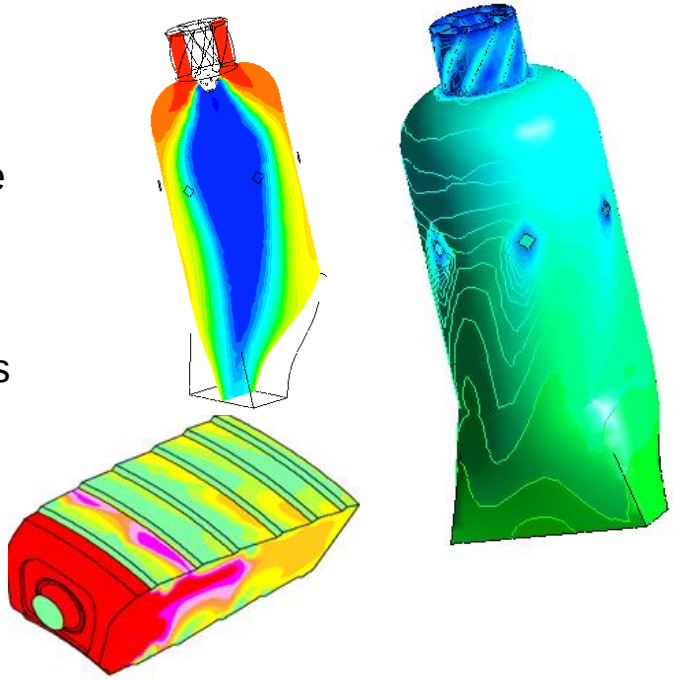


Gas Turbine Combustion Chamber Analysis :

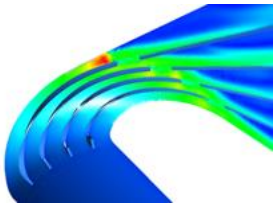
- CFD analysis of Annular & Reverse flow combustion chamber
- Hexahedral / Tetrahedral meshing depending on t complexity of model
- Includes swirl inlet condition
- Reacting flow with Turbulent Eddy break up model, Two- step reaction mode
- Dispersed Multiphase flow modeling
- Liquid fuel spray with droplet distribution
- Oxygen mass, velocity, pressure and temperature distribution
- Wide range of physical models for turbulence, sprays, combustion and combustion interaction.
- Combustion modeling of turbulent diffusion flames
- Prediction of exit temperature profile for inlet to Turbine
- Optimisation of Combustor.
- Soot formation & NOx emission

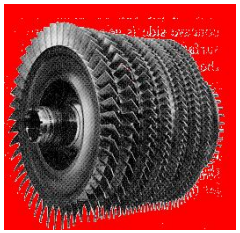






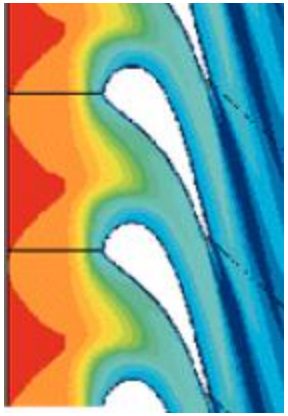
Gas Turbine Capabilities – Turbine

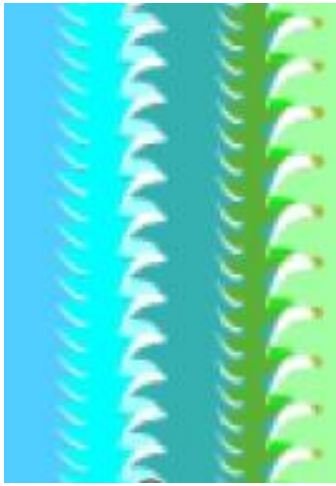


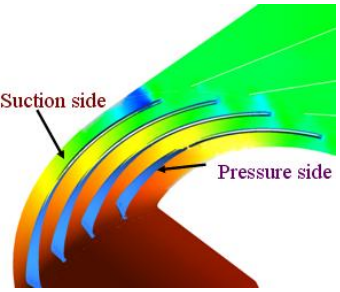


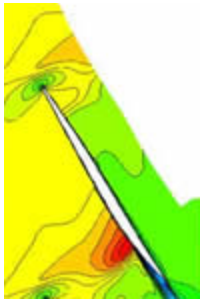
Gas Turbine - Axial and Radial Turbine Analysis

- Validation of the performance of turbine with experimental data.
- Axial and Radial Stator & Rotor Analysis
- Performance Prediction.
- Single/ Multi Stage Turbine.
- Prediction of blade loading & efficiency
- Rotor Blade Tip Clearance
- Frozen Rotor interface (between stator & rotor)
- Conjugate heat transfer considering blade model
- Prediction of high temperatures as well as radial, circumferential and axial variations in flow quantities on the turbine blade life.
- Blade Cooling : simultaneous computation of gas and solid by conjugate heat transfer method.
- Prediction of blade temperature and heat transfer co-efficients.



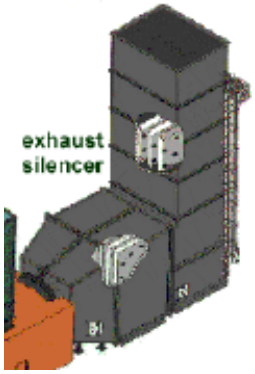


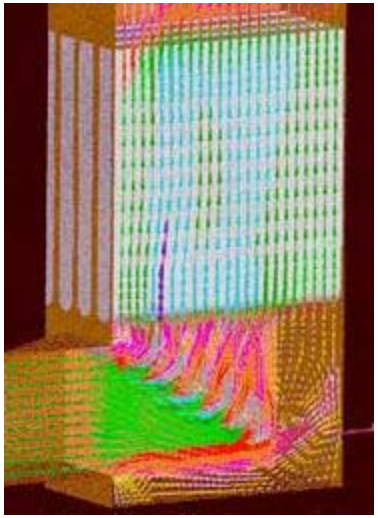




Gas Turbine Capabilities – Exhaust System

- Gas Turbine Exhaust System for Industrial as well as the aircraft engines
- To validate the pressure and temperature at the exhaust system with experimental data.
- To compare the Flow distribution, Temperature & pressure distribution with variation in the geometrical configurations.
- Use of modular approach for time effective meshing with minimum number of cells .
- Pressure recovery and losses.
- Predication of Heat Transfer Co efficient

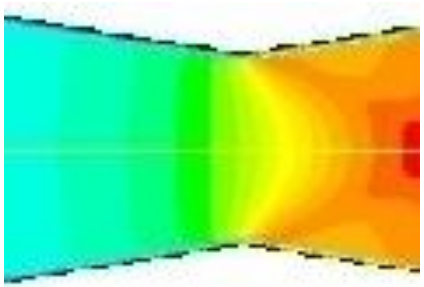




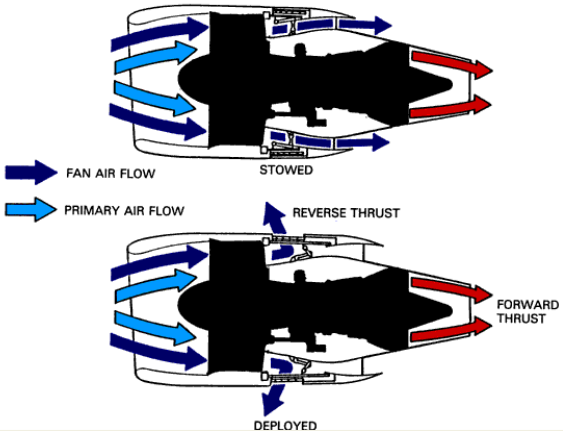
Gas Turbine Capabilities – Secondary Flow System, Heat Transfer, Other Components Analysis

- Gas Turbine Nozzle
- Cavities
- Ducts
- Nacelles
- Thrust Reverser
- Secondary Flow & Heat Transfer Analysis
- Gas Turbine secondary flow system, cavity flow, leakage path and heat transfer analysis
- Secondary flow & Heat transfer Analysis.
- Prediction of fluid parameters i.e. Mass Flow, Temperature & pressure distribution
- To predict the Heat Transfer coefficient on the surface and windage temperature rise.
- Turbine Casing Temperature Prediction
- Conjugate Heat Transfer Modeling

AES Capabilities in Aerospace



- CFD Analysis of ventilation system
- External aerodynamics
- Internal Flow CFD Analysis
- Thermal Analysis
- Thermal analysis of electronic system
- Aircraft engine different component CFD analysis
- CFD analysis for different altitude conditions
- Hydraulic system CFD analysis
- Airport Ventilation and flow analysis
- Anti-Icing System
- Electronic Cooling System Analysis
- Environmental analysis
- Fuel tanks and fuel pump CFD analysis
- Nozzle CFD analysis
- Thrust Reverser CFD Analysis
- Inlet system and diffuser CFD Analysis
- ATEX for explosive atmosphere of Gas Turbine Ventilation
- Multistage Analysis



Major Areas in Steam Turbine

AES is capable of provide a wide range of CFD solutions in Steam Turbine :

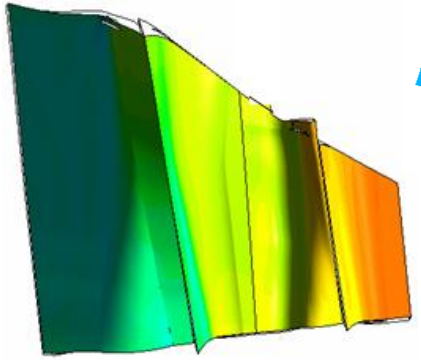
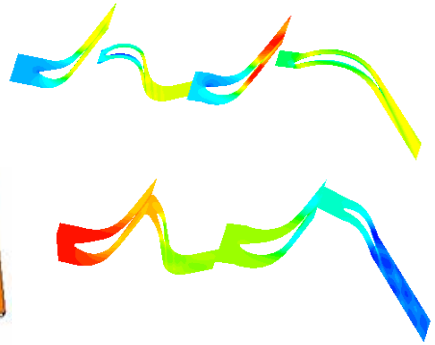
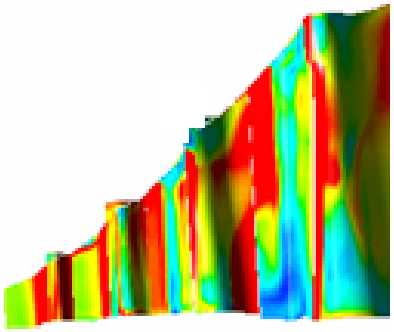
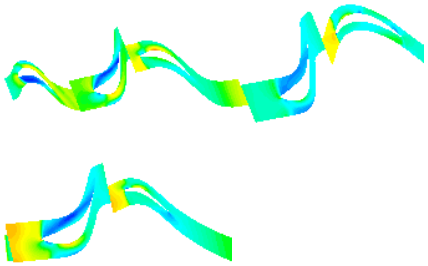
- Flow conditions ranging from subsonic to supersonic
- To solve the wide range of specialized multi physics problems encountered in the steam turbine.

Major Areas

- HP Inlet System
- HP Turbine
- LP Turbine
- HP Outlet System
- Bleed Pipe
- IP Inlet & IP Outlet System
- Nozzle system
- Secondary Air Flow
- Exhaust Hood System

Key Applications

- Internal Flows
- Thermal Management
- Fluid Structure Interaction (FSI)
- Aerodynamics & Aerothermodynamics
- Heat Transfer
- Multidisciplinary Design & Optimization

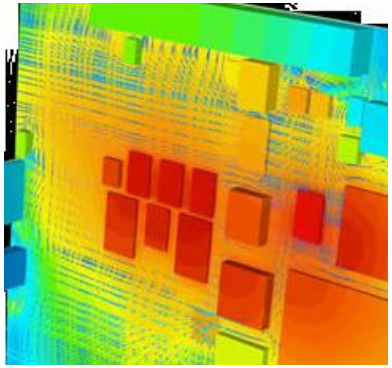





Major Areas in Multiphase CFD Analysis

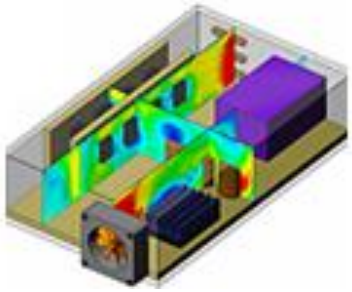
AES is capable of provide a wide range of CFD solutions in Multiphase :

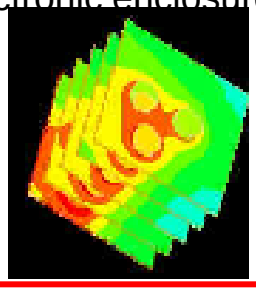
- To solve the wide range of specialized problems encountered.
- Provide the accuracy, turnaround time, and unique capabilities to improve the productivity of the design process.
- Multiphase flow is simultaneous flow of:
  - Materials with different states or phases (i.e. gas, liquid or solid).
  - Materials with different chemical properties but in the same state or phase (i.e. liquid-liquid systems such as oil droplets in water).
- The primary and secondary phases:
  - One of the phases is continuous (primary) while the other(s) (secondary) are dispersed within the continuous phase.
  - A diameter has to be assigned for each secondary phase to calculate its interaction (drag) with the primary phase.
  - A secondary phase with a particle size distribution is modeled by assigning a separate phase for each particle diameter.

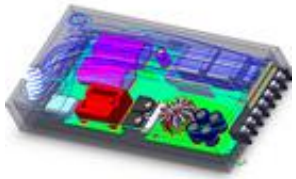
AES Capabilities in Electronic/Semiconductor



- CFD Analysis of Numerical Study of Forced Convection over the heat sources.
- Optimisation of flow path over Power Supply, Heat Sinks of a Electronics System
- Thermal Optimization of Electronic Systems
- System-level Thermal Simulation
- Three dimensional conjugate heat transfer in an Electronic package.
- Enhanced Electronic System Reliability
- Natural Convection
- Thermal Performance of Air-cooled with Natural convection and low velocity Electronic cooling sysdtem.
- Forced Convection air flows.
- Electronic equipment with Natural convection & radiation.
- Thermal analysis of the electronic enclosure in a harsh working condition.







Thank you