

FINE™/Hexa

Technical Specification

NUMECA, a new wave in fluid dynamics



A fully integrated platform of Computational Fluid Dynamics

based on **Un-structured Grid System** combining :

- **HEXSTREAM™**: 3D Unstructured Navier-Stokes Solver
- **HEXPRESS™** : Automatic Full Hexahedral Grid Generation system,
- **CFView™** : Computational Field Visualization System,
- **FINE™ GUI** : Interactive Graphic User Interface,
- **Computational MONITORING**

HARDWARE REQUIREMENTS

(recommended for full capabilities usage) :

- Standard equipments : monitor, keyboard, mouse
- CD-Rom drive
- 3-button mouse
- 24-bit color graphics and 1280x1240 pixel resolution monitor (i.e. NVidia 6800)
- Mandatory Ethernet card for a node-locked license on LINUX
- RAM minimum requirement : 512 Mb, > 1024 Mb recommended (for 1 million points)
- Swap space : 3 times of RAM size
- Hard disk storage capacity depends on project types and number of points, 750 Mb space is needed to store mesh and solution files of a 1-million-points project

COMPUTER PLATFORMS

- Unix, Linux
- Pentium/Athlon (WindowsNT, 2000, XP)

HEXSTREAM™ FLOW SOLVER

NUMERICAL METHOD

- Fully unstructured
- Cell centred conservative finite volume method
- Explicit density based algorithm with preconditioning
- Spatial discretization
 - 2nd order central schemes with artificial dissipation
 - 1st and 2nd order Upwind Roe Scheme**
- Time discretization
 - Dual time stepping
 - Explicit Runge-Kutta smoother with local time stepping
- Hierarchy based multi-grid (FAS)
- Agglomeration multi-grid*

PARALLEL PROCESSING

- Supported on LINUX platforms
- Distributed/shared memory (MPI based)
- All solver capabilities supported (except mesh adaptation)
- Automatic partitioning
- Automatic solution reconstruction
- Speed up ~80%

BOUNDARY CONDITIONS

- **Inlets:**
 - Static
 - Total quantities imposed
 - Mass flow imposed
- **Outlets:**
 - Static pressure imposed
 - Mass flow imposed
 - Radial equilibrium,
 - Backflow control
- **Walls:**
 - Euler
 - Navier-Stokes walls
 - Adiabatic
 - Temperature imposed
 - Heat flux imposed
 - Moving walls
 - Smooth/rough walls.
- **External Riemann invariant**

FLOWS CAPABILITIES

- Cartesian/Cylindrical coordinates
- Euler
- Laminar
- Turbulent
- Steady state flow
- Unsteady flow
- Compressible
- Incompressible (Pre-conditioning)
- Subsonic, transonic, supersonic
- Newtonian liquids and gases
- Gravity
- Large scale CHT
- Turbomachinery-Rotor/Stator Interface

- Turbulence Models:
 - Spalart-Allmaras 1 equation model
 - Spalart-Allmaras extended (SARC)
 - k-ε model wall-functions
 - k-ε model low Reynolds number
 - k-omega (SST)
 - k-omega (Wilcox)
- Control surface averages (lift, drag etc)
- Mesh adaptation

FINE™ GUI

INTERACTIVE GRAPHIC USER INTERFACE

- Fully integrated GUI
- Simple user-friendly POINT & CLICK graphical user interface (GUI) :
 - Mouse-driven
 - Context-sensitive
 - Intuitive and fast to learn interaction
- Easy-to-use object-oriented interface:
 - pulldown menus
 - pullright menus
 - dialogue boxes
 - keyboard input areas
- Selection of graphical entities by :
 - mouse picking or
 - keyboard entries
- View buttons operations for geometry and quantity representations in any perspective, with immediate visual feedback
- Multiwindows environment
- Access to pre and post processors
- Task management
- Convergence tracking
- Parallel computation set-up
- Batch mode

COMPUTATIONAL MONITORING:

Direct run-time Convergence History monitoring of:

- Global and Block Residuals
- Forces: Lift, Drag, Momentum
- Turbulence Variables

*New Generation of Accurate and Automated
CFD Integrated Tools for Complex Geometry*

Hexpress™

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- **A STAND ALONE MESH GENERATOR FOR NON-NUMECA'S SOLVER AND CSM CODES OR EMBEDDED IN NUMECA'S UNSTRUCTURED CFD SUITE FINE™/MARINE AND FINE™/HEXA**
- **3D GEOMETRIES PURE HEXAHEDRAL CELLS WITHIN PASSAGE AND NEAR SURFACE BOUNDARIES**
- **LIMITED USER INPUT**
- **EASE OF USE:**
 - ▶ **COMPREHENSIVE WIZARD FOR STEP-BY-STEP GRID GENERATION**
 - ▶ **FULLY AUTOMATED TEMPLATES FOR SIMILAR GEOMETRIES**

FEATURES

- Fast and Automatic mesh generator
- Non-conformal all-hexahedra meshes
- Mesh generation in 2 main parts:
 - Domain to mesh preparation (CAD data processing)
 - Mesh generation (Volume to surface, Octree approach)
- Geometry Manipulation Menu
- Domain simplification:
 - Manual Edge/Face Merge/Split utility
 - Automatic Edge/Face Merge utility based on feature angle recognition
- All-hexahedra meshes
 - Accuracy of classical numerical schemes
 - High aspect ratio cells in boundary layer
- Mesh Periodicity
- Multi-domain and FNMB connections
- Multi-block Meshing
- Hybrid mesh generation
- Grid Quality Monitoring
- Interactive mesh correction tool
- Automatic Mesh partitioning (in FINE™/Marine and FINE™/Hexa)
- Face orientation correction in Star-CD surface mesh to STL conversion
- Batch Mode
- 64 bits Mesh Generation

MESH WIZARD

- **Initiate meshing**
 - Transfer your CAD file to a computational domain
 - Automatically set an initial grid for your domain or import a pre-used mesh
- **Mesh refinement/adaptation**
 - Choose generic meshing criteria:
 - surface curvature
 - number of cells between two surfaces
 - Set a target cell size either:
 - locally (close to selected surfaces) or
 - within an interactively created volume
- **Finalize meshing**
 - Automatically snap the grid points on CAD geometry
- **Optimize mesh quality**
- **Insert Boundary Layers** around surfaces and curves
- Possibility to **STOP** meshing process at each step

IMPORT FORMATS

- Direct import for:
 - CATIA V5 (*.CatPart) files:
 - PARASOLID files:
 - STL + properties files (Stereolithographics)
- Through CADfix:
 - Simple and fast file import:
 - IGES

- STEP
- STL
- ACIS
- CADD5
- Pro-Engineer
- Powerful and efficient CAD cleaning tool

EXPORT FORMATS

- FINE/Marine and FINE/HEXA
- STAR-CD
- FLUENT
- CSM code (SAMCEF BACON)

COMPUTER PLATFORMS

- Unix:
 - SGI
 - SUN
 - HP
 - IBM
 - DEC
 - Alpha
 - Itanium 2
 - PA-RISC 64 bits machines
- Linux:
 - Opteron (LINUX 64 bits)
 - Pentium EM64T (LINUX 64 bits)
- Pentium/Athlon (Windows2000, XP)

Automated Unstructured Full HEX-meshing

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