

# FINE™/Marine

## Technical Specification

*NUMECA, a new wave in fluid dynamics*



**A fully integrated platform of Computational Fluid Dynamics dedicated for naval architecture based on fully hexahedral un-structured Grid System combining :**

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

### HARDWARE REQUIREMENTS

(recommended for full capabilities usage) :

- Parallel machine with fast inter-connexion.
- Ram requirement: about 2Gb per million nodes
- Recommended CPU loading: less than 500 000 nodes per processor
- 64 bits machine with sufficient memory required for preprocessing (350Mb per million nodes)

### COMPUTER PLATFORMS

- Linux Intel 32 bits
- Linux Opteron 64 bits
- IBM Power PC

### ISIS-CFD™ FLOW SOLVER

#### NUMERICAL METHOD

- Fully unstructured
- Cell centred conservative finite volume method  
Pressure equation formulation
- Free-surface capturing strategy with high-resolution interface schemes
- Spatial discretization:  
2<sup>nd</sup> order centered and backward schemes
- Time discretization  
2<sup>nd</sup> order backward scheme

#### PARALLEL PROCESSING

- Up to 999 processors
- Domain decomposition with Metis
- Distributed memory (MPI based)
- Automatic partitioning
- Automatic solution reconstruction

### BOUNDARY CONDITIONS

- **Inlets:**
  - Flow field imposed
  - Prescribed Stokes waves (1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> order)
- **Outlets:**
  - Prescribed pressure
  - Extrapolated pressure gradient
- **Walls:**
  - Euler
  - Navier-Stokes walls
  - Moving walls
- **Symmetry Conditions:**
  - Plane of symmetry

### FLOWS CAPABILITIES

- Free-surface or mono-fluid flows
- Propeller modelled through an actuator-disk theory
- Cartesian coordinates
- Euler
- Laminar
- Turbulent
- Steady state flow
- Unsteady flow
- Incompressible
- Gravity
- Turbulence Models:
  - Spalart-Allmaras 1 equation model
  - k-ε model Launder-Sharma
  - k-omega (SST)
  - k-omega (BSL)
  - k-omega (Wilcox)
  - EARSM (Explicit Algebraic Reynolds Stress Model)

Except the Spalart-Almaras one-equation-model, all models can be used with:

- wall functions
- low-Reynolds formulations
- rotation correction

### 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

\* available in the next release

# High Fidelity CFD system for Naval Architecture

# Hexpress™

## Technical Specification

*NUMECA, a new wave in fluid dynamics*



- **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
- **Conformal 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 (WindowsNT, 2000, XP)

\*Available in the next release

## Automated Unstructured Full HEX-meshing

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