

Each of the above modules can be used alone or as part of a suite of modules coupled together through coupler interfaces.

Many elements of the 3DYNAFS® software suite have been extensively validated with in-house experiments as well as with field tests in government laboratories and comparisons with results from the literature.

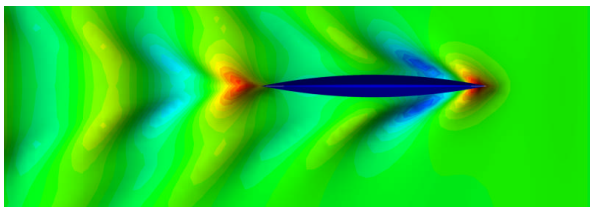
APPLICATIONS

3DYNAFS® has been used for applications in the naval and marine, energy, chemical, food and medical fields including modeling and study of:

- Fluid – Structure interactions,
- Bubble deformation in vortex flow fields
- Multiple bubble interactions,
- Cavitation inception and noise,
- Bubble – Cell interactions
- Explosions near floating and submerged bodies and near the ocean free surface
- Seismic air-gun modeling
- Ultrasound contrast agent dynamics
- Coated micro-bubbles for drug delivery

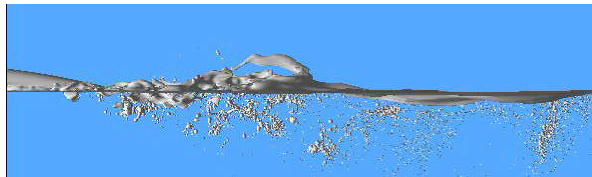
Its hydrodynamic applications include:

- Ship hydrodynamics
- Ship and wave interactions
- Ship-Ship interaction
- Ship/Air layers
- Breaking waves
- Shallow water effects
- Nonlinear free surface waves



DYNAFLOW, INC. provides Research & Development in Applied Sciences. Our capabilities span the spectrum of software development, analysis, numerical simulation, experimentation, testing and experience in:

- Water Jet Technology**
- Acoustics**
- Flow Oscillation, Vibration, & Sound Generation**
- Dynamic Materials Properties**
- Stress Wave Propagation**
- Material Erosion due to Drop Impact**
- Fluid-Structure Interactions**
- Material Science**
- Multiphase Flows**
- Material Erosion due to Cavitation**
- Underwater Explosions**
- Flow Visualization**
- Liquid & Air Filtration**
- Computational Fluid Dynamics**
- Computed Tomography**
- Fluid Mechanics**
- Software for Science**



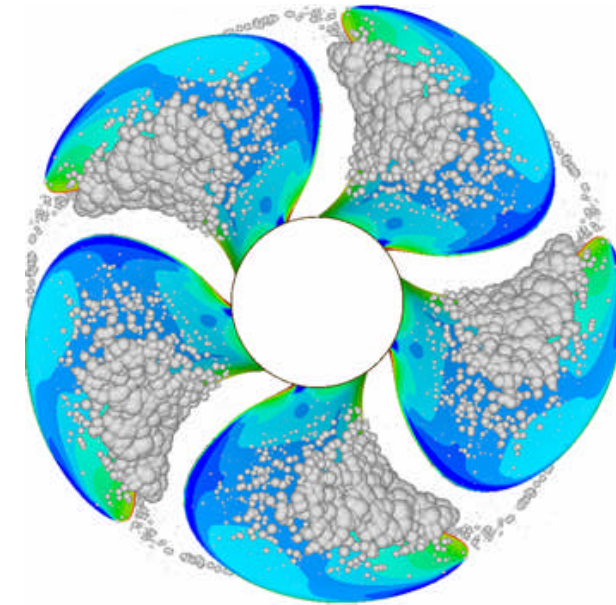
For more information or questions about possible developments for other applications, please contact:

DYNAFLOW, INC.
10621-J Iron Bridge Road
Jessup, MD 20794-9381, USA
TEL: (301) 604-3688
FAX: (301) 604-3689
E-mail: info@dynaflow-inc.com
URL: <http://www.dynaflow-inc.com>

3DYNAFS®
A Comprehensive Flow Physics Solver

HIGHLIGHTS

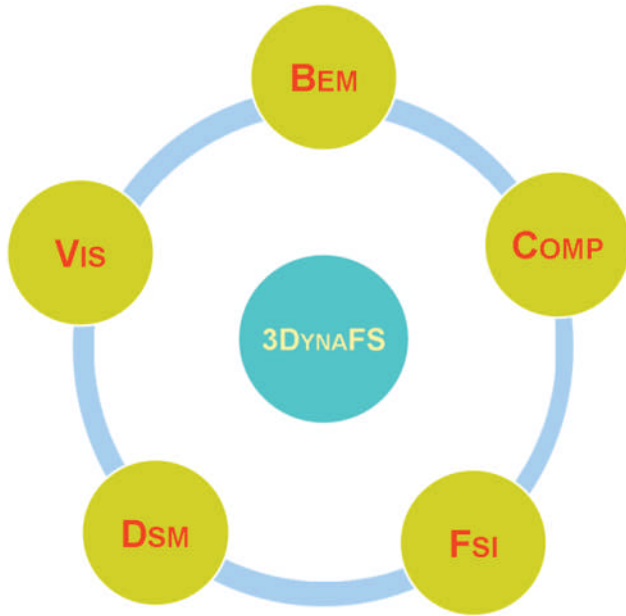
- Potential Flow*
- Viscous Flow*
- Compressible Flow*
- Cavitation and Bubble Dynamics*
- Multiphase Flow*
- Free Surface Dynamics*
- Ship Hydrodynamics*
- Fluid Structure Interaction*



3DYNAFS®

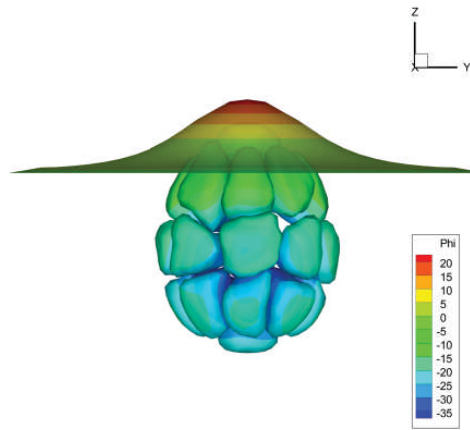
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3DYNAFS[®], which stands for “Three-Dimensional Dynamics of Free Surfaces” is a general Computational Fluid Dynamics (CFD) software suite, specialized for the study of the large deformations and interactions involved in bubble dynamics, cavitation, two-phase flows, surface waves, ship hydrodynamics, and fluid/structure interactions. 3DYNAFS[®] includes a set of specialized modules for handling a variety of fluid dynamics problems.



3DYNAFS-BEM[®]

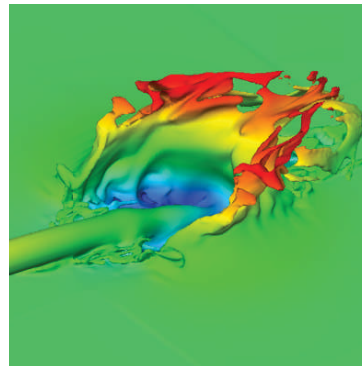
This module, based on the Boundary Element Method, utilizes Green’s identity to reduce the number of dimensions of the problem by one. A flow field problem is reduced to a solution of the velocity potential and its normal derivative along the boundary of the domain. This results in drastic reduction in computational time compared with other types of hydrodynamic codes.



Multi-bubble interaction near a free surface- BEM module

3DYNAFS-VIS[®]

This module is a viscous flow solver, which solves Incompressible Navier-Stokes equations in generalized curvilinear coordinates. It uses the finite volume method with multi-block structured grids and overset grids. It includes a Level Set method for two-phase flows, a k-ε model and an LES model for turbulent flows, and also a Viscoelastic model.



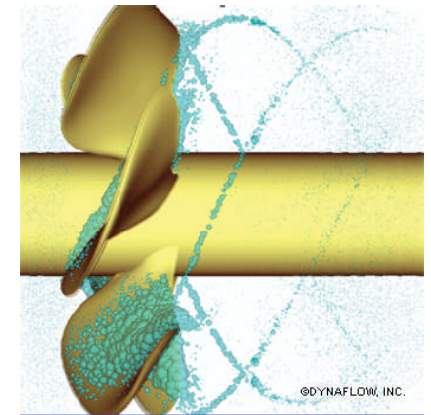
Plunging Jet – VIS Module

3DYNAFS-COMP[®]

This module is a compressible Euler flow solver in Cartesian coordinates. It utilizes a high-order finite difference method with Level-Set and Mixed-Cell methods for multi-materials and multiphase flows.

3DYNAFS-DSM[®]

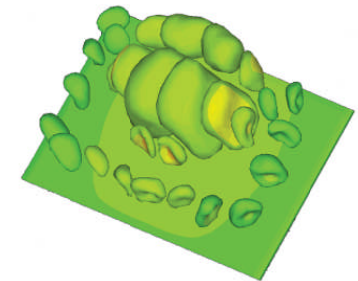
This is a module to simulate complex flows involving separation areas and particle tracking dynamics - including bubbly flows. The module includes a Vortex Element Method sub-module to simulate shear layers. It also has a Discrete Bubble Module and a Discrete Particle Module to solve bubble dynamics and particle trajectories in flows by accounting for the interaction between the discrete entities.



Cavitation bubble around a marine propeller flow – VIS and DSM modules

3DYNAFS-FSI[®]

This Fluid Structure Interaction module enables the various 3DYNAFS[®] modules to become coupled with a structure code (such as Dyna3D, EPSA...) using a coupler interface. This allows the study of fluid dynamics of a problem along with the structural dynamics of any nearby objects.



Multi-bubble interaction near a solid plate- BEM and FSI module