DYNASIM©

A PC Based
Ship Maneuvering Simulator

DYNAFLOW, INC.

Research & Development in Applied Sciences

http: www.dynaflow-inc.com

DYNA

Definition

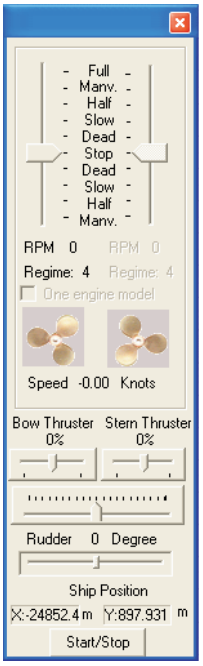
- DYNASIM© is a user-friendly ship simulator that utilizes ship maneuvering characteristics to faithfully reproduce ship motion in the presence of:
  - winds
  - waves
  - currents
  - obstacles
  - other ships....etc.
- Multi-threading enables simultaneous simulation of multiple ships.
- An auto-pilot following traffic regulation enables traffic simulation in harbors and waterways

Status indication dials

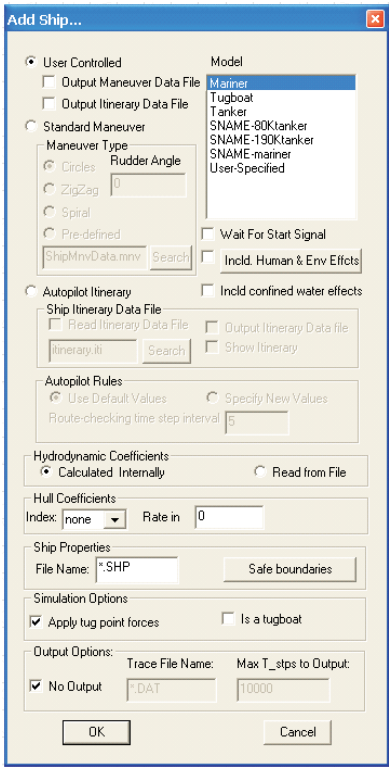
Capabilities

- DYNASIM© incorporates state of the art models of ship motion and is capable of executing real time simulations of ship maneuvers in complex environments in real or accelerated time.
- DYNASIM© employs modular mathematical models for the various components of the ship (hull, propellers, rudders, thrusters) and environmental effects (wind, current, waves) and waterways (bottom, pier walls) to achieve a sophisticated and faithful mathematical model for ship maneuvers. These models are based on collective experience resulting from the development of several ship maneuvering software.
- DYNASIM© runs on a Windows operating system and has a user-friendly interactive graphic interface. It achieves capabilities on par with expensive stand-alone full-mission simulators.

ASIM©



Ship control panel



Ship definition panel

Applications

DYNASIM© is suitable for the following applications:

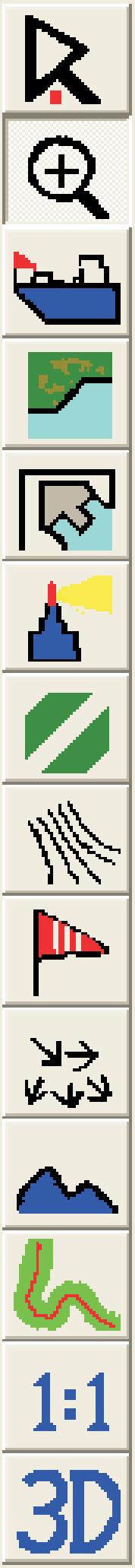
- Training of master pilots
- Traffic safety evaluation in harbors
- Safety study of vessel types, traffic densities, waterway geometries
- Harbor structures design
- Navigation channels design
- Port traffic planning
- Marine/navigation regulation development
- Tug operation optimization

Route properties panel

Advantages & Features

DYNASIM© includes the following:

- Advanced mathematical modeling of ship maneuvering hydrodynamics
- Environmental effects: wind, wave, current, bathymetry,...
- User input ship data file
- Ship characteristics: type, geometry, twin screw, bow/stern thrusters, tugs,..
- Simulation of IMO standard ship maneuvers
- Autopilot with collision avoidance
- Configurable preplanned routes and ship schedules
- Harbor/waterway system safety metric
- Fuel consumption calculation
- Tug operation simulation by a user controlled tugboat and/or by tabulated force vectors
- Human errors and delays
- Graphic User Interface with user control input through a keyboard, a mouse, and a joystick
- Technical support and flexible customization



DYNASIM© Simulation Modes

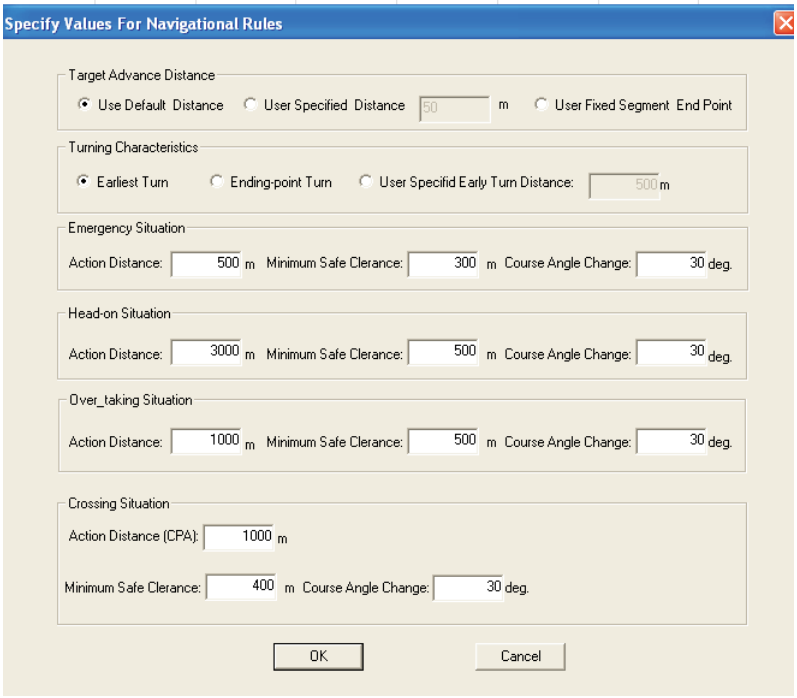
DYNASIM© has three basic simulation modes:

- **User controlled mode:** in DYNASIM© the user controls the rudder, the engine, and any lateral thrusters through a graphic control panel to simulate the navigation of a ship.

- **Standard maneuver mode:** DYNASIM© can simulate a ship performing one of the classical maneuvers (turning circle, zigzag, spiral) recommended by the International Maritime Organization (IMO) for certification and evaluation of ship hydrodynamic characteristics and maneuverability.

- **Computer controlled navigation mode:** DYNASIM© can model ship traffic in the open ocean or in a restricted environment. The behaviors of the auto-piloted ships along prescribed routes in the simulation are based on the U.S. Code of Conduct of Vessels. Traffic central parameters can also be adjusted by the user.

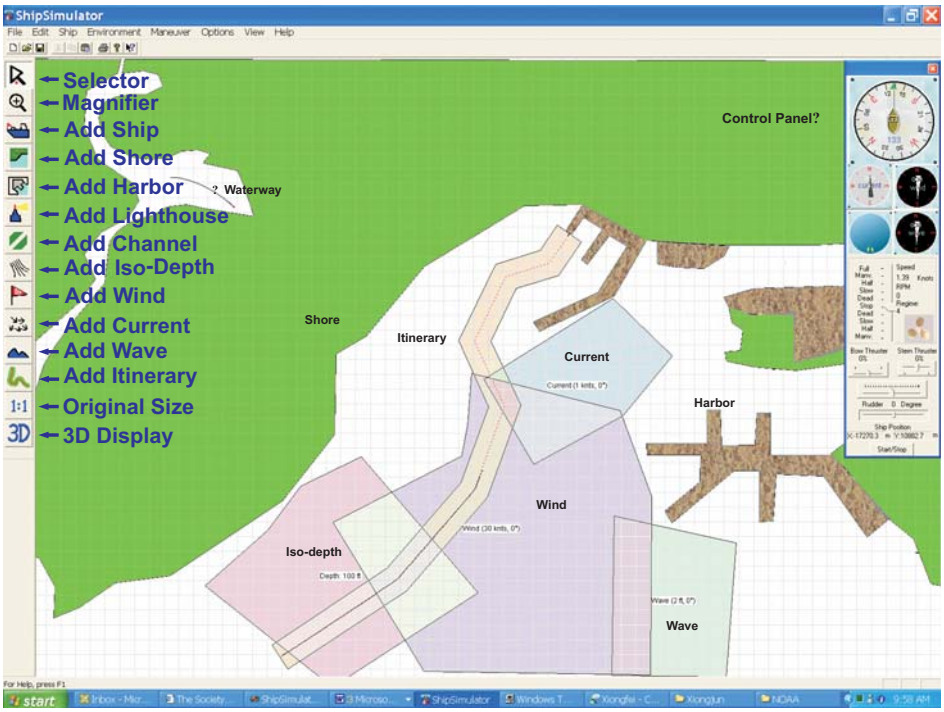
Session recording and replaying



Auto-Pilot navigation rules

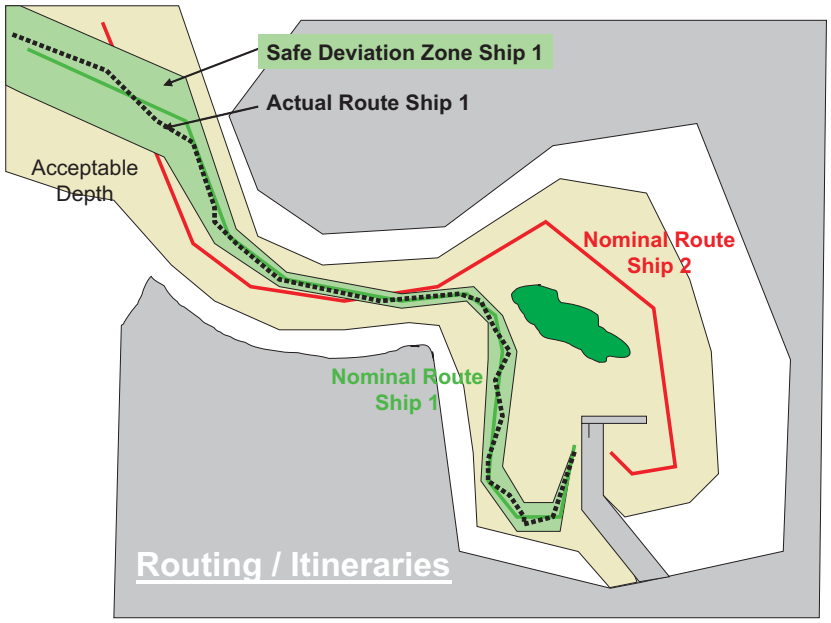
Environment Definition

Environmental conditions can be user input and drawn with a set of tool bars or can be read from an environmental data file.



Screen shot of simulator with environmental conditions

Traffic Modeling

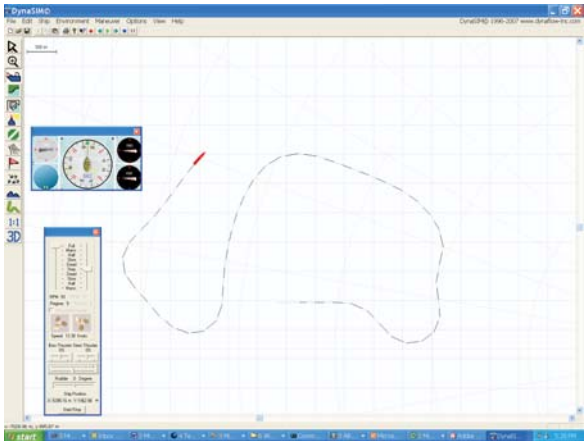


Route evaluation and traffic planning

DYNASIM© Commercial Versions

DYNASIM© Basic

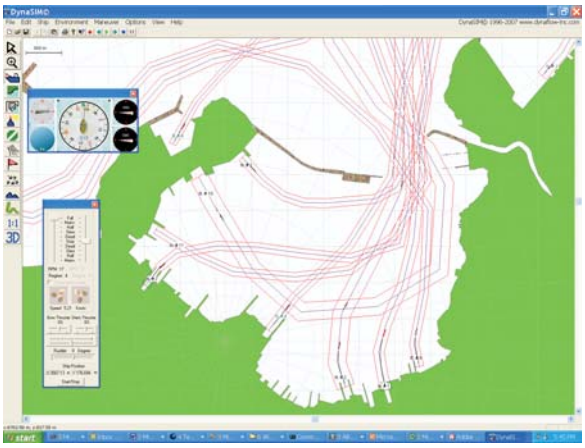
- Basic ship maneuvers using a keyboard and a mouse or a joystick
- User configurable environments (coastline, wind, wave, current, bathymetry, channels, etc.)
- Simulation of IMO standard ship maneuvers (turning circle, zigzag, spiral)
- Editable ship data files (tankers, containers, mariners)



Basic Version

DYNASIM© Traffic

- All features of DYNASIM© Basic version, plus computer controlled maneuvers along pre-planned routes
- Collision avoidance following navigation rules
- Harbor simulation with prescribed ship schedules
- Calculation of system safety and fuel consumption



Traffic Version

DYNASIM© Tug Boat

- All features of DYNASIM© Traffic version plus tugboat in user controlled mode
- Simulation of tugboats as tabulated point force vectors
- Twin engines/screws with separate controls for each engine

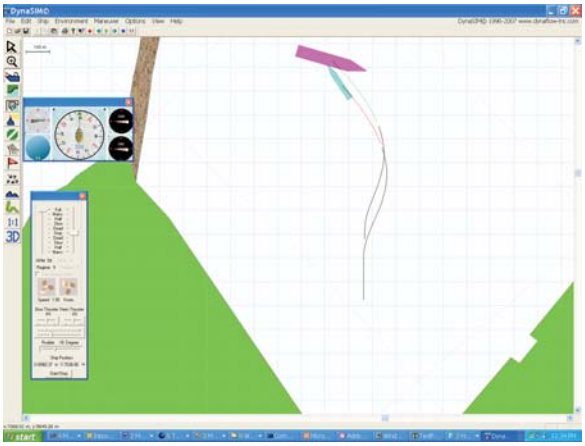
Hardware Requirements

Minimum Requirements

CPU: P3 400 Khz
Memory: 128 MB
Free disk space: 256 MB
Monitor resolution: 1024 x 768

Recommended Hardware

CPU: P4 2.8 GHz or better
Memory: 512 MB or more
Free disk space: 1 GB or more
Monitor resolution: 1280 x 1024 or higher
OS: Windows XP or above
Joystick



Tug Boat Version

References

1.Cheng, J.-Y., Chahine, G.L., and Hsiao, C-T., "A computational tool for simulating hydrodynamics behavior of multiple vessels in a harbor," DYNAFLOW, INC. Technical Report 2M1011-NOAA-1, Jan. 2002.

2.Chahine, G. L. , Kalumuck K. M., Cheng J.-Y., and Goumilevski, A., "High fidelity ocean surf zone model for use in USMC simulators," DYNAFLOW, INC. Technical Report 99001-AAAV-1, Nov. 2001

3.Cheng, J-Y., Chahine, G.L. & Kalumuck, K.M., "Computations of hydrodynamic characteristics of a floating amphibious vehicle using BEM," BETECH2001, Florida, 2001.

4.Cheng, J-Y., Goumilevski, A. G., and Chahine, G. L., "A 3D BEM simulation of breaking waves on a gentle beach," Proc., 14th ASCE Eng. Mechanics Conf., Austin, TX, May 2000.

5.Goumilevski, A., Cheng, J, & Chahine, G. L., "wave breaking on a sloping beach: comparisons between experiments & simulations," Proc., 14th ASCE Engr. Mech. Conf., Austin, TX, May 2000.

6.Kalumuck, K., Chahine, G., & Goumilevski, A., "BEM modeling of the interaction between breaking waves and a floating body in the surf zone." Proc., 13th ASCE Engr. Mech. Conf., Baltimore, MD, June 1999.

7.Chahine, G.L., Kalumuck, K.M., Miller, E.R. and Jakobsen, B.K., "High fidelity ocean surf zone model for use in USMC simulator," DYNAFLOW, INC. Technical Report 97018-1, 1998.

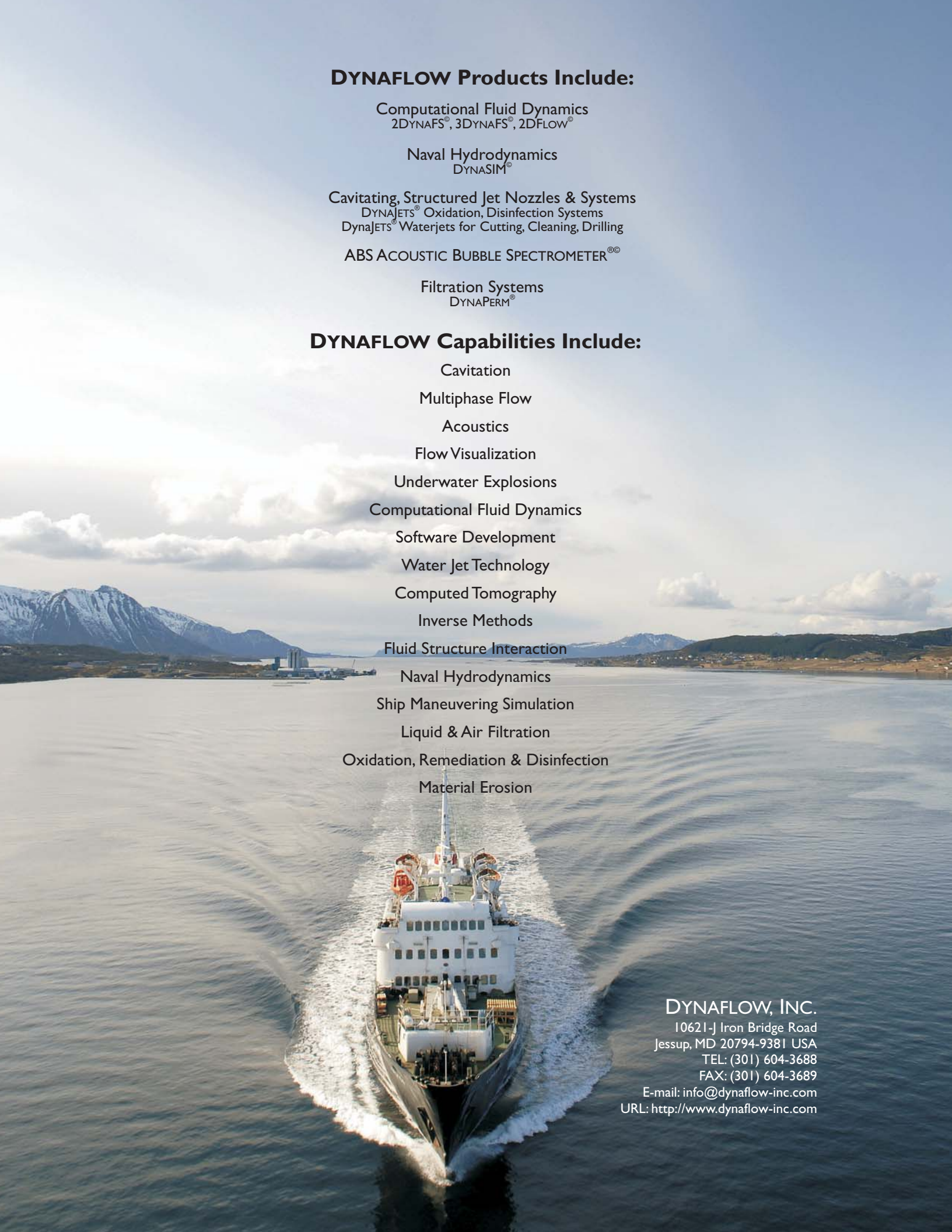
8.Duraiswami, R., Chahine, A., and Chahine, G. L., "Development of a desktop ship simulator using systems identification techniques," DYNAFLOW, INC. Technical Report 95016-1nsf, December 1997.

9.Zilman, G., Duraiswami, R., Chahine, G. L., "Optimal ship design and simulator development using system identification technique", DYNAFLOW, INC. Technical report 94006-1nsf, October 1994.

Parallel Developments

- The hydrodynamic characteristics implemented in DYNASIM© can be updated using the results from advanced computational hydrodynamics codes such as DYNAFLOW's 3DYNAFS©, which can handle nonlinear, large amplitude vehicle motion, high waves, surf zone waves, etc.

- An additional major characteristic of DYNASIM© is the incorporation of a multi-objective system identification technique to determine the vehicle parameters. This enables the autopilot to adjust the vehicle parameters based on feedback from ship response to pilot commands.



DYNAFLOW Products Include:

Computational Fluid Dynamics
2DYNAFS©, 3DYNAFS©, 2DFLOW©

Naval Hydrodynamics
DYNASIM©

Cavitating, Structured Jet Nozzles & Systems
DYNAJETS® Oxidation, Disinfection Systems
DynaJETS® Waterjets for Cutting, Cleaning, Drilling

ABS ACOUSTIC BUBBLE SPECTROMETER®©

Filtration Systems
DYNAPERM®

DYNAFLOW Capabilities Include:

Cavitation

Multiphase Flow

Acoustics

Flow Visualization

Underwater Explosions

Computational Fluid Dynamics

Software Development

Water Jet Technology

Computed Tomography

Inverse Methods

Fluid Structure Interaction

Naval Hydrodynamics

Ship Maneuvering Simulation

Liquid & Air Filtration

Oxidation, Remediation & Disinfection

Material Erosion

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