Numerical Simulation of Fluid Flow Past Ships

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BACKGROUND

Today, computational fluid dynamics is a common method used to study different applications that involve fluid flow. Although most fluid flow problems involve a one phase fluid, the technique used in this project can be extended to problems involving two fluids. Both the airflow and water flow patterns are important in design of shape and configuration of ships.

MODEL INFORMATION

- Length = 240m
- Width = 40m
- Height = 20m
- Velocity = 10m/s
- Froude number $\frac{vo^2}{gH} = 0.043$
- g = -9.8
- H = 24m
- Time step = 0.06s
- Files are written every 10 time step
- # of nodes = 1334543
- # of elements = 7721216
- 40 time steps takes 6 hours in 64 Cray T3E

GOVERNING EQUATIONS

- 1. Navier Stokes Equation (Conservation of Momentum)

$$\mathbf{p}\left(\frac{\partial \mathbf{y}}{\partial \mathbf{x}} + \mathbf{u} \times \nabla \mathbf{u} - \mathbf{gz}\right) + \nabla \mathbf{p} - \mu \nabla^2 \mathbf{u} = \mathbf{0}$$

- 2. Incompressibility Constraint (Conservation of Mass)

$$\nabla \times \boldsymbol{u} = \mathbf{0}$$

- 3. Advection Equation for (Interface Function)

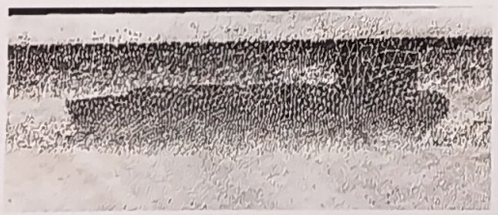
$$\frac{\partial \emptyset}{\partial t} + \boldsymbol{u} \times \nabla \emptyset = \mathbf{0}$$

$\emptyset = 1$: water $\qquad$ $\emptyset = 0$: air

RESULTS

Method

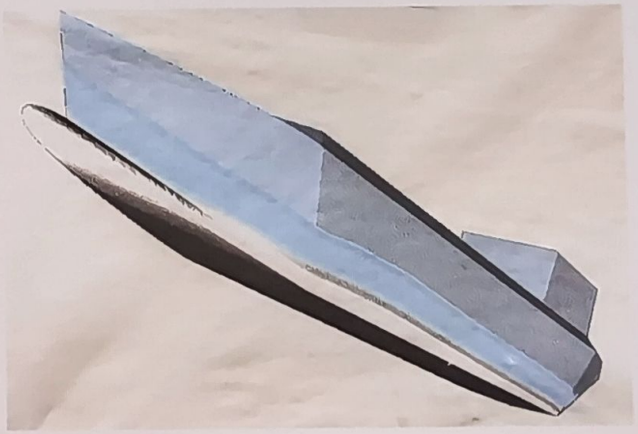
- Modeling- ModelG
- Mesh Generation
- Flow Simulation on CRAY T3E-1200
- Visulation-Ensight on SGI



Pressure Distribution

Pressure Distribution on Barrier

Pressure on Ship



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