

Calm Water Resistance

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1 Resistance Prediction

This section describes the steps taken to make the resistance prediction.

1.1 Case Setup

The most relevant parameters are listed below:

- Froude number is 0.4
- maxCo set to 0.3
- Simulated to 60 seconds
- Geometry and mesh provided by Dr. Kevin Maki

The mesh given had very good properties. Orthogonality was very good which made for fast computations because few, if any, non-orthogonal corrector iterations were needed. Ship particulars can be obtained using checkMesh. The max y^+ value is 165 at Fr 0.4. The average y^+ on this grid at Fr 0.4 was 90 which indicates a good resolution of the boundary layer. These are within the wall region suggestion of $30 < y^+ < 500$.

1.2 Simulation

Simulations were run in parallel on the flux cluster at the Center for Advanced Computing using OpenFOAM(R)'s interFoam solver from Version 1.7.x.

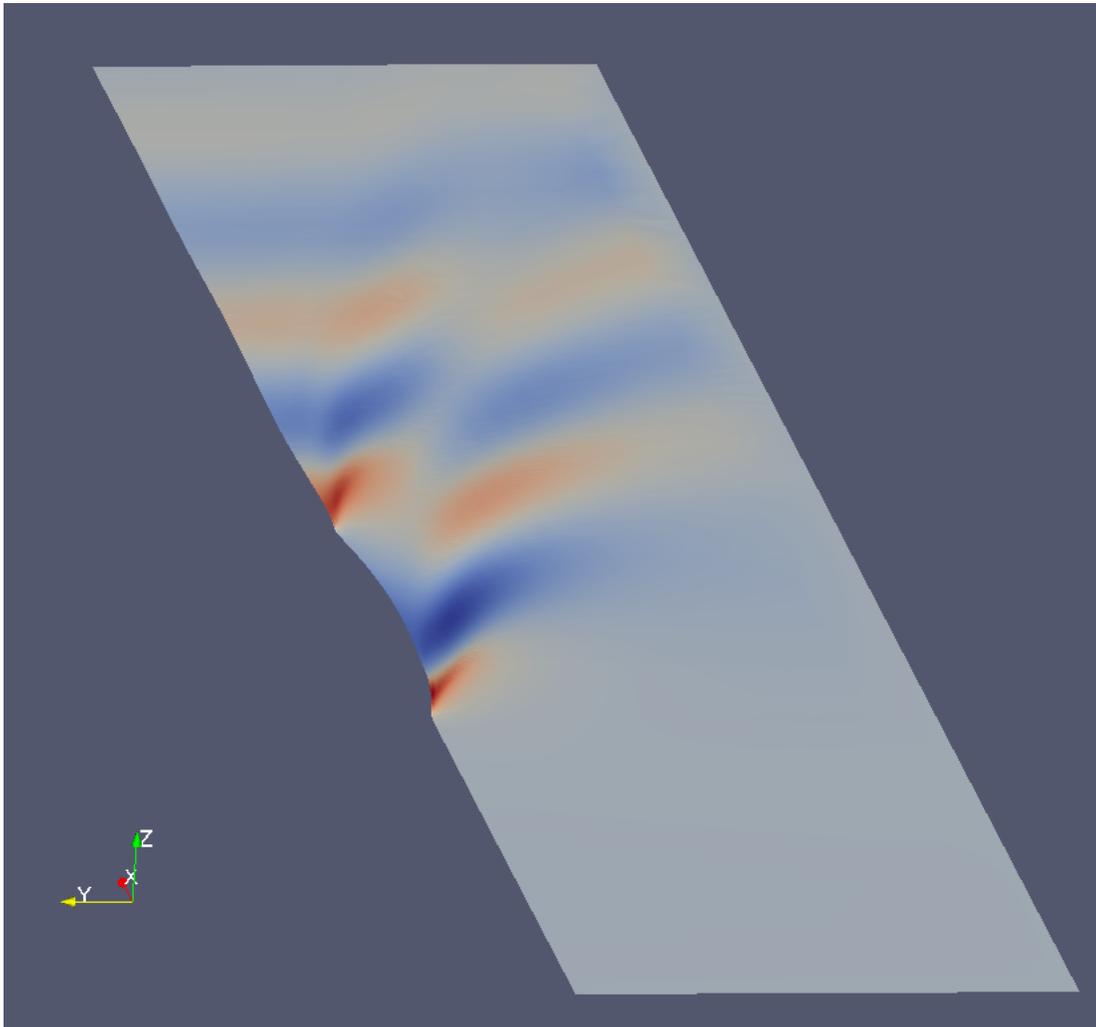


Figure 1: Wave Contour for $Fr=0.4$

1.3 Post-Processing

The solution was initially post processed using paraFoam to check the qualitative solution. The result is shown in figure 1. To get resistance values, the hull force was output to a file then parsed with a python program. Only the last fifth of data values were averaged to determine the steady state mean. This also plotted the output, an example is shown in figure 2. The medium mesh was used to compute resistance values at $Fr=0.15$ and 0.4 . ASME uncertainty analysis was used at $Fr=0.32$ to compute the extrapolated value of C_t as well as order of accuracy and Grid Convergence Index.

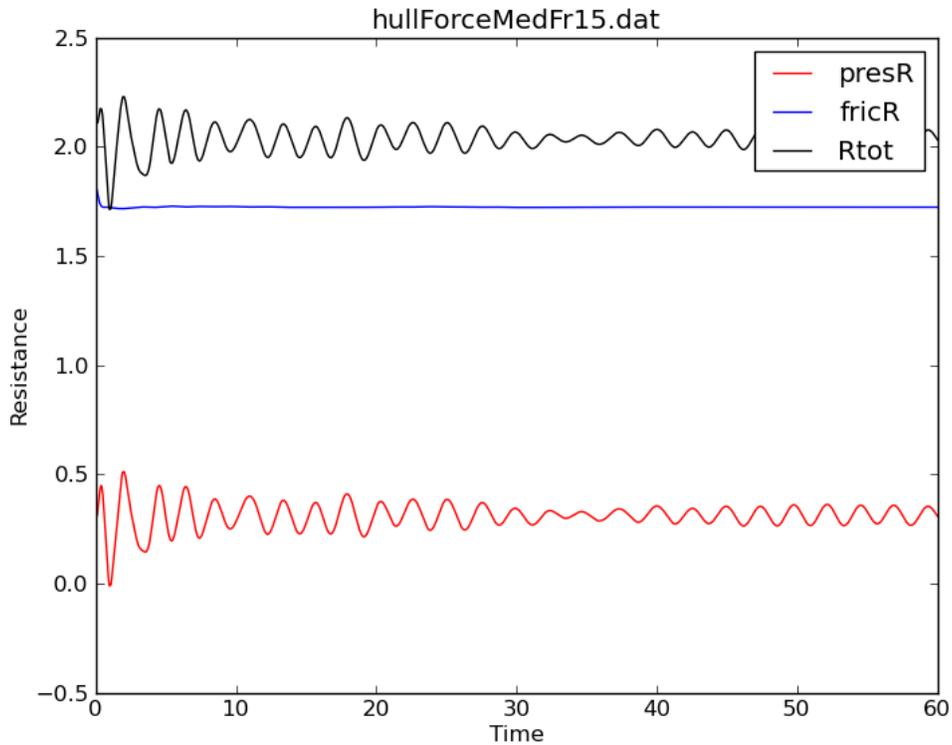


Figure 2: Resistance for $Fr=0.15$

Table 1: C_t values predicted by CFD

Fr	C_t
0.15	0.00388
0.32	0.00468
0.40	0.00524

1.4 Discussion of Results

Table 1 shows the results from performing the Volume of Fluid Experiments on a Wigley Hull.

Figure 3 shows a comparison of C_t values predicted by different engineering methods. The CFD methods investigated here seem to perform comparable to both the experiments and Michell's integral at the 3 speeds tested. It did, however, seem to predict the lowest resistance at all 3 Froude numbers. As additional work, it would be nice to test the cases at more Froude numbers to see if the predicted resistance is always lowest, or if it follows another trend.

Experimental measurements are from the 17th ITTC Resistance Committee in a report dated May 26, 1983 by H. Tanaka.

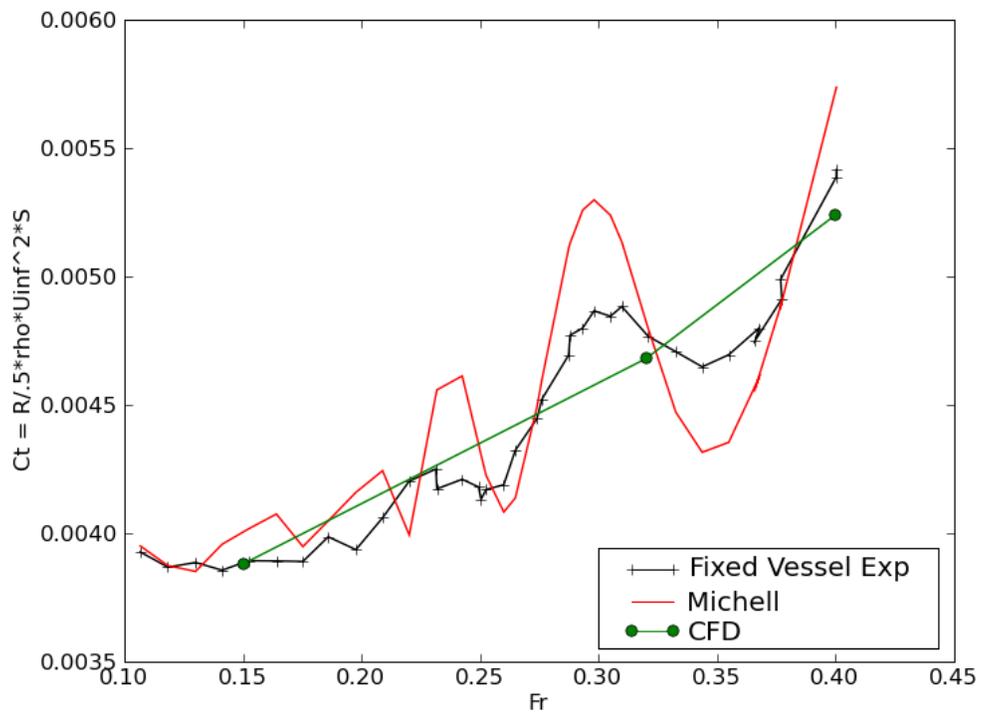


Figure 3: C_t Of All Methods