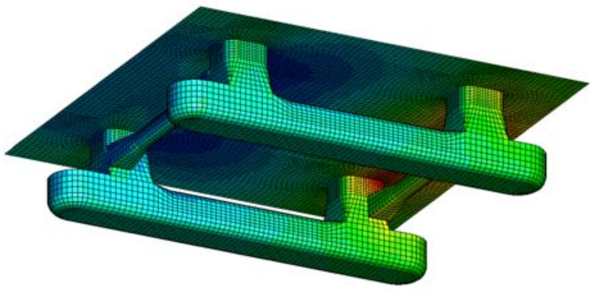
MULDIF

Prediction of hydrodynamic loads and responses in waves and current

SINTEF Ocean offers numerical calculations of loads and responses as an alternative to or in addition to model tests. MULDIF is a linear, three-dimensional, frequency domain radiation/diffraction program, developed for the analysis of the hydrodynamic interaction of waves and current with large volume structures. MULDIF is applicable to multiple bodies in both infinite and finite water depth. It is verified against other numerical codes and validated against model tests.



MAIN OUTPUT

- Hydrostatic coefficients
- Added mass and damping coefficients
- Wave excitation forces and moments
- Motion amplitudes and phases for a freely floating body. Viscous forces may also be specified.
- Free surface elevation or dynamic airgap
- Hydrodynamic pressure and fluid velocities in the fluid
- Horizontal mean drift forces and mean yaw moment
- Pressure distribution on body

MAIN INPUT

- Hull geometry represented by flat panels
- In case of wave-current interaction, additional discretization of the free surface in the vincinity of the body
- Wave and current data, arbitrary directions
- Mass data
- Additional added mass, damping and restoring forces
- Viscous roll damping for ships
- Input for drag force calculation on bracings/pontoons

THEORY/ASSUMPTIONS

- Inviscid irrotational, incompressible, homogeneous fluid
- Linear, potential flow theory
- 3D boundary element method
- Wave-current interaction
- Infinite and finite water depth
- Frequency domain
- Quadratic viscous damping in motion response calculation

CONNECTION TO OTHER SOFTWARE

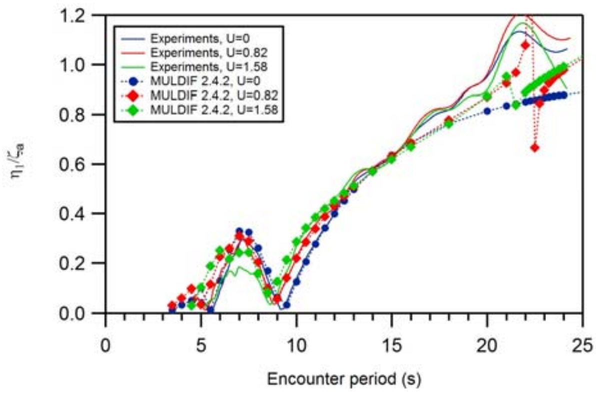
- Output may be given in VERES format for application in VERES postprocessor
- User Interface in SIMA
- Wave-drift damping coefficients can be calculated by running MULDIF in SIMA
- MULDIF can provide hydrodynamic input to SIMO

APPLICATIONS

- Seakeeping analysis
- Provide hydrodynamic input to time-domain simulations for marine operations or mooring analysis
- Airgap analyses
- Design of floating bridges
- Analysis of aquaculture structures

WAVE-CURRENT INTERACTION

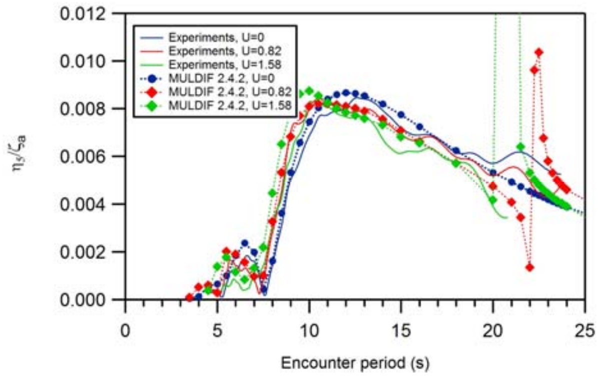
A major feature of MULDIF is wave-current interaction. Wave-current interaction effects may be important both for wave drift forces used in mooring analyses and in air gap calculations. It may also be important in design of floating bridges. The significance of the effects increases with the structure's ability to modify the steady flow around the structure.



NUMERICAL APPROACH

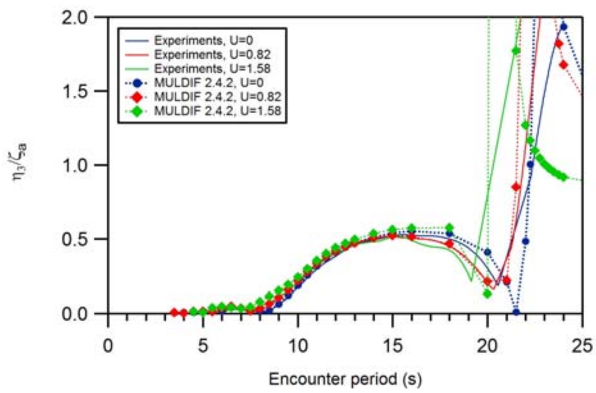
The free surface condition is linearized retaining terms proportional to the wave amplitude. Additionally the incident current velocity U is assumed small and only terms to order U are kept.

The velocity potentials on the mean wetted surface of the body are determined by the use of Green functions. Without current, a Green function satisfying the linear free surface condition is used and only the mean wetted surface of the body is discretized into panels. With wave-current interaction a domain decomposition formulation is used. In the inner domain where the steady disturbance potential due to the body is important, the free surface must be discretized into panels as well. A numerical formulation using the Green function satisfying the far-field free surface condition in the outer domain is then applied. The Green function is derived by means of a Taylor expansion in the wave form parameter $\tau = U\omega/g$.



Without current irregular frequencies can be removed by the lid method. With wave-current interaction irregular frequencies cannot be removed.

Viscous forces may be applied in the motion response calculation, where the quadratic terms are linearized by equivalent linearization and the responses are obtained by iteration.



REFERENCES

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CONTACT:

Elin Marita Hermundstad
elin.hermundstad@sintef.no