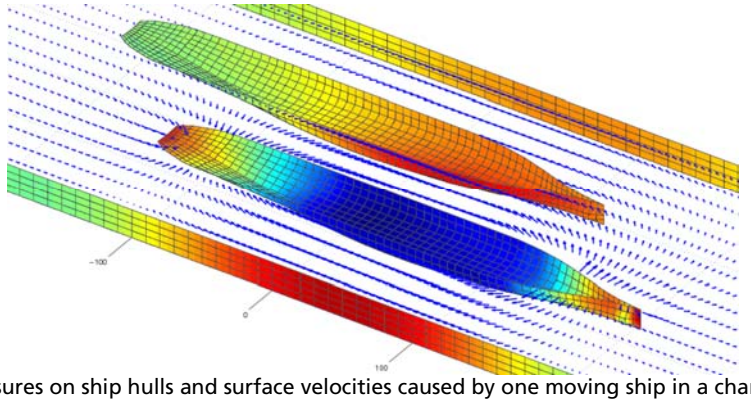
# SHIP-PASSING

## A panel code for computing ship interaction forces

### Background

SHIP-PASSING is a software package to compute the forces on ships sailing close to each other and to compute the forces on moored ships due to passing ships in harbours with complex layouts and in channels with variable cross-section. These interaction forces can then be applied in other models such as SHIP-MOORINGS and SHIP-NAVIGATOR to simulate moored and sailing ship behaviour respectively.

When two ships pass, the fluid flows between them and this induces changes in the water pressure causing forces on both ships. Similarly, a ship passing close to a quay or a bank is subject to a "suction" force towards the bank. Such effects are important in determining the safety of ship manoeuvring along narrow channels, in locks or when ships pass close to each other. Furthermore, in many harbours, ships are moored close to navigation channels. Passing ships cause forces on these moored ships and often speed limits have to be imposed to ensure safe mooring.



Pressures on ship hulls and surface velocities caused by one moving ship in a channel

### Applications

Results of SHIP-PASSING can be used with SHIP-MOORINGS and SHIP-NAVIGATOR to:

- design port layouts and in particular to determine the required distance between channels and berths and to dimension two-way channels;
- support the design of mooring systems by providing the forces on moored ships caused by passing ships;
- support the framing of regulations (e.g. speed limits) and design guidelines (e.g. distance between navigation channels and berths).
- compute forces due to the presence of other sailing ships accounting for quays and banks,
- provide the interaction forces between two manoeuvring ships that are required to model ship handling simulations realistically;

### Method

The SHIP-PASSING code uses a panel method to represent the three-dimensional unsteady potential flow. Fluids can be unbounded for deep unrestricted water, depth-limited for shallow water and optionally restricted by channel sides. Comparisons with slender-body theory and with experiments show that for typical navigation studies the error in the predicted forces is less than 10%.

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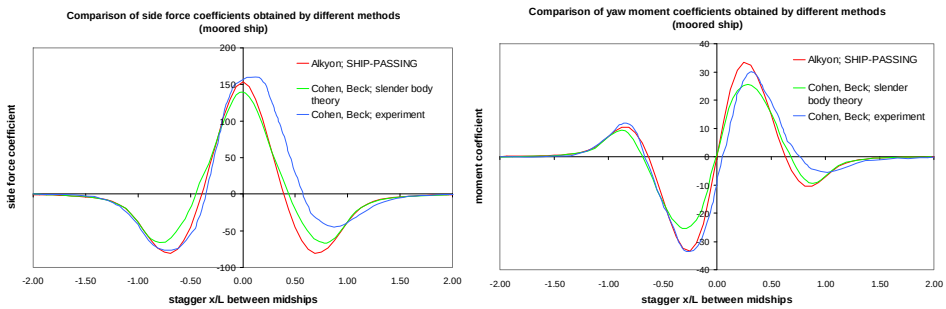
Model description



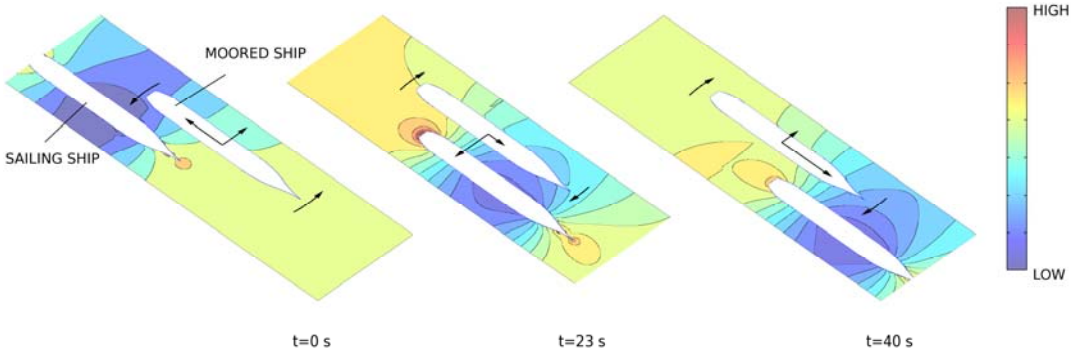

Side force and yaw moment coefficients for parabolic shapes in shallow water, as computed by ship-passing; compared with slender-body theory and experiments (Cohen, Beck)

## Representation

SHIP-PASSING uses PATRAN or FEMAP geometry models to represent the 3D ship and channel geometries. Alkyon schematise ships and channel boundaries from technical drawings, depth contour lines and ship body plans. The movement of the ship is described by temporal interpolation of position, heading and velocity, giving the flexibility to specify either steady or unsteady ship motions.

Results of simulations are time-series of forces and moments acting on bodies in the flow. The results can be applied in SHIP-NAVIGATOR or SHIP-MOORINGS.

Velocity fields and pressure fields around bodies can be visualised to provide insight into the flow behaviour and the way this influences the interaction forces.




Simulation of one sailing ship passing a moored ship in a channel. The figures show the surface pressure contours around ship water lines for three time steps; colours indicate surface pressure; arrows indicate surge force, sway force and yaw moment on moored ship.

## References

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J.A.Pinkster, The Influence of a Free Surface on Passing Ship Effects, International Shipbuilder Progress, Vol 51, No 4, 2004, pp 313-338

S. B. Cohen, R. F. Beck, Experimental and Theoretical Hydrodynamic Forces on a Mathematical Model in Confined Waters. Journal of Ship Research Vol. 27, No 2, 1983, pp. 75-89

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