Marine Hydrodynamics
Assignment 1

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Sammendrag

For specified (see below) two-dimensional geometries, assuming potential theory in unbounded fluid, and use of Green's second identity, calculate the velocity potential along the body and the added mass forces, for a circle, an ellipse, a square and a rectangle, moving laterally, and with rotation. Find also the cross coupling added mass coefficients. For the circle, the reference solution is: $\phi = -a^2 x/(^2)$ where a denotes the cylinder radius, $r^2 = x^2 + y^2$.

1 Teori

In this assignment we use the method of panels. By splitting the geometry into N equal parts, and assuming that ϕ, $\frac{\partial \phi}{\partial n}$ is constant every segment. From Newman chapter 4 we have (79):

$$\int \phi \frac{\partial G}{\partial n} - G \frac{\partial \phi}{\partial n} = -\pi \phi(x, y)$$

where $G = ln(r)$, a source in 2D

$$-\pi \phi(x_0) + \int_C \phi \frac{\partial}{\partial n} ln(r) dl = \int ln(r) \frac{\partial \phi}{\partial n} dl$$

where x_0 states a point on our geometry.

We got a trick from the lectures, turning it into:

$$-\pi \phi(x_0) + \sum_{n=1}^{N} \phi(x_n)(\theta_a - \theta_b) = \int ln(r) \frac{\partial \phi}{\partial n} dl$$

$$\begin{pmatrix} -\pi & (\theta_a - \theta_b)_0 & (\theta_a - \theta_b)_1 & \dots \\ (\theta_a - \theta_b)_N & -\pi & (\theta_a - \theta_b)_0 & \dots \\ (\theta_a - \theta_b)_{N-1} & (\theta_a - \theta_b)_N & -\pi & \dots \\ \dots & \dots & \dots. & \dots \end{pmatrix} \begin{pmatrix} \phi_0 \\ \phi_1 \\ \phi_2 \\ \dots \\ \phi_N \end{pmatrix} = \begin{pmatrix} \int ln(r_0) \frac{\partial \phi}{\partial n} dl \\ \int ln(r_1) \frac{\partial \phi}{\partial n} dl \\ \int ln(r_2) \frac{\partial \phi}{\partial n} dl \\ \dots \end{pmatrix}$$

To calculate the ϕ values we created a fictional point between the x_N points, where we stand in this ghostpoint and calculate the $\Delta\theta$ to the x_N values. To evaluate the integrals we used the trapezoidal method.

2 Conclusion