MODULE II : MANEUVERABILITY

Topic: Experimental Determination of Hydrodynamic Derivatives

Question 1

In a straight line test to determine the hydrodynamic derivatives conducted on a 2m long ship model at a tow speed of 1 m/s, the measurements are as follows:

Drift angle	2	4	6	-2	-4	-6
Y(Newton)	20	36	43	-21	-35	-42
N(Newton-m)	-15	-33	-52	14	32	525

Find $Y_v^{'}$ and $N_v^{'}$.

Answer:

We have $\beta = -v^{'} = -v/V$

Thus, $\frac{\partial Y}{\partial \beta} = -V\frac{\partial Y}{\partial v}$; $\frac{\partial N}{\partial \beta} = -V\frac{\partial N}{\partial v}$

or,

$Y_v = -Y_\beta / V$; $N_v = -N_\beta / V$

Thus, $Y_v^{'} = \frac{Y_v}{0.5\rho V L^2} = -\frac{Y_\beta}{0.5\rho V^2 L^2}$; $N_v = \frac{N_v}{0.5\rho V L^3} = -\frac{N_\beta}{0.5\rho V^2 L^3}$

From the experimental results we get (see figure below):

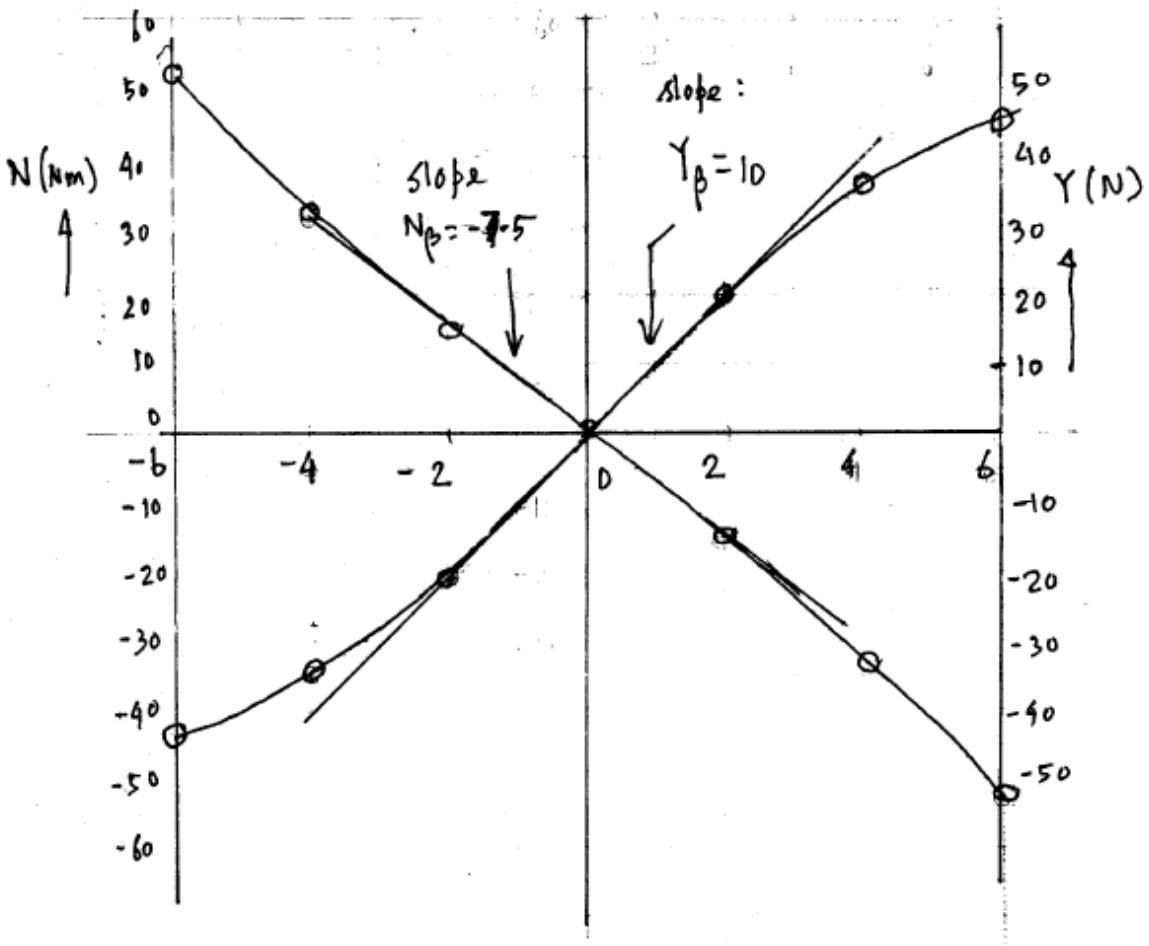
$\frac{\partial Y}{\partial \beta} \approx 10N/\deg = 10\times\pi/180 N/rad = 0.1745 N/rad$

$\frac{\partial N}{\partial \beta} \approx -7.5Nm/\deg = -7.5\times\pi/180 Nm/rad = -0.131 Nm/rad$

Thus,

$Y_v^{'} = -\frac{Y_\beta}{0.5\rho V^2 L^2} = -\frac{0.1745}{(0.5)(1000)(1^2)(2^2)} = -8.275\times10^{-5}$

$N_v = -\frac{N_\beta}{0.5\rho V^2 L^3} = \frac{0.131}{(0.5)1000)(1^2)(2^3)} = 3.275\times10^{-5}$


N (Nm)
Y (N)
Slope
N_β = -7.5
Slope :
Y_β = 10
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-6
-4
-2
0
2
4
6