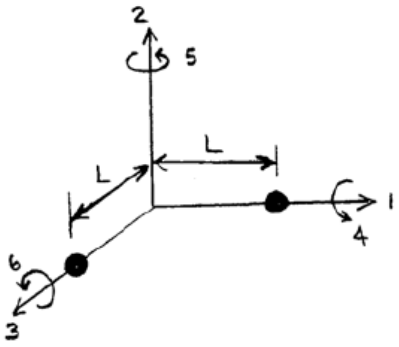
2.20 Marine Hydrodynamics Homework #7(b)
Due: November 10, 2009

Question 1:

An offshore structure is composed of two identical spheres of radius R which are respectively located at $(L, 0, 0)$ and $(0, 0, L)$ and with respect to a certain coordinate system. Assume $L \gg R$. *In terms of this coordinate system*, identify whether each of the 6×6 added mass coefficients m_{ij} of the structure are zero (0), positive (+), or negative (−) (do not work out the actual numbers):

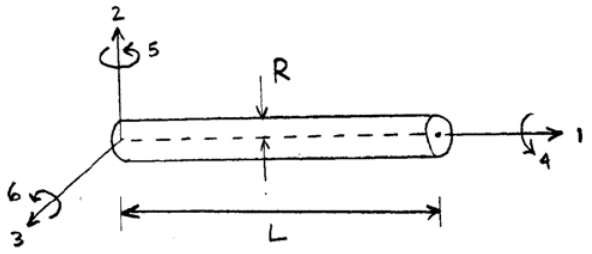
$i=$	1	2	3	4	5	6
$j=$ 1						
2						
3						
4						
5						
6						



If the structure has a velocity $(U_1, U_2, U_3, U_4, U_5, U_6)=(1, 1, 0, 0, 0, 0)$, the kinetic energy of the surrounding fluid in terms of fluid density ρ, and (single) sphere volume $\mathcal{V}$ is $KE=$_____.

Question 2:

A submarine can be approximately modeled as a slender circular cylinder shown below ($L \gg R$). The added mass coefficients of the submarine are given by $m_{22}/\rho=$_____; $m_{55}/\rho=$_____; $m_{44}/\rho=$_____.



During a certain maneuver, the submarine maintains an angle of attack θ_0 and moves at a velocity $(U_1, U_2, U_3, U_4, U_5, U_6) = (U_0 \cos\theta_0, -U_0 \sin\theta_0, U_3(t), 0, 0, 0)$. Assuming potential flow, the *approximate* hydrodynamic forces and moments on the submarine are:
$(F_1, F_2, F_3)=$(_____, _____, _____) and
$(M_1, M_2, M_3)=$(_____, _____, _____).