Existence and uniqueness in the linearised two-dimensional problem of a thin obstacle in a finite depth strip

Bayu PRIHANDONO, Université de Poitiers

One of the general problems in hydrodynamics is the study of stationary flow from liquids over submerged obstacles. The Neumann-Kelvin problem is a linearised version of the perturbation potential model, for waves of small amplitude and impulsion. This problem is developed from the derivation of the Navier-Stokes formulation. In this work, we study the existence and uniqueness of a solution for the two-dimensional Neumann-Kelvin problem in the case when a tiny obstacle is laying on the bottom of a strip. The problem is obtained by linearization of the equations of the wave-resistance problem for a submerged body in a flow. We introduce the variational formulation and analyze the existence and uniqueness of the solution for our model by using Lax-Milgram theorem [1]. We provide an alternative description of the problem by considering the stream function which is a harmonic conjugate of the potential velocity of the fluid [2]. The results cover super-critical and sub-critical cases in the stream of finite depth fluid. In the super-critical case, we only have Evanescent solutions that implies the existence of a unique finite energy solution is naturaly prove by using Lax-Milgram theorem. Otherwise, if we are in the sub-critical case, we have both Oscillatory and Evanescent solutions which is one of the hypothesis of Lax-Milgram do not hold anymore (coercivity) and this is related the fact that we have the oscillatory solutions. The recovery of the solution for the initial problem is discussed for both sub-critical and super-critical flows.

Références

[1] Carlo D. Pagani and Dario Pierotti, *The Neumann-Kelvin Problem for a Beam*, Journal of Mathematical Analysis and Applications, 1999.

[2] Dario Pierotti, *On the plane problem of the flow around a submerged beam*, Journal of Differential Equations, 2008.

Bayu PRIHANDONO, LMA, Université de Poitiers, Site du Futuroscope - Tlport 2 11 Boulevard Marie et Pierre Curie Btiment H3 - TSA 61125 86073 POITIERS CEDEX 9
bayu.prihandono@math.univ-poitiers.fr