Geophysical Research Abstracts
Vol. 18, EGU2016-13557, 2016
EGU General Assembly 2016

Stability of steady rotational water-waves of finite amplitude on arbitrary shear currents

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January 13, 2016

A versatile solver for the two-dimensional Euler equations with an unknown free-surface has been developed. This code offers the possibility to calculate two-dimensional, steady rotational water-waves of finite amplitude on an arbitrary shear current. Written in PYTHON the code incorporates both pseudo-spectral and finite-difference methods in the discretisation of the equations and thus allows the user to capture waves with large steepnesses. As such it has been possible to establish that, in a counter-flowing situation, the existence of wave solutions is not guaranteed and depends on a pair of parameters representing mass flux and vorticity. This result was predicted, for linear solutions, by Constantin. Furthermore, experimental comparisons, both with and without vorticity, have proven the precision of this code. Finally, waves propagating on top of highly realistic shear currents (exponential profiles under the surface) have been calculated following current profiles such as those used by Nwogu.

In addition, a stability analysis routine has been developed to study the stability regimes of base waves calculated with the two-dimensional code. This linear stability analysis is based on three dimensional perturbations of the steady situation which lead to a generalised eigenvalue problem. Common instabilities of the first and second class have been detected, while a third class of wave-instability appears due to the presence of strong vorticity.

References

[1] Adrian Constantin and Walter Strauss. Exact steady periodic water waves with vorticity. *Communications on Pure and Applied Mathematics*, 57(4):481–527, April 2004.

[2] Okey G. Nwogu. Interaction of finite-amplitude waves with vertically sheared current fields. *Journal of Fluid Mechanics*, 627:179, May 2009.