Update schemes enhancing stability and efficiency of series solution methods to subcritical flow over topography

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We consider the problem of irrotational flow over topography of an inviscid, constant density fluid. Of the many solution techniques available, series methods appear the most favourable because of the ease of gaining error estimates, and the fact the solution provides flow quantities everywhere in the domain immediately. The procedure is iterative with a known boundary problem solved at each step, after the free boundary profile has been approximated in some way. Every iteration requires an update of the free surface position. Typically the update is performed using the Bernoulli equation on the free surface as a cost function. In this paper we discuss alternate forms of the cost function. In general these involve a combination of the two boundary conditions on the free surface. This approach has been adopted for seepage problems, where significant improvements in stability and efficiency over previous methods have been observed. The nature of the boundary conditions in subcritical flow over topography makes implementing the new approach considerably more challenging than in the seepage case. However the possibility of improvements in efficiency and stability make this investigation worthwhile, particularly when consideration is given to the cost of computation in the three dimensional case, the ultimate aim of our research.