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THE DISCRETE NON-LOCAL SPONGE FILTERS AS OUTGOING BOUNDARY CONDITION FOR WATER WAVE RADIATION AND SCATTERING

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ABSTRACT

The discrete non-local sponge filters boundary condition is an absorbing boundary condition used for closing infinite domain calculations. This boundary condition is obtained as a combination of local sponge filter and the discrete non-local planar DNL. This combination can produce significant improvements with respect to the circular DNL. Here we examine how to design optimal sponge filter parameters in a discrete layer for scattering calculations. We end by examining several water waves radiation and scattering problems around a circular pile.

INTRODUCTION

Numerous radiation and scattering water waves problems has been solved using finite difference method (FDM) and finite element method (FEM) with a circular DNL boundary condition [Bonet et.al. 1997]. The exact sponge filter idea has been developed for the solution of the Klein-Gordon equation[Israeli and Orszag 1981] and the solution of water waves radiation and scattering problem governed by the 2D Helmholtz equation[Bonet et.al. 1997]. In such cases, the damping is combined with local absorbing boundary condition. An other kind of exact layer is the (PML) Bérenger layer. It was extended and developed in curvilinear coordinate for the two-di-

ORIGINAL PROBLEM AND REFORMULATIONS

We consider the two-dimensional Berkhoff equation [Berkhoff 1976],

$$\nabla_h(CC_g\nabla\phi) + k^2CC_g\phi = 0 \qquad (1)$$

to be solved outside a given scatterer with a boundary Γ. Here ϕ is the scattered wave field and k is the wave number, such that, $k(x,y)$ changes continuously reaching the constant k_0 value as the outer part of any bounded and closed region. C and C_g are the phase and group velocity, respectively. A boundary condition, which is derived from the incident wave, is given on Γ,