Meeting: 1003, Atlanta, Georgia, SIAMMINI 2, SIAM Minisymposium on Discontinuous Galerkin Methods: Theory and Applications

1003-65-1038 **Jacobus J. van der Vegt*** (j.j.w.vandervegt@math.utwente.nl), University of Twente, Department of Applied Mathematics, P.O. Box 217, 7500 AE Enschede, Netherlands, and **Satyendra K. Tomar** (s.k.tomar@math.utwente.nl), University of Twente, Department of Applied Mathematics, P.O. Box 217, 7500 AE Enschede, Netherlands. *An Implicit Discontinuous Galerkin Finite Element Method for Non-Linear Water Waves.*

In this presentation, we discuss a discontinuous Galerkin finite element method for non-linear free surface gravity waves. The algorithm is based on an arbitrary Lagrangian Eulerian description of the flow field using deforming elements, which makes it possible to accurately represent non-linear waves with a significant amplitude. We prove that the algorithm is unconditionally stable for linear waves and does not require additional smoothing or artificial viscosity terms in the free surface boundary condition to prevent numerical instabilities on a non-uniform mesh. An error analysis of the full time-dependent algorithm is discussed, showing that the error in the wave height and velocity potential is in both cases of optimal order in the L2-norm in space and second order in time, without the need for a separate velocity reconstruction. The error analysis is confirmed with numerical simulations. In addition, a Fourier analysis of the fully discrete scheme is conducted which shows the dependence of the frequency error and wave dissipation on the time step and mesh size. The algorithm is demonstrated on a number of model problems. (Received October 03, 2004)