

Curriculum Vitae for Henrik Bredmose

Name: Henrik Bredmose
Date of Birth: December 23, 1974
Married to Malene Brandt
Children: Freja Bredmose Brandt
Nationality: Danish
Member of DCAMM since 1999
Adress: Frilands Allé 32, DK-2500 Valby, Denmark
Tel: +45 3695 3393 (office hours), +45 2872 8827 (mobile)
Email: henrik@henrikbredmose.dk
Website: www.henrikbredmose.dk

Profile

Experienced water wave specialist with strong background in applied mathematics. Special interest in numerical methods and violent flows. Research experience from academic as well as private sector. Considerable international experience.

Education

2002 Ph.D. in Wave Hydrodynamics, Informatics and Mathematical Modelling and Department of Mechanical Engineering, Technical University of Denmark. 'Deterministic Modelling of Water Waves in the Frequency Domain'. Supervised by Prof. Per Madsen (main supervisor) and Dr. Hemming Schäffer (DHI Water & Environment, co supervisor).

Relevant courses: Functional Analysis, Hydrodynamic Instability, Computational Aspects and Application of Spectral Methods.

1999 M.Sc. in Engineering, Technical University of Denmark. Specialized in Applied Mathematics and Hydrodynamics. Was enrolled at the ECMI programme (European Consortium for Mathematics in Industry).

Relevant courses: Advanced Partial Differential Equations, Nonlinear Dynamical Systems, Numerical Methods for Data fitting, Nonlinear Differential Equations, Nonlinear Partial Differential Equations, Complex Variables and Applications, Offshore Engineering, Fluvial and Marine Sediment Transport, Turbulence Theory, Wave Hydrodynamics, Computational Hydrodynamics, Computational Fluid Dynamics.

Employments

Currently (Nov 2006–present): Post doctoral Research Assistant. School of Mathematics, University of Bristol, UK. Research into overtopping at breakwaters and coastal

structures. Numerical and mathematical modelling of individual overtopping events in close collaboration with experimental work at University of Plymouth. Daily workplace is at the Danish Technical University.

2007: Post doctoral Research. DTU. Five months of research on the derivation of Boussinesq-type wave models including vorticity. The work focuses on improving the mathematical description of wave breaking and wave induced circulations.

Jan 2005– Oct 2006: Research Engineer. DHI Water & Environment, Denmark. Modelling of wave impacts on offshore wind turbine foundations using a 3D Navier-Stokes solver. I developed a coupling allowing waves from a Boussinesq solver to be transferred to this Navier-Stokes code. I was also involved in laboratory experiments, wave modelling studies and mathematical modelling of the stratified flow at a cooling water outlet.

Dec 2002– Jan 2005: Post doctoral Research Assistant. School of Mathematics, University of Bristol, UK. Mathematical and numerical modelling of wave impacts on breakwaters, as part of the BWIMCOST project. The work focused on the effect of entrained air on the impact of waves. The work included modelling of nonlinear wave transformation and compressible flow close to the break water. The latter task led to the development of a flow model for a mixture of water and air, solved in terms of finite volume methods for hyperbolic problems.

Research experience and experience abroad

2006–present: Postdoctoral research assistant at School of Mathematics, University of Bristol. Mathematical and numerical modelling of violent waves flowing over coastal structures (overtopping). Potential flow modelling for fully nonlinear wave transformation is combined with a solver for compressible flow, allowing a description of the two-phase flow of water and entrained air. Incorporation of the Schwarz-Christoffel mapping into a potential flow solver to allow a piecewise linear sea bed variation. The work is carried out in close collaboration with a research group at University of Plymouth.

2005–2006: Research Engineer at DHI Water & Environment, Denmark. Development of a coupling between a Boussinesq solver and a Navier Stokes solver. Research on wave impacts on offshore wind turbine foundations, including run-up. Impacts from breaking and irregular waves.

2002–2005: Postdoctoral research assistant at School of Mathematics, University of Bristol. The work focuses on the effect of aeration on the pressure forces from violent wave impacts on breakwaters. Included topics are identification of incident and reflected wave fields from sea bed pressure records using FFT's and linear least square fits, nonlinear wave transformation using Boussinesq modelling and boundary integral modelling plus detailed computations of compressible flow close to the breakwater.

1999–2002: Ph.D. project on deterministic wave evolution equations. Models based on Boussinesq formulations as well as fully dispersive theory. Incorporation of wave breaking by adapting the surface roller breaking scheme of Boussinesq time domain

formulations. Speed-up of the numerical solution using Fast Fourier Transform. Analysis of amplitude dispersion within the models. Development of a model retaining cubic nonlinearity.

2001: Visiting Dr. Yehuda Agnon, Faculty of Civil Engineering, Israel Institute of Technology for four months. Worked on the incorporation of cubic nonlinearity within fully dispersive evolution equations. The model developed can be seen as a Zakharov-type model, being able to describe the spatial evolution of a broad banded wave spectrum at sloping bed.

1999: M.Sc.-project 'Evolution Equations for Wave-wave Interaction'. Derivation, analysis and implementation of deterministic evolution equations based on Boussinesq models.

1998: Visited Prof. D.H. Peregrine, School of Mathematics, University of Bristol for four months. Modelling of a series of wave tank experiments using a Boussinesq model and a fully nonlinear potential flow solver. Additional acceleration terms were incorporated into the Boussinesq model, to simulate horizontal and vertical shaking of the wave tank. The shape of 'Table top' waves was reproduced using the potential flow solver. The work is reported in Bredmose et al (2003).

1998: 'Shoaling of Sixth-order Stokes Waves on a Current'. Graduate student project at Department of Hydrodynamics and Water Resources (ISVA), Technical University of Denmark. Supervised by Assoc. Prof. Ivar G. Jonsson. The work is reported in Pihl et al (2001).

Publications

Theses

H. Bredmose 'Evolution equations for wave-wave interaction' (1999). Master Thesis, Department of Mathematical Modelling, Technical University of Denmark. 309 pages.

H. Bredmose 'Deterministic modelling of water waves in the frequency domain' (2002). Ph.D. Thesis. Department of Mechanical Engineering, Technical University of Denmark, 248 pages plus appendices.

Journal papers

H. Bredmose, D.H. Peregrine, G.N. Bullock and C. Obhrai (2007). 'A 2D model for the compressible flow of aerated water'. In preparation.

H. Bredmose, D.H. Peregrine, G.N. Bullock and C. Obhrai (2007). 'Violent breaking wave impacts. Part 2: Modelling of wave transformation, wall pressures and air effects'. In preparation.

G. N. Bulluck, C. Obhrai, D.H. Peregrine and H. Bredmose (2007). 'Violent breaking wave impacts. Part 1: Results from large-scale regular wave tests on vertical and sloping walls'. Coastal Engineering. In press.

H. Bredmose, Y. Agnon, P.A. Madsen and H.A. Schäffer (2005) 'Wave transformation models with exact second-order transfer'. *European Jour. Mech./ B Fluids* 24(6) pp 659–682.

H. Bredmose, H.A. Schäffer and P.A. Madsen (2004) 'Boussinesq evolution equations: Numerical efficiency, breaking and amplitude dispersion'. *Coastal Engineering* 51(11–12) pp 1117–1142.

H. Bredmose, M. Brocchini, D.H. Peregrine and L. Thais (2003) 'Experimental investigation and numerical modelling of steep forced water waves'. *J. Fluid Mech.* vol 490, pp 217–249.

J.H. Pihl, H. Bredmose and J. Larsen (2001) 'Shoaling of sixth-order Stokes waves on a current'. *Ocean Engng.* 28(6), pp 667–687.

Conference proceedings papers

H. Bredmose, D.H. Peregrine and A. Hunt (2007) 'Wave height? A study of the impact of wave groups on a coastal structure'. *Proc. 22nd Int. Workshop on Water Waves and Floating Bodies, Plitvice Lakes, Croatia, April 2007.* 4pp.

D.H. Peregrine, H. Bredmose, G.N. Bullock, A.C. Hunt and C. Obhrai (2006) 'Water wave impact on walls and the role of air'. *Proc. 30th Int. Conf. Coastal Engng., San Diego 2006.* ASCE.

H. Bredmose, J. Skourup, E.A. Hansen, E.D. Christensen, L.M. Pedersen and A. Mitzlaff (2006) 'Numerical reproduction of extreme wave loads on a gravity wind turbine foundation'. *Proc. 25th Int. Conf. Offshore Mech. Arctic Engng. Hamburg 2006.* ASME.

G.N. Bullock, C. Obhrai, G. Müller, G. Wolters, D.H. Peregrine and H. Bredmose (2005) 'Advances in the understanding of wave-impact forces'. *Proc. of Int. Conf. Coastlines, Structures and Breakwaters, 2005.*

E.D. Christensen, H. Bredmose and E.A. Hansen (2005) 'Extreme wave forces and wave run-up on offshore wind turbine foundations'. *Copenhagen Offshore Wind 2005.*

D.H. Peregrine, H. Bredmose, G. Bullock, C. Obhrai, G. Müller and G. Wolters (2004). 'Violent water wave impacts on walls and the role of air'. *29th Int. Conf. Coast. Engng. Lisbon.* ASCE.

G. Bullock, C. Obhrai, G. Müller, G. Wolters, D.H. Peregrine and H. Bredmose (2004). 'Characteristics and design implications of breaking wave impacts'. *29th Int. Conf. Coast. Engng. Lisbon.* ASCE.

C. Obhrai, G. Bullock, G. Müller, G. Wolters, D.H. Peregrine, H. Bredmose and J. Grüne (2004). 'Violent wave impacts on vertical and inclined walls: large scale model tests'. *29th Int. Conf. Coast. Engng. Lisbon.* ASCE.

H. Bredmose, D.H. Peregrine, G. N. Bullock, C. Obhrai, G. Müller and G. Wolters (2004) 'Extreme wave impact pressures and the effect of aeration', *Proc. 19th Internat. Workshop on Water waves and Floating Bodies, Cortona, Italy, 4pp.*

G. Bullock, C. Obhrai, G. Müller, G. Wolters, D.H. Peregrine and H. Bredmose (2003) 'Field and laboratory measurements of wave impacts'. *Proc of the 3rd Coastal Struc-*

tures Conference, Portland, Oregon. ASCE.

H. Bredmose, D.H. Peregrine, A. Porter and G. Bullock (2003) 'Wave impact and aerated water'. Proc. 18th Int. Workshop on Water waves and Floating Bodies, Le Croisic, France, 4pp.

H. Bredmose, P.A. Madsen, H.A. Schäffer and Y. Agnon (2002) 'Fully dispersive evolution equations: wave breaking and efficiency'. Proc. of 28'th Int. Conf. on Coastal Engng., Cardiff, Wales. ASCE.

H. Bredmose, P.A. Madsen and H.A. Schäffer (2001) 'Modelling of wave breaking in Boussinesq evolution equations'. In 'Ocean Wave Measurement and Analysis. Proc. of the Waves 2001 Symposium, San Francisco, US'. ASCE.

H. Bredmose, P.A. Madsen and H.A. Schäffer (2000) 'On the accuracy of Boussinesq evolution equations'. Proc. of 27'th Int. Conf. on Coastal Engng., Sydney, Australia. ASCE.

Talks at conferences

'Wave height? A study of the impact of wave groups on a coastal structure'. 22nd International Workshop on Water Waves and Floating Bodies', Plitvice Lakes, Croatia, April 2007.

'Numerical reproduction of extreme wave loads on a gravity wind turbine foundation'. 25th International Conference on Offshore Mechanics and Arctic Engineering, Hamburg, Germany 2006.

'Extreme wave impact pressures and the effect of aeration'. 19th International Workshop on Water Waves and Floating Bodies, Cortona, Italy, March 2004.

'Wave Impact and Aerated Water'. 18th International Workshop on Water Waves and Floating Bodies, LeCroisic, France, April 2003.

'Wave Evolution Equations with FFT-solver and Improved Breaking'. 28'th International Conference on Coastal Engineering, Cardiff, July 2002.

'Spectral modelling of wave breaking in Boussinesq evolution equations'. Waves 2001 Symposium, San Francisco, September 2001.

'A new breaking formulation for deterministic evolution equations'. Surface Water Waves 2001, Cambridge, August 2001.

'Experimental and numerical investigation of steep forced water waves'. Euromech Colloquium 416 'Interaction of strong turbulence with free surfaces'. September 2000.

'On the accuracy of Boussinesq evolution equations'. 27'th International Conference on Coastal Engineering, Sydney, July 2000.

Teaching activities

Tutorials at University of Bristol: first year Calculus and Mechanics (fall 2003). Assistant teacher in the graduate courses 'Wave Hydrodynamics' (spring 1999, spring 2000)

and 'Nonlinear Wave Dynamics' (fall 1999, fall 2000). Assistant teacher in the graduate courses 'Mathematical Analysis B' (spring 1998), 'Mathematical Analysis 2' (spring 1996, fall 1996), and 'Mathematical Analysis 1' (fall 1995).

Review work

Refereed four papers for Journal of Fluid Mechanics one for Coastal Engineering and one for International Journal of Fluids and Structures.

Administrative experience

Organizer of the workshop 'The Fascination of Fluid Mechanics' at University of Bristol 1 and 2 July 2004.

Organizer of the 70 hours Ph.D. course 'Seminar Course in Mathematics, Statistics, Operations Research and Numerical Analysis', Fall 2000.