THE ANNALS OF "DUNĂREA DE JOS" UNIVERSITY OF GALAŢI
FASCICLE X, APPLIED MECHANICS, ISSN 1221-4612
2010

A Lagrangian Approach for the Wave Body Interactions Problem

Robert Toderaşcu, Liliana Rusu, Claudia Lucas
Faculty of Mechanical Engineering, Galaţi, România
Technical University of Lisbon

Abstract

By proving the first form of Hamilton's principle an equivalent Lagrangian formulation is developed for the problem of wave-body interaction. In this approach the equations and conditions modeling the kinematical constrains are treated and solved before formulate dynamically equations and most of the curiosities introduced by the classical approach disappear. Then the principle is used to derive Lagrange equations in independent coordinates which are functional differential equations modeling the nonlocal character of wave-body interaction.

References

1. **Athanassoulis, G.A.,** *Application of Hamiltonian formalism in studying steady water-wave problems,* Technical Report, NTUA,
Greece 1990.
2. **Athanassoulis, G.A.,** *Analytical Dynamics of Wave-Body Interaction,* National Technical University of Athens, Greece, 1995 .
3. **Batchelor,G.K.,** *An Introduction to Fluid Dynamics*, Cambridge University Press 1967.
4. **Benjamin, T.B. & Olver, P.J.,** *Hamiltonian structure , symmetries and conservation laws for water waves*, 1982 , 125 , pp.137-185
5. **Broer, L.J.F.,** *On the Hamiltonian Theory of Surface Waves*, Applied Scientific Research, 1974, 29, pp. 430-446
6. **Gantmacher, F.,** *Lectures on Analytical Mechanics,* MIR Publishers, Moscow,1970.
7. **Goldstein, H .,** *Classical Mechanics,* Addison Wesley, Co, Cambridge Mass 1980.
8. **Luke, J.C.,** *A variational principle for a fluid with free surface,* Journal of Fluid **M**echanics, 1967.
9. **Milder, M.D.,** *A note regarding 'On Hamilton's principle for surface waves',* Journal of Fluid Mechanics, 1977, vol 83, part 1, pg. 159-161.
10. **Miles, J.W.,** *On Hamilton principle for surface waves,* Journal of Fluid Mechanics, 1977, vol 83, pg153-158.
11. **Miles, J.W.,** *Hamiltonian formulations for surface waves,* Journal of Fluid Mechanics 1982.
12. **E. Rusu,** *"Lagrange Equations for analysis the Dynamics of Marine Risers"* - The XIX National Conference of Mechanics, Târgovişte, 1995, Vol.-III- pp.417-424.
13. **E. Rusu,** *"Numerical Investigations for Representing the Free Surface of Water-Waves"* - The Annals of *"Dunărea de Jos"* University of Galaţi, Fascicle X Applied Mechanics, 1996, pp.3-8.
14. **E. Rusu,** *"Lagrange's Equations of Water-Waves"* -The Annals of *"Dunărea de Jos"* University of Galaţi, Fascicle X Applied Mechanics, 1996 pp. 27-34.
15. **E. Rusu** *"New Hamiltonian Techniques in Water-Waves"***-,** Scientific report, Extended summary of the Ph.D. thesis Dept. of Naval Architecture and Marine Engineering, National Technical University of Athens, April 1997, pp. 1-31.
15. **E. Rusu** "*Numerical Investigations for Representing the Free Surface of Fluids Using Hermite Polynomials"***,** National Symposium for Offshore Technology, Ploieşti, April 1998, pp. 187-194.
16. **E. Rusu, I. Matulea,** *"Solving Green's Integral Equation Using MATLAB"* National Symposium for Offshore Technology, Ploieşti, April 1998, pp. 195- 203.
17. **E. Rusu, S. Macuta,**"*A New Technique for the Prediction of Wave Conditions in Coastal Areas"* published in the proceedings of the international Symposium TECHNONAV '98, Constanţa, Romania, May 1998.
18. **E. Rusu, I. Matulea,** *"A New Deterministic Model of Water-Waves Using the Boundary Element Method"* -Second European Boundary Element Method Symposium, EUROBEAM 98, Wessex Institute of Technology, Southampton, U.K.,19-21 May 1998.
19. **E. Rusu, I. Matulea,** *"The kinematical subproblem of water-waves solved using boundary element method"* published in the proceedings of the Second International Conference, Shipbuilding '98, Varna, Bulgaria 18 - 19 June 1998.
20. **E. Rusu, S. Macuta,** *"A New Deterministic Model for the Transient Motion of Water-waves Using Hamiltonian Dynamics"* published in the proceedings of the Second International Conference, Shipbuilding '98, Varna, Bulgaria 18 - 19 June 1998.
21. **Rusu, I. Matulea,** *"Development of New Techniques for the prediictions of waves conditions in the Offshore Areas"* **E.** International Workshop on Deep Water Mooring and Related Topics in Offshore Engineering, 23 Oct. 1998, ICEPRONAV Galaţi, pp 10.1-10.10.

22. **Volterra, V.,** *Theory of Functional and of Integral and Itegrodifferential Equations* Dover Publications, inc New York, 1959.
23. **Wehausen, J.V., Laitone, E.,** *Surface waves, D*over Inc. Publications, New-York, 1977.
24. **West, B.J.,** *Deep Water Gravity Waves,* Lecture Notes in Physics, Vol. 146, Springer-Verlag, New York, 1981.
25. **Whitham, G.B.,** *Linear and Nonlinear Waves,* John Wiley & Sons, New York, 1974.
26. **Wright, J. & Creamer, D.B.,** *Improved linear representation of surface waves,* Part 2. *Slowly varying bottoms and currents,* Journal of Fluid Mechanics, 1994, vol 261, pg 65-74.
27. **Zakharov, V.E.,** *Inverse and direct cascade in the wind - driven surface turbulence and wave breaking,* Springer-Verlag, Berlin, 1992.