



**ERCIM "ALAIN
BENSOUSSAN"
FELLOWSHIP
PROGRAMME**



Scientific Report

First name / Family name

Raj Narayan DHARA

Nationality

Indian

Name of the *Host Organisation*

Norwegian University of Science
and Technology (NTNU)

First Name / family name
of the *Scientific Coordinator*
Period of the fellowship

Mats Ehrnström

01/06/2017 to 30/09/2018

I - SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The main research area is a part of the subject of Fluid mechanics dedicated to particular interest of studying travelling water waves. Here we discuss the completed work so far.

Among many other equations which have been devised to capture the main competing effects in water, reduced Ostrovsky equation (rO) is one of them. The rO has been considered with a nonlocal effect induced by the Coriolis parameter due to the earth rotation added to the popular inviscid Burger equation.

Together with G. Bruell, former postdoc at the department, our study motivated by rO has been done in a nonlocal framework. During studying the above problem, we generalize the problem (known as fractional Korteweg-de Vries (fKdV) equation) and obtained the

existence, regularity properties and limiting behaviour for a travelling wave solutions to the fKdV.

II - PUBLICATION(S) DURING YOUR FELLOWSHIP

Pending (submitted for publication):

G. Bruell, R. N. Dhara, Waves of maximal height for a class nonlocal equations with homogeneous symbol, [arXiv:1810.00248](https://arxiv.org/abs/1810.00248)

Abstract. We discuss the existence and regularity of periodic traveling-wave solutions of a class of nonlocal equations with homogeneous symbol of order $-r$, where $r > 1$. Based on the properties of the nonlocal convolution operator, we apply analytic bifurcation theory and show that a highest, peaked, periodic traveling-wave solution is reached as the limiting case at the end of the main bifurcation curve. The regularity of the highest wave is proved to be exactly Lipschitz. As an application of our analysis, we reformulate the steady reduced Ostrovsky equation in a nonlocal form in terms of a Fourier multiplier operator with symbol $m(k) = k^2$. Thereby we recover its unique highest 2π -periodic, singular traveling-wave solution, having the property of being exactly Lipschitz at the crest.

III - ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

1. *Lund Workshop on Fluid Dynamics and Dispersive Equations*, 25th -- 29th June, 2018, Lund, Sweden. Poster presentation.
2. *Emerging Trends in Applied Mathematics and Mechanics 2018*, Faculty of Mathematics and Computer Science, Jagiellonian University in Krakow, Poland, 18th – 22nd June, 2018. Talk: ‘A nonlocal approach for waves of maximal height for the reduced Ostrovsky equation’.
3. *Workshop on Inverse Scattering and Dispersive PDEs in One Space Dimension*, 08th – 11th August, 2017, Toronto, Canada.
4. *Summer School on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering*, 31st July – 04th August, 2017, Toronto, Canada.

IV - RESEARCH EXCHANGE PROGRAMME (REP)

It was a great pleasure to visit the Department of Mathematics and Statistics, University of Cyprus (UCY), Cyprus. Duration: 10.09.18-14.09.18.

Talk: *Waves of maximal height for a class nonlocal equations with homogeneous symbol*.

Local Scientific Coordinator: MILAKIS EMMANOUIL

Research Exchange: It has been an impactful discussion on understanding an extension and geometric properties for a class of open sets with rough boundaries in weighted settings. The proposed project to extend the present interest of research projects by the host, expected to be implemented to several applications, e.g., spectral stability for the Neumann problems.