

SEMINAR NOTICE

*Department of Physics and Engineering Physics
University of Saskatchewan*

SPEAKER: Dr. Alexey Shevyakov
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TOPIC: *Exact Solutions of a Fully Nonlinear Two-fluid Model*

DATE: October 18, 2016

TIME: 3:30-4:30 p.m.

PLACE: Physics 103

ABSTRACT:

Despite the fact that Euler and Navier-Stokes equations governing gas and fluid dynamics are known for a over 150 years, there is still a large number of open questions and unsolved problems related to those models. In particular, the contemporary science is far from a full understanding of analytical properties of these equations; exact and approximate solutions are known only in a relatively small number of simplified settings; direct numerical simulation is extremely resource-demanding and often imprecise.

Over the years, in order to describe specific physical settings, such as, for example, surface and internal waves, multiple simplified models of the systems of Euler and Navier-Stokes fluid dynamics equations have been derived, aiming at the reduction of the mathematical complexity of the full set of equations, while retaining essential properties of phenomena of interest and providing sufficient physical insight and computational precision. Basic examples of such simplifications include dimension and/or symmetry reductions, linearizations, and more general approximations involving asymptotic relationships. Fundamental nonlinear partial differential equations (PDEs) of mathematical physics, such as Burgers', Korteweg-de Vries (KdV), nonlinear Schrodinger, and Kadomtsev-Petviashvili (KP) equations, as well as many other important models arise in the context of fluid dynamics. Such reduced models often exhibit rich mathematical structure. In many cases, exact solutions of reduced models correspond to, and in fact closely describe, physical phenomena.

I will discuss a model of nonlinear internal waves in a stratified system of two non-mixing fluids of different densities in a long horizontal channel within the gravity field. This one-dimensional two-fluid model has been derived in by Choi and Camassa through layer-averaging, under an asymptotic "shallow water" assumption of a small ratio of the fluid channel depth to the characteristic wavelength, yet without assuming that wave amplitudes are small compared to the fluid layer depths.

For the Choi-Camassa model, an equivalence transformation will be presented, leading to a special dimensionless form of the equations, involving only a single dimensionless constant physical parameter, as opposed to five parameters present in the original model.

Coffee and Cookies will be served in Physics 103 at 3:00 p.m. for those attending the seminar.