Doctoral School of Physics - Eötvös Loránd University (ELTE)

Semester report

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Ph.D. Thesis topic:
Study of solitons and applications with analytical and numerical methods

Introduction:

i. *Personal circumstances:* I began my PhD program at ELTE by registering few months ago on October 2017. During my first week I got to know some of the people in School of Physics. I did a lot of primary things such as opening a bank account and getting a tax number. I recognized immediately the potential opportunities within the branch I am working in. While there is usually another students in my branch, during this placement I am the only one. Everyone has been very welcoming and I am continually reminded that if I need help with anything I only need to contact them.
   In the first semester at ELTE, I also took one course entitled "Environmental fluid flow", by Prof. Janosi, which is related to the project, and research guide under the supervision of Dr. Bene.
ii. *Background of planned research:* In research, the dynamics of nonlinear phenomena, particularly solitons and their applications with analytical and numerical methods will be studied. Our primary interest is how nonintegrable perturbations lead to decay of solitons and how this can be applied in hydrodynamics.

Description of research work carried out in current semester:

This semester our main concern was the numerics. As the first step, Linux as the operating system was installed. We used Ubuntu distribution of Linux, which is compatible with the OpenFOAM software. OpenFOAM is free, offering to users the freedom to run, copy, distribute, study, change, and improve the software. Although many engineers handle computations on a number of commercial software, technologically OpenFOAM is equivalent to commercial softwares. It is also able to create individualized solutions and offer great scope of custom development. On the other hand, OpenFOAM is gaining considerable popularity in academic research and among industrial users, both as a research platform and a black-box CFD and structural analysis solver. The main ingredients of its design are:

- Expressive and versatile syntax, allowing easy implementation of complex physical model
- Extensive capabilities, including wealth of physical modelling, accurate and robust discretization, and complex geometry handling, to the level present in commercial CFD
- Open architecture and open source development, where complete source code is available to all users for customization and extension at no cost

In this regard, after installing OpenFOAM on Ubuntu we ran three different samples. Furthermore, all system files, initial conditions and boundary conditions were studied. A common approach to our problem in making solitary waves is Dam Break. After designing an

appropriate tank, the simple Dam Break was tested and the results was checked by the supervisor. A common used method in this issue is Volume of Fluid method which is suggested by OpenFOAM solver. The next step is to find initial condition as well as geometry of the tank to make the kinks of the KdV model.
In conclusion, I believe that using Dam-Break flows coupled with shallow water equations with appropriate source terms will tackle the problem.