Capstone Proposal

Student: Sultan Aitzhan
Supervisor: Professor Katie Oliveras

Title

Approximate expansions for Wave & KdV equations via the velocity potential and non-local formulations.

Subject Areas

Partial differential equations, asymptotic analysis, fluid dynamics, nonlinear waves, numerical analysis, integral equations.

Challenges

Theoretical knowledge

The approximation procedure for the Euler Equations in the two formulations requires a solid understanding of the Euler's equations and the non-local formulation.

The student has taken advanced courses such as OPDE and Numerical Analysis. The student will further familiarise himself with the specific topics such as perturbation series, non-local formulation, and Euler's equations over the course of semester 1 and semester 2 as needed.

Exploration

Having finished the theoretical part of the project, what can be done with the results?

Prof's Response:

Scope

Although the wave & KdV equations have been derived from the Euler's equations on the whole line, no corresponding work has been done at least in the case of the KdV equation on the half-line. In addition, it was recently shown that the Euler's equations can be a reduced to one, time-dependent equation. However, the wave & KdV equations have yet to be derived from the single, time-dependent equation, for both a whole line, and a half line.

The first goal of this project is to derive the wave & KdV equations from the Euler's equations on a half-line, while determining an appropriate boundary condition. The second goal is to derive the wave & KdV equations from the single, time-dependent equation on the whole line and a half-line. Finally, depending on results, the third goal of the project is to examine the utility and potential applications of results, which will be accomplished via exploration.

Expectations associated with grade achievement

Prof's response:

Semester 1 plan with time allocation

Estimated consultation time is one hour per week. Consultation consists of one-on-one video meetings.

Time	Task	Deliverable
Week 1	Derive Euler's equations	
Week 2	Derive Euler's equations in the velocity potential & nondimensionalise the equations.	
Week 3	Derive the wave & KdV equations on a whole line & draft the capstone proposal.	
Week 4	Derive the wave & KdV equations on a whole line & finalise the capstone proposal.	
16 Sep 5pm		Proposal
Week 5	Derive the wave & KdV equations on a whole line.	
Week 6	Derive the wave & KdV equations on a whole line.	
Week 7	Set-up the half-line problem.	
Week 8	Derive wave & KdV equations on a half line.	
Week 9	Derive wave & KdV equations on a half line.	
Week 10	Reduce Euler's equations to a single equation on a whole line.	
Week 11	Derive the wave & KdV equations from the single equation on a whole line .	
Week 12	Derive the wave & KdV equations from the single equation on a half line .	Presentation
Week 13	Write-up the results.	Presentation
15 Nov 5pm		Report 1