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

Differential equations, asymptotic analysis, fluid dynamics, nonlinear waves.

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 in the case a 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 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, by 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.

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	Set-up the half-line problem.	
Week 6	Derive wave & KdV equations on a half line.	
Week 7	Derive wave & KdV equations on a half line.	
Week 8	Reduce Euler's equations to a single equation on a whole line.	
Week 9	Reduce Euler's equations to a single equation on a whole line.	
Week 10	Derive the wave & KdV equations on a whole line.	
Week 11	Derive the wave & KdV equations on a whole line.	
Week 12	Write-up the results.	Presentation
Week 13	Write-up the results.	Presentation
15 Nov 5pm		Report 1