PROJECTS WITH PROF. OLGA TRICHTCHENKO
(FOR SENIOR UNDERGRADUATE OR GRADUATE STUDENTS)

1. Modelling shallow water or deep water (available now)

This project explores how to **compute solutions** for a model equations which describe waves in shallow water (Korteweg-de Vries equation) and a model for waves in deep water (nonlinear Schrodinger equation). The method will be based on Fourier analysis and the computation will be done in Python. The goal of this work is to check if the data assimilation algorithms proposed in previous work, do indeed work on these numerical computations. An application of where data assimilation techniques is in weather or climate models.

2. Waves with strong surface tension (available now)

There is existing MATLAB code for computing solutions for travelling water waves in the presence of surface tension. However, it has not been used to analyse solutions when surface tension is strong, which is important when looking at small scales, for example in capillary flow or microfluidic device. The goal of the project is to **run and modify the code** to compute solutions with strong surface tension and analyse their stability.

3. Analysing resonances (available now)

Resonant behaviour shows up in many physical systems. In water waves, sometimes when waves of particular frequencies collide and interact, they produce nonlinear behaviour, often manifested as waves of much larger amplitude. These waves can be destructive and could possibly lead to rogue waves. The goal of this work is to use model equations and **asymptotic methods**, to show explicitly how large the nonlinear effect is.

4. Generating Waves in a Wave Tank (available fall or winter)

This project will focus on the **experimental** research of water waves. I have recently acquired a wave tank. This will need to be set up and different methods for generating waves will be tested such as having different types of paddles in different positions in the tank. Once several of these methods are set up, methods for measurement of wave amplitude and frequency will need to be implemented. These can include methods using reflection or refraction of light, pressure measurements.