Faculty of Engineering & Applied Science

SOFE-4820U: Modelling and Simulation

Project Milestone - Project Proposal

Group Number: 3

Due Date: February 19, 2023

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Problem Statement

Estimating the impact of sea level rise on coastal infrastructure: Designing a model to predict the effect of sea level rise on critical coastal infrastructure, such as roads, bridges, airports, and seaports. The simulation can help city planners and policymakers develop strategies to manage infrastructure resilience, minimise economic losses, and protect public safety.

Abstract

Sea level rise is a significant global challenge that is threatening coastal infrastructure and communities worldwide. In this project, we aim to design a model to predict the effect of sea level rise on critical coastal infrastructure such as roads, bridges, airports, and seaports. The simulation will integrate various factors such as elevation, storm surge, and coastal erosion to estimate the impact of sea level rise on the infrastructure. The model can help policymakers and city planners develop strategies to manage infrastructure resilience, minimise economic losses, and protect public safety. The simulation will be based on existing data and will incorporate climate projections to assess the impact of future sea level rise. The results of this project can assist in planning for the effects of sea level rise and identifying priority areas for adaptation and mitigation efforts.

Project Scope

The following are the general steps we will take to complete this project:

- Define the problem statement and the system under study:
    - In this case, the problem statement is to design a model to predict the effect of sea level rise on coastal infrastructure.
- Identify the variables, parameters and dataset that will be used in the model:
    - Variables may include elevation, storm surge, coastal erosion, and sea level rise projections. Parameters may include the dimensions and properties of the infrastructure being studied. The Datasets we will use to validate and base our model on is NASA's global mean sea level [1].
- Develop the mathematical equations and algorithms:
    - Use the identified variables and parameters to develop a simplified mathematical model for sea level rise.
- Create a Simulink model:
    - Create a Simulink project environment to model the approximate mathematical representation of sea level rise..
- Configure the Simulink model:
    - Set the simulation parameters, including the simulation time, solver settings, and initial conditions, using NASA's dataset.

- Run the simulation:
    - Start the simulation and observe the results. The simulation may include a graphical output, but first we will focus on validating the numerical data, and other output variables.
- Analyse and interpret the simulation results:
    - Analyse the results of the simulation, identify any issues or discrepancies, and interpret the results in the context of the original problem statement.
- Validate the simulation:
    - Validate the Results by comparing them with the existing data, and refine the model as needed.
- Document the model and simulation:
    - Document the Procedure, including the problem statement, model equations, Simulink model, simulation parameters, and results.

Source of Data

NASA's Global Mean Sea Level Change dataset is a long-term record of global mean sea level (GMSL) variations from satellite altimetry measurements. It is based on data collected by the TOPEX/Poseidon, Jason-1, Jason-2, and Jason-3 satellite missions, which use radar altimeters to measure the height of the ocean surface. The dataset provides monthly and yearly estimates of GMSL from 1993 to present, with a spatial resolution of 1 degree by 1 degree. The estimates are based on a combination of satellite altimetry data, in situ measurements from tide gauges, and other data sources, and are corrected for factors such as atmospheric pressure and ocean tides. The GMSL estimates in this dataset show a clear trend of rising sea levels over time, with an average rate of increase of approximately 3.3 millimetres per year. The rate of sea level rise has been increasing over the past few decades, largely due to the melting of land-based ice sheets and glaciers and the thermal expansion of the oceans as they absorb heat from the atmosphere. This dataset is widely used by researchers and policymakers to study and plan for the impacts of sea level rise on coastal communities, ecosystems, and infrastructure.

Team Table

This table lists out the main responsibilities of the team members linked to their skills. Every team member will collaborate on processes which might not be listed below, for example creating the simulink model and solving problems that appear.

Name	Technical and Soft Skills	Main Responsibility
Osamah Al-Bayati	Python and knowledge of physics	Identify the variables, parameters and dataset that will be used in the model, Analyse and interpret the simulation results & Validate

		the simulation
Shwan Majeed	Knowledge of python and Matlab	Run the simulation, and Analyze and interpret the simulation.
Tanzir Hossain	Knowledge of Python	Define the problem statement and the system under study, develop the mathematical equations and algorithms
Walid Ayub	Knowledge of Matlab Simulink and physics	Creating and configuring the simulink model, and Documenting the procedure

References

[1] N. A. S. A. Earth Science Data Systems, “Sea level change data Pathfinder,” NASA, 04-Nov-2021. [Online]. Available: https://www.earthdata.nasa.gov/learn/pathfinders/sea-level-change#:~:text=Global%20sea%20level%20has%20risen,to%208%20feet%20by%202100.&text=billion%20people%20could%20be%20impacted%20by%20changes%20in%20sea%20level. [Accessed: 19-Feb-2023].