Osdag Screening Task Report

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Introduction

This document explains the implementation and visualization approach used for the Osdag screening assignment. The task focuses on extracting internal force data from an Xarray (NetCDF) dataset and visualizing shear force and bending moment diagrams using Python and Matplotlib (PyPlot). Both 2D and 3D visualizations are created following industry-standard post-processing styles similar to MIDAS.

Task 1: 2D Shear Force Diagram (SFD) and Bending Moment Diagram (BMD)

In Task 1, the objective is to generate the shear force and bending moment diagrams for the central longitudinal girder of the bridge. The central girder is identified by the element sequence [15, 24, 33, 42, 51, 60, 69, 78, 83]. These elements form a continuous line along the bridge span.

The NetCDF file is loaded using the Xarray library. From the dataset, the internal force components Mz (bending moment) and Vy (shear force) are extracted at both the start (_i) and end (_j) of each element. For plotting a continuous diagram, the Mz_i and Vy_i values from the first element are used as the starting node, followed by Mz_j and Vy_j values from each subsequent element.

The extracted nodal values are plotted using Matplotlib. Separate 2D line plots are generated for the bending moment diagram and shear force diagram. The sign convention is preserved exactly as stored in the dataset, without any manual modification. Appropriate titles, axis labels, markers, and grid lines are included to ensure clarity and readability.

Video Demonstration:
Screening Task 1 – https://youtu.be/cLfdEYuYi3I?si=oXc9iEqPHiacEo-2

Task 2: 3D Shear Force and Bending Moment Diagrams for All Girders

Task 2 extends the visualization to all five longitudinal girders of the bridge. Each girder is defined by a specific sequence of element tags as provided in the assignment description. The same Xarray dataset is used to extract bending moment (Mz) and shear force (Vy) values for all girders.

For each girder, nodal force values are assembled in the same manner as Task 1, ensuring continuity along the bridge length. To create a 3D visualization, the bridge length is represented along the x-axis, the internal force magnitude is plotted along the vertical y-axis, and each girder is placed at a distinct lateral position along the z-axis.

The 3D plots include a baseline representation of the bridge framing at zero force level, with the shear force or bending moment diagrams extruded vertically above it. Color maps are applied to represent the magnitude of internal forces, resulting in a visualization style similar to MIDAS post-processing. Camera angle, line thickness, and spacing are carefully adjusted to improve visual understanding.

Video Demonstration:
Screening Task 2 – https://youtu.be/vUwlncXn4E0?si=nI4MswKij5_OwHYm

Conclusion

The completed implementation demonstrates correct usage of Xarray for data extraction and Matplotlib for both 2D and 3D structural visualizations. The diagrams are continuous, accurate, and visually clear, fulfilling all the requirements of the Osdag screening task. The approach is modular, readable, and suitable for further extension or automation.