Beam Analysis GUI using Influence Line Diagrams (ILDs)

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Abstract

This report presents a graphical user interface (GUI) developed using PyQt5 to analyze a simply supported beam under a pair of moving loads. The application utilizes Influence Line Diagrams (ILDs) for calculating reactions, shear force, and bending moment. Features such as ILD plotting, automated analysis, and PDF export functionality are integrated. This tool aims to assist students and engineers in understanding and applying ILDs interactively.

1 Introduction

Influence Line Diagrams are graphical tools used to determine the variation of response functions (such as support reactions, shear force, and bending moment) as a moving load traverses over a beam. This project implements a user-friendly GUI for performing ILD-based analysis on a simply supported beam with two moving loads.

2 Methodology

The beam analysis is based on statics and influence line theory. The GUI allows input of:

- Beam span (L)
- Load magnitudes (W_1, W_2)
- Spacing between loads (d)
- Positions of loads on the beam

The application calculates:

- Maximum reactions at supports A and B
- Shear force at midspan
- Bending moment at support A

- Maximum values of shear force and bending moment along the span

The ILDs are plotted using Matplotlib, and the results can be exported along with the plot as a PDF using ReportLab.

3 Features

- **Real-time Beam Analysis:** Computes support reactions, shear force, and bending moment.
- **ILD Plotting:** Graphical ILDs for RA, RB, BM at midspan, and SF at midspan.
- **Interactive GUI:** Built using PyQt5 with user-friendly layout.
- **PDF Export:** Generates PDF report including analysis and ILD plots.

Beam Analysis Configuration and Results

Input Parameters:

- Beam Length $L = 10$ m
- Point Load $W_1 = 20$ kN at 3 m
- Point Load $W_2 = 30$ kN at 5 m
- Spacing between loads $d = 2$ m

Results from GUI Simulation:

Quantity	**Value**
Max Reaction at A (kN)	44.0
Max Reaction at B (kN)	46.0
BM at A (kNm)	48.0
SF at Midspan (kN)	2.75
Max SF (kN)	$-\infty$ (Bug – needs fix)
Location of Max SF (m)	0
Max BM (kNm)	105.8
Location of Max BM (m)	5.4

4 GUI Screenshot

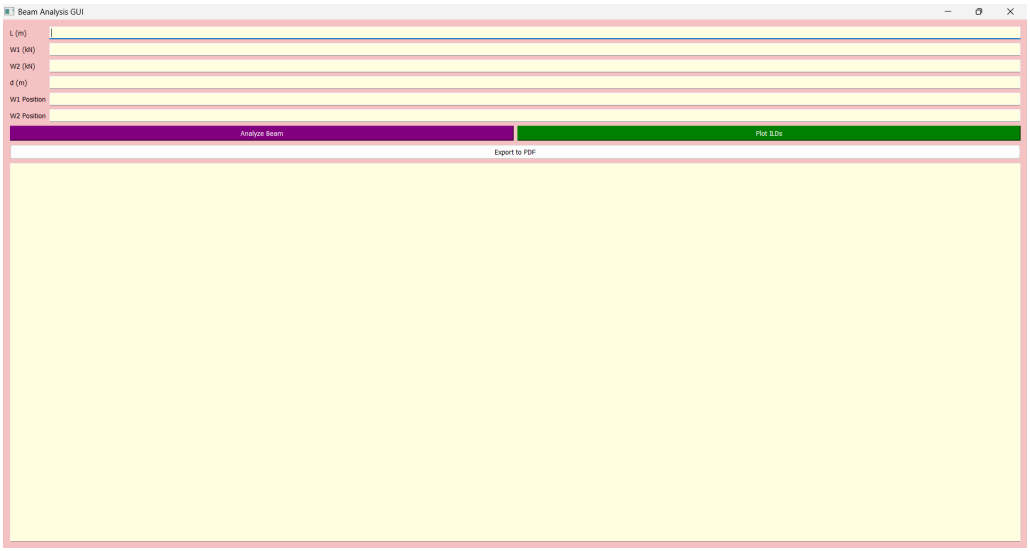

Figure 1: Beam Analysis GUI showing input fields and results

5 How to Run

1. Install dependencies: `PyQt5, matplotlib, numpy, reportlab`
2. Run the GUI: `python beam_gui.py`
3. Enter the inputs and click `Analyze Beam` or `Plot ILDs`
4. Export results using `Export to PDF`

6 Conclusion

This GUI provides a compact and intuitive interface for structural analysis using ILDs. It automates tedious calculations and enables visual learning. The tool is extendable to more complex load cases and support conditions in the future.

7 Repository Link

GitHub: `https://github.com/ALOK66373/beam_analysis_gui`