Inverse Finite Element Method for Beam Analysis

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***Abstract*—This report gives an overview of the Inverse Finite Element Method (iFEM) for beam analysis, including its theoretical foundations, implementation details, and potential applications. The iFEM approach allows for the reconstruction of structural displacements and strains from measured data, providing a powerful tool for structural health monitoring and damage detection in beam-like structures.**

***Index Terms*—iFEM, Inverse Finite Element Method, Beam Analysis**

I. Introduction

This document is a model and instructions for LaTeX. Please observe the conference page limits.

II. Methodology

A. Geometry of the problem

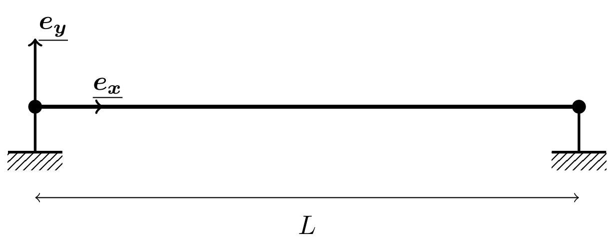

Fig. 1. Simply supported beam configuration

The work carried out on all of this report was done on a simply supported beam

B. Element type

Euler Beam elements were used for the discretization of the beam structure. These elements are suitable for slender beams where shear deformation is negligible. Using 4 Gauss Point for the shape functions integration. The residual is following the principle of virtual work.

$$R = \int_L \delta\epsilon^T \sigma dL - \int_L \delta u^T b dL - \sum_{i=1}^{nLoad} \delta u_i^T Q_i \qquad (1)$$

C. Material properties

Unit mass, unit loacal inertia, Young's modulus of 210e9 Pa and a cross section of 0.01 m2 were used for the beam. Make a table of the properties used.

TABLE I
Material properties

Table Head	**Table Column Head**		
	Table column subhead	***Subhead***	***Subhead***
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D. Model

E. Load Scenarii

1) Nodal load (Dynamic and quasi-static):

2) Distributed load: Uniform (Dynamic):

3) Distributed load: 2nd mode shape (Dynamic):

F. Inverse simulation

III. Results

A. Inverse crime

B. Mesh sensibility

C. Noise sensibility

D. Time discretization sensibility

IV. Conclusion