Lehrstuhl für Statik und Dynamik

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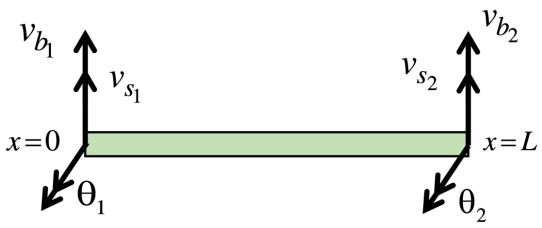
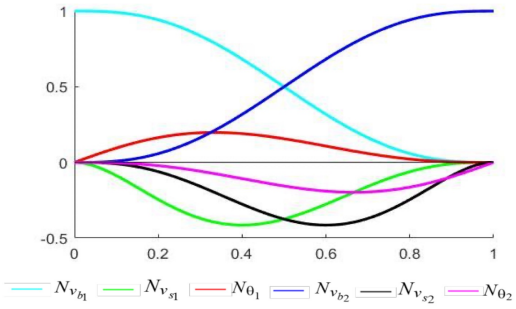
Bachelor‘s Thesis:

FEM implementation of locking-free Timoshenko beam element

Classical Euler-Bernoulli beam elements are widely used for their simplicity and efficiency but neglect shear deformation, making them inaccurate for short or thick beams where shear effects are significant. The Timoshenko beam theory accounts for shear deformation and improves accuracy, but standard finite element implementations often suffer from shear locking, leading to overly stiff and unreliable results, especially for slender beams.

One approach to mitigate this issue is to split the displacement field into bending and shear components and establish a relation between them. This refined formulation preserves the physical consistency of the Timoshenko theory while eliminating shear locking, leading to more accurate and robust results across a wide range of beam geometries.





Key objectives:

- Study the Timoshenko beam theory and its finite element discretization
- Derive and implement an improved beam element in Python or MATLAB
- Validate the implementation using benchmark problems and analytical solutions
- Compare performance and accuracy with Euler-Bernoulli and standard Timoshenko beam formulations

Recommended Background:

- Knowledge of beam theories and basic finite element method
- Experience with Python/MATLAB programming

Language : English

Start Date : Summer semester 2026

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