

STEADY-STATE VIBRATION OF CANTILEVER BEAMS

Test name: CANT-SORDER

Code: MEMOSA-FVM

Features tested: Spatial discretization order of structural solver

Description: Steady-state vibration of a cantilever beam subjected to shear stress at the free end is simulated. The spatial discretization order is determined by studying the errors in the deflection of the beam tip at six successively refined mesh resolutions.

Result Summary: The spatial discretization order is found to be 2.009. This is consistent with the second-order spatial discretization of the numerical scheme.

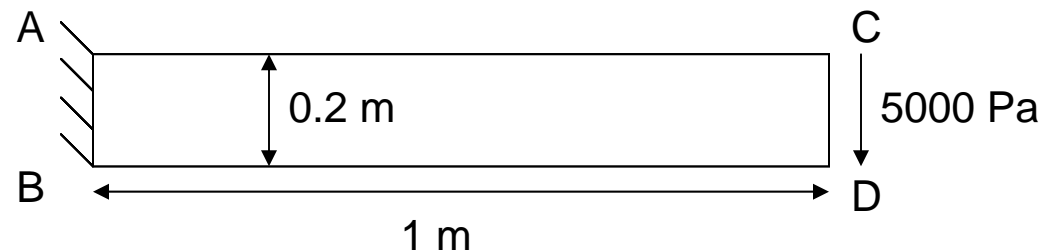
Assessment: Passed.

References: S. Das, S. Mathur and J. Y. Murthy, “*An unstructured finite volume method for structure-electrostatics interaction in MEMS*”, IMECE2010-40036, Vancouver, BC, 2010.

Test Description

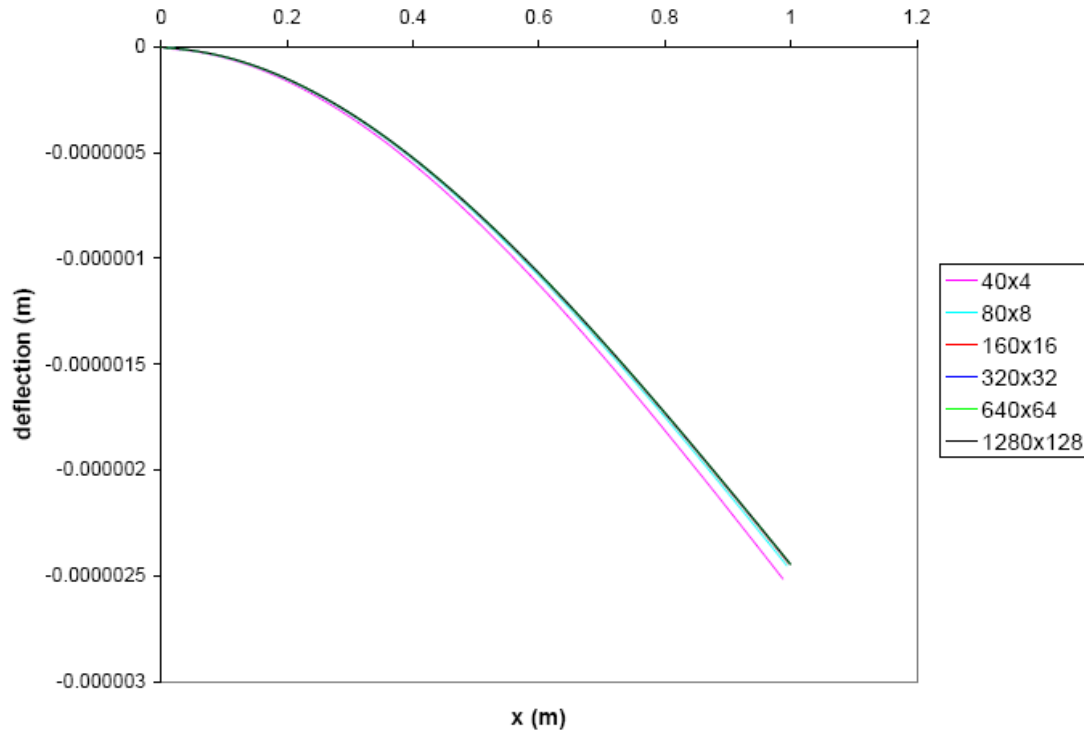
Overview: A cantilever beam is subjected to shear stress at the free end. The objective is to compute the spatial discretization order of the numerical scheme.

| Parameter | Value |
|-----------------|---------|
| Young's Modulus | 210 GPa |
| Poisson's ratio | 0.25 |



Description: Computations are performed in MEMOSA-FVM. A cantilever beam is subjected to shear stress $\tau = 5000$ Pa at the free end. The top and bottom faces are traction-free surfaces. The left face is constrained to have zero displacement. Six successively refined uniform quad meshes, of size 40x4, 80x8, 160x16, 320x32, 640x64, and 1280x128 are used for the computation. The errors in the tip deflection, with respect to the case with the finest mesh, are used to obtain the spatial discretization order of the structural solver.

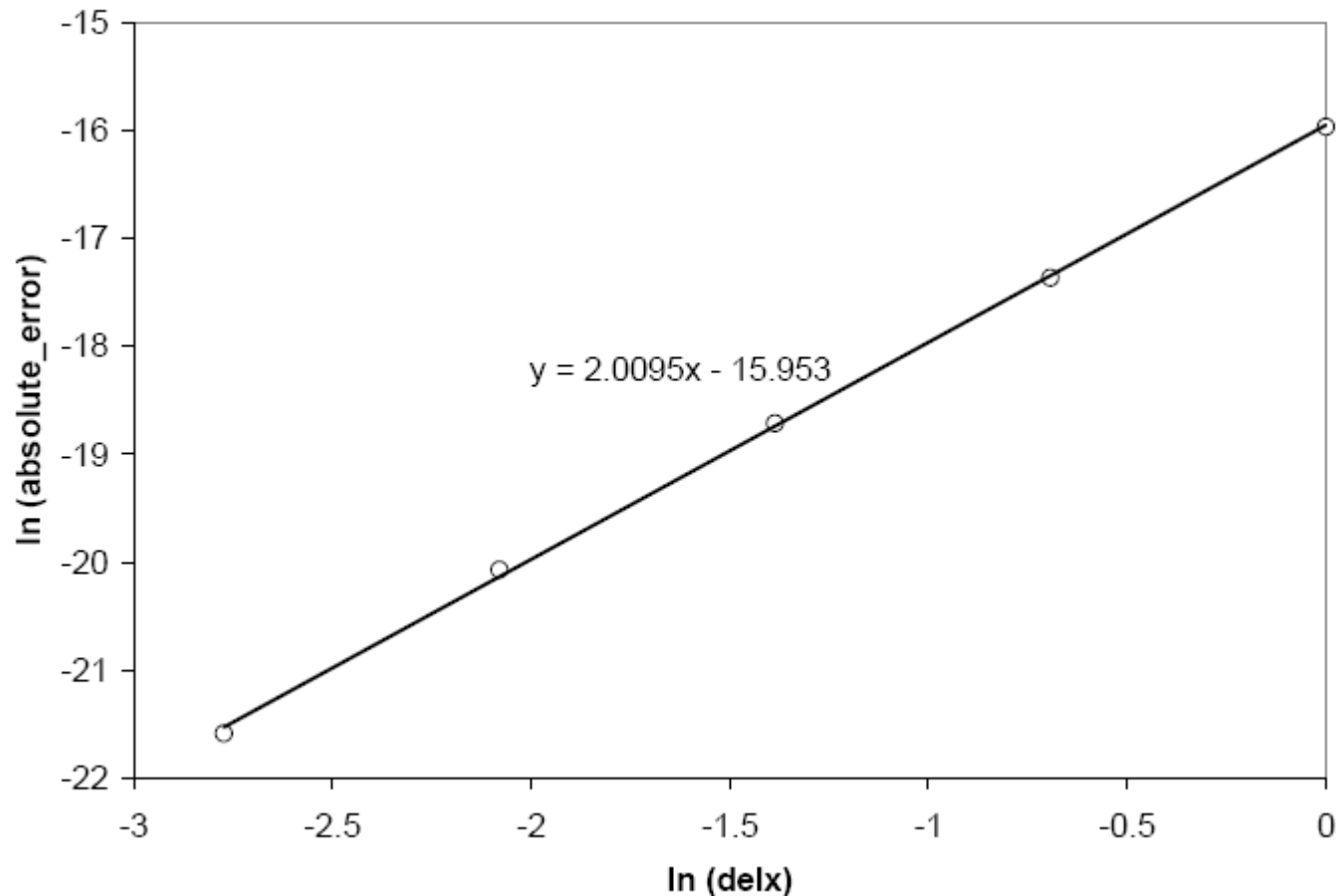
Results



| Resolution | Tip Deflection (m) |
|------------|--------------------|
| 40x4 | -2.5615e-6 |
| 80x8 | -2.4740e-6 |
| 160x16 | -2.4528e-6 |
| 320x32 | -2.4472e-6 |
| 640x64 | -2.4457e-6 |
| 1280x128 | -2.4453e-6 |

| Resolution | 40x4 | 80x8 | 160x16 | 320x32 | 640x64 |
|-----------------------------|----------|----------|----------|----------|----------|
| Error in tip deflection (m) | 1.162e-7 | 2.877e-8 | 7.472e-9 | 1.929e-9 | 4.24e-10 |

Order of Spatial Discretization



Order = 2.0095

Assessment

- The order of accuracy is as expected. We have second-order spatial discretization.
- The test is considered passed.