Inhaltsverzeichnis

1 lathon introduction

lathon is a tool for documentation of numerical computation of tasks usually arising in engineering fields. python is used to compute the formulas and latex is then used for the documentation. Files that are able to be parsed with lathon should also be valid python files, and therefore should run with a python interpreter directly, but this won't result in a latex document.

1.1 blocks

the lathon blocks are seperated by two ## following an instruction. The instruction must be one of these entities:

- ##python: This block will be executed by the python interpreter and is not added to the document.
- ##lathon: This block will be executed by the python interpreter and is added to the document. Only python one line instructions are allowed. lathon is writing the instruction plus the result of the instruction to the document. (eg.: a = b + c = 100). Units can be added with sympy.
- ##latex: This block will be added to the document directly. # is used to make sure this line is not run by the python interpreter.
- ##code This block will be executed by the python interpreter and is added to the document as a code block.

1.2 lathon python API by example

```
import lathon

parser = lathon.Parser()
parser.parse_file("lathon_docs.py")
parser.parse_file("lathon_example.py")
parser.show()
```

2 Example

In this example we are computing the first eigenfrequencies of a cantilever beam. First we are going to use the analytic solution and then we are going to compare this result with a computation by FreeCAD via the FEM-workbench.

2.1 imports

```
import lathon
from numpy import pi
from sympy import sqrt
from sympy.physics.units import m, mm, Pa, kg, s
from matplotlib import pyplot as plt
```

2.2 defining the catilever beam

$$l = 1000.0\,\mathrm{mm} \qquad \text{the length of the cantilever beam} \tag{1}$$

$$w = 200.0\,\mathrm{mm} \qquad \text{the width of the cantilever beam} \tag{2}$$

$$h = 100.0\,\mathrm{mm} \qquad \text{the height of the cantilever beam} \tag{3}$$

$$\mathrm{A} = h \cdot w = 20000.0\,\mathrm{mm}^2 \qquad \text{the cross section area of the cantilever beam} \tag{4}$$

$$E = 70000000.0\,\frac{\mathrm{kg}}{\mathrm{mm}\cdot\mathrm{s}^2} \qquad \text{the Young's modulus for aluminium} \tag{5}$$

$$\nu = 0.3 \qquad \text{Poisson atio} \tag{6}$$

$$\mathrm{G} = \frac{E}{2\cdot\nu + 2} = 26923076.9230769\,\frac{\mathrm{kg}}{\mathrm{mm}\cdot\mathrm{s}^2} \tag{7}$$

$$\rho = 2.7\cdot 10^{-6}\,\frac{\mathrm{kg}}{\mathrm{mm}^3} \qquad \text{the density of aluminium} \tag{8}$$

2.3 Analytic solution

$$I_{yy} = \frac{h^3\cdot w}{12} = 1666.66666666667\,\mathrm{cm}^4 \qquad \text{the second moment of area of the cantilever beam} \tag{9}$$

$$I_{zz} = \frac{h\cdot w^3}{12} = 6666.66666666667\,\mathrm{cm}^4 \qquad \text{the second moment of area of the cantilever beam} \tag{10}$$

$$I_p = I_{yy} + I_{zz} = 8333.33333333333\,\mathrm{cm}^4 \qquad \text{polar second moment of area} \tag{11}$$

$$k_{b1} = 4.73 \qquad \text{constant for the first bending eigenfrequency of a cantilever beam} \tag{12}$$

$$c_{t1} = \frac{0.0173333333333333\cdot h^5}{w^5} - \frac{0.21\cdot h}{w} + \frac{1}{3} = 0.228875 \qquad \text{approximation formula} \tag{13}$$

$$I_t = c_{t1}\cdot h^3\cdot w = 4577.5\,\mathrm{cm}^4 \qquad \text{approximation formula} \tag{14}$$

$$\nu_{b1} = \frac{k_{b1}^2\cdot\sqrt{\frac{E\cdot I_{yy}}{\rho}}}{2\cdot\pi\cdot l^2\cdot\sqrt{\mathrm{A}}} = 523.38217545379\,\mathrm{Hz} \qquad \text{the first bending eigenfrequency of a cantilever beam} \tag{15}$$

$$\nu_{b2} = \frac{k_{b1}^2\cdot\sqrt{\frac{E\cdot I_{zz}}{\rho}}}{2\cdot\pi\cdot l^2\cdot\sqrt{\mathrm{A}}} = 1046.76435090758\,\mathrm{Hz} \qquad \text{the first bending eigenfrequency of a cantilever beam} \tag{16}$$

$$\nu_{t1} = \frac{\sqrt{\frac{I_t}{I_p\cdot\rho}}\cdot\sqrt{\mathrm{G}}}{2\cdot l} = 1170.1869965256\,\mathrm{Hz} \tag{17}$$

2.4 FreeCAD result

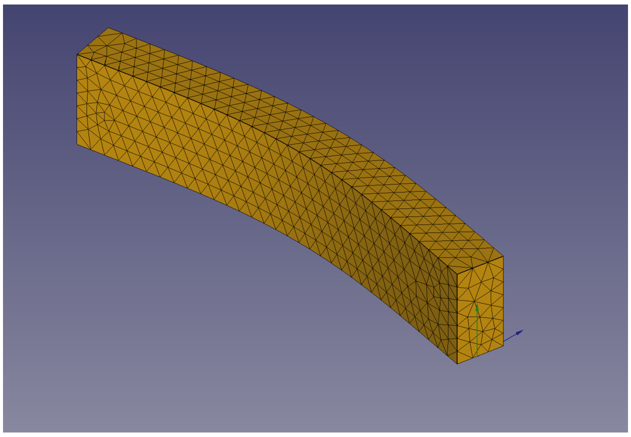

Abbildung 1: first bending mode first axis

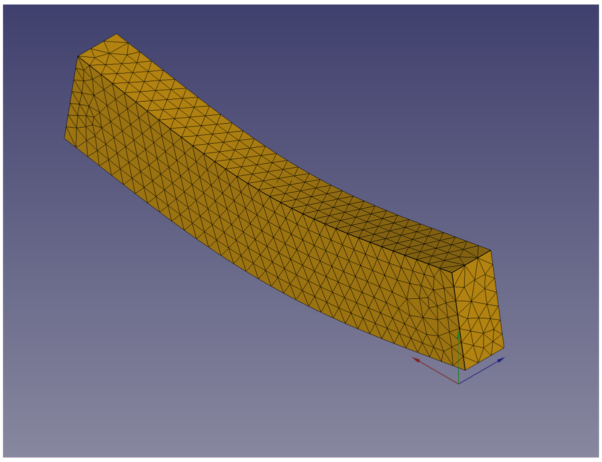

Abbildung 2: first bending mode second axis

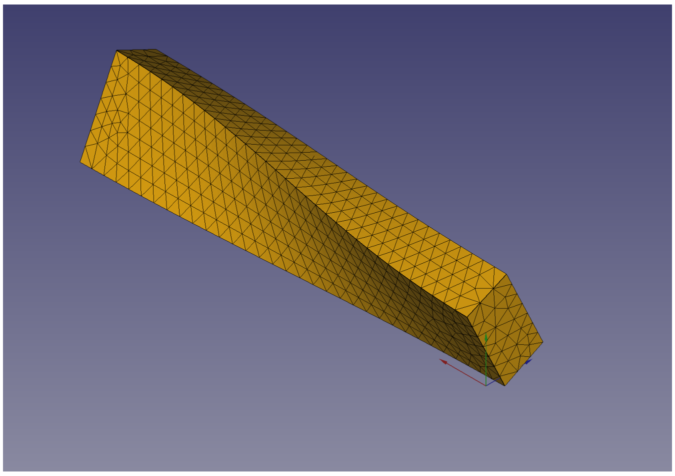

Abbildung 3: first torsion mode

```
                        S T E P       1


    E I G E N V A L U E   O U T P U T

MODE NO     EIGENVALUE                       FREQUENCY
                                        REAL PART            IMAGINARY PART
                             (RAD/TIME)      (CYCLES/TIME      (RAD/TIME)

     4    0.7309040E-07   0.2703524E-03   0.4302792E-04   0.0000000E+00
     5    0.5759223E-06   0.7588954E-03   0.1207820E-03   0.0000000E+00
     6    0.1016917E-05   0.1008423E-02   0.1604955E-03   0.0000000E+00
     7    0.1019283E+08   0.3192620E+04   0.5081213E+03   0.0000000E+00
     8    0.3408953E+08   0.5838624E+04   0.9292459E+03   0.0000000E+00
     9    0.6034271E+08   0.7768057E+04   0.1236325E+04   0.0000000E+00
    10    0.7069911E+08   0.8408276E+04   0.1338219E+04   0.0000000E+00
```

Abbildung 4: cantilever beam result