Mat-5.3741 Theory of Elasticity (5 cp) L **Spring 2007**

Stenberg/Juntunen

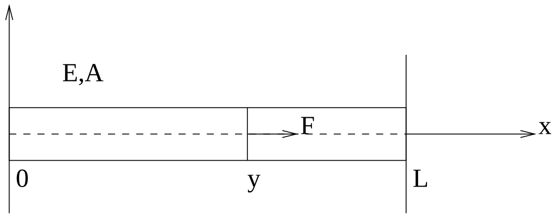
Exercise 1

Problem 1

If you do not remember (or have not seen) the result $\mathrm{N}(B) = \mathrm{R}(B^T)^\perp$ from linear algebra, prove it (or look it up in your textbook).

Problem 2

Consider a rod (E, A, L) fixed at both ends and loaded by a force F at point y, $(0 < y < L)$:



Find the expression for the displacement $u(x)$ in the form

$$u(x) = K(x, y)F.$$

Problem 3 **(home exercise)**

In the lectures we learned that the equilibrium equations

$$A^T C A x = f$$

are obtained from the principle of minimum potential energy. Show that an equivalent formulation is the principle of minimum complementary energy:

$$\min_y \frac{1}{2} y^T C^{-1} y \qquad \text{subject to } A^T y = f.$$

Hint: Look up the technique of Lagrange multipliers.

Problem 4

Read through section 4. Dynamical systems and eigenvalues from the handouts.

Problem 5

A project work for the next two weeks. Hints will be given in exercises at week 4 and this will be **home exercise for week 5**.

Make your own MATLAB program by which simple strusses can be analyzed. Make experiments on systems with and without unique solutions. In the latter case, check the nullspaces of the equilibrium equation and the force compatibility conditions. Compute and print the eigenmodes of some simple structures.