4. Homework in Nonlinear Mechanics, 15. 11. 2013

Deadline, 22. 11. 2013

`VSi` is i–th digit of **your** registration number. For registration number 26102734 are `VS6=7`, `VS8=4`.

TASK 1: Consider the following deformations of the body:

1. Body is stretched out in the directions $\vec{e}_\xi = \frac{\sqrt{3}}{2}\vec{e}_1 + \frac{1}{2}\vec{e}_2$, $\vec{e}_\eta = \frac{\sqrt{3}}{2}\vec{e}_2 + \frac{1}{2}\vec{e}_1$ and $\vec{e}_\zeta = \vec{e}_3$ with factors λ, $\frac{1}{\sqrt{\lambda}}$ and $\frac{1}{\sqrt{\lambda}}$, respectively.
2. Body is rotated in the direction $\vec{e}_\zeta$ for angle α.
3. Body is first stretched out in the directions $\vec{e}_\xi = \frac{\sqrt{3}}{2}\vec{e}_1 + \frac{1}{2}\vec{e}_2$, $\vec{e}_\eta = \frac{\sqrt{3}}{2}\vec{e}_2 + \frac{1}{2}\vec{e}_1$ and $\vec{e}_\zeta = \vec{e}_3$ with factors λ, $\frac{1}{\sqrt{\lambda}}$ and $\frac{1}{\sqrt{\lambda}}$, respectively and then rotated in the direction $\vec{e}_\zeta$ for angle α.
4. Body is first rotated in the direction $\vec{e}_\zeta$ for angle α and then stretched out in the directions $\vec{e}_\xi = \frac{\sqrt{3}}{2}\vec{e}_1 + \frac{1}{2}\vec{e}_2$, $\vec{e}_\eta = \frac{\sqrt{3}}{2}\vec{e}_2 + \frac{1}{2}\vec{e}_1$ and $\vec{e}_\zeta = \vec{e}_3$ with factors λ, $\frac{1}{\sqrt{\lambda}}$ and $\frac{1}{\sqrt{\lambda}}$, respectively.

Let us denote the deformation gradients at 1., 2., 3. and 4. task points with abbreviations F_1, F_2, F_3 and F_4, respectively.

1. Calculate the deformation gradients F_1, F_2, F_3 and F_4;
2. Calculate RU polar decompositions of deformation gradients:
   $F_1 = R_1 U_1$, $F_2 = R_2 U_2$, $F_3 = R_3 U_3$ in $F_4 = R_4 U_4$;
3. Calculate VR polar decompositions of deformation gradients:
   $F_1 = V_1 R_1$, $F_2 = V_2 R_2$, $F_3 = V_3 R_3$ in $F_4 = V_4 R_4$;
4. Calculate the circumference of the initial circle expressed by equation $x_1^{0^2} + x_2^{0^2} = 1$ after the deformation, according to the deformation in the third case.
5. Calculate the area of the initial sphere expressed by equation $x_1^{0^2} + x_2^{0^2} + x_3^{0^2} = 1$ after the deformation, according to the deformation in the third case.
6. Calculate the volume of the initial unit ball expressed by equation $x_1^{0^2} + x_2^{0^2} + x_3^{0^2} \leq 1$ after the deformation, according to the deformation in the third case.

Data: $\lambda = \dfrac{(\mathtt{VS7} + 10)}{10}$, $\alpha = (\mathtt{VS8} + 1) \cdot 10^\circ$.