

Due: 8:30 a.m. November 9, Tuesday, 2021 (No late homework accepted)

1. [50 points] (*Stretch*) A state of deformation known as *simple shear* occurs when F is given by the component matrix:

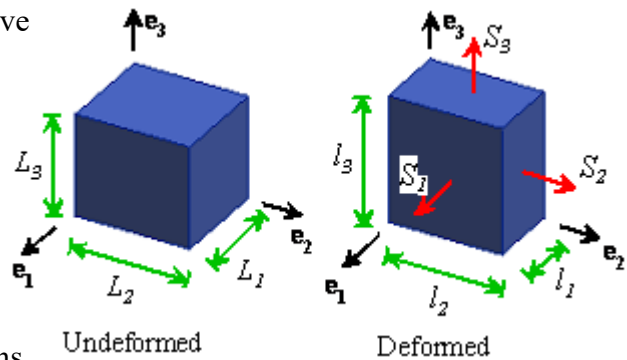
$$F = \begin{bmatrix} 1 & g & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Given $\gamma = 0.5$,

- 1.1. Find left Cauchy-Green deformation tensor B and right Cauchy-Green deformation tensor C .
- 1.2. Find eigenvalues (e_1, e_2 , and e_3) of B and C . Are they identical?
- 1.3. Find principal stretches ($\lambda_1, \lambda_2, \lambda_3$) and principal stretch directions (b_1, b_2 , and b_3).
- 1.4. Verify that $B = \lambda_1^2 b_1 \otimes b_1 + \lambda_2^2 b_2 \otimes b_2 + \lambda_3^2 b_3 \otimes b_3$
- 1.5. Calculate three invariants and their alternative set (i.e., normalized form).

2.1 [20 points] (*Hyperelastic material*) Derive expressions for the Cauchy stress and the Nominal stress for an incompressible, Neo-Hookean material subjected to

- 2.1.1 Uniaxial tension (e_1 -directional stretch is λ)
- 2.1.2 Equibiaxial tension (e_1 - and e_2 -directions stretches are λ)



- 2.2 [10 points] Repeat problem 2.1 for a Mooney-Rivlin material.
- 2.3. [10 points] Repeat problem 2.1 for an Arruda-Boyce material.

2.3 [10 points] Repeat problem 2.1 for a Ogden material.