

ME 211A: Stretch

September 22, 2018

3.70 Question

Given the following right Cauchy-Green deformation tensor at a point

$$[C] = \begin{bmatrix} 9 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 0.36 \end{bmatrix} \quad (1)$$

- (a) Find the stretch for the material elements that were in the direction of \mathbf{e}_1 , \mathbf{e}_2 and \mathbf{e}_3 .
- (b) Find the stretch for the material element that was in the direction of $\mathbf{e}_1 + \mathbf{e}_2$.
- (c) Find $\cos \theta$, where θ is the angle between $d\mathbf{x}^{(1)}$ and $d\mathbf{x}^{(2)}$ and where $d\mathbf{X}^{(1)} = dS_1\mathbf{e}_1$ and $d\mathbf{X}^{(2)} = dS_2\mathbf{e}_1$ deform into $d\mathbf{x}^{(1)} = ds_1\mathbf{m}$ and $d\mathbf{x}^{(2)} = ds_2\mathbf{n}$.

Solution

(a) We remind that $\frac{\left| \frac{v}{-} \right|}{\left| \frac{V}{-} \right|} = \sqrt{\frac{\frac{v \cdot v}{--}}{\frac{V \cdot V}{--}}} = \sqrt{\frac{\frac{\left| \frac{V}{-} \right| \frac{e}{-i} \cdot \frac{C}{-} \left| \frac{V}{-} \right| \frac{e}{-i}}{\frac{V \cdot V}{--}}} = \sqrt{C_{ij}}$, then $\lambda \left(\frac{V}{-} \right) = \frac{\left| \frac{v}{-} \right|}{\left| \frac{V}{-} \right|} = \sqrt{C_{ij}}$

Stretch for

(b)

(c)