

Conditions for small perturbations

We consider the transformation $\underline{x} = \underline{\Phi}(\underline{X}, t)$ defined by:

$$x_1 = X_1 + X_2 \quad (1)$$

$$x_2 = X_2 \quad (2)$$

$$x_3 = X_3 \quad (3)$$

Question 1: Make a graphical representation of the reference configuration and of the deformed configuration. Calculate the gradient of the transformation, $\underline{\underline{F}}$.

Question 2: Is this an homogenous transformation? It is acceptable from a physical point of view?

Question 3: Calculate the expansion of the following vectors: \underline{e}_1 , \underline{e}_2 and $\frac{\underline{e}_1 + \underline{e}_2}{\sqrt{2}}$

Question 4: Calculate $\underline{\underline{e}}$ and $\underline{\underline{\varepsilon}}$? Can we consider we are in small perturbations?

Question 5: Consider the transformation $x_1 = X_1 + \alpha \cdot X_2$, $x_2 = X_2$ and $x_3 = X_3$. What is the condition for having small perturbations?