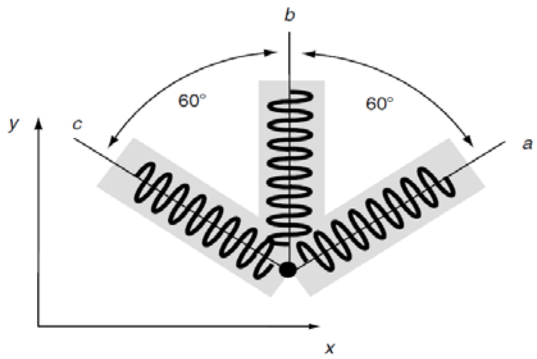
1. The schematic of a rosette strain gage is shown in the following figure, and the output of the device will provide data on the strains along the gage arms *a*, *b*, and *c*. During one application, it is found that $\varepsilon_a = 0.001,\ \varepsilon_b = 0.002,$ and $\varepsilon_c = 0.004$. Using the two-dimensional strain transformation relations, calculate the surface strain components $\varepsilon_x,\ \varepsilon_y,$ and ε_{xy}.



2. Show that the following strain field $\varepsilon_x = Ay^3,\ \varepsilon_y = Ax^3,\ \varepsilon_{xy} = Bxy(x+y), \varepsilon_z = \varepsilon_{xz} = \varepsilon_{yz} = 0$ gives continuous, singlevalued displacements in a simply connected region only if the constants are related by $A = 2B/3$.

3. A multi-valued displacement field is given by

$$u = v = 0, \quad w = \frac{b}{2\pi} \tan^{-1} \frac{y}{x}.$$

Determine the corresponding strain field and verify that the compatibility condition is satisfied. This is an example of a case in which the compatibility condition is necessary but not sufficient to guarantee single-valued displacements.

4. Determine the form of displacement gradient $\mathbf{u}\tilde{\nabla}$ in cylindrical coordinates. Using this result, express the strain-displacement relationship in terms of Cylindrical coordinates.

5. (Optional) A three-dimensional strain field is specified by

$$\varepsilon_{ij} = \begin{bmatrix} 1 & -2 & 0 \\ -2 & -4 & 0 \\ 0 & 0 & 5 \end{bmatrix} \times 10^{-3},$$

with reference to a conventional rectangular coordinate system. Use MATLAB or a similar software to calculate and plot the normal strain component ε_{nn} and the shear strain component ε_{nt}, as a function of angle θ in the interval $0 \le \theta \le \pi/2$. Both ***n*** and ***t*** are unit vectors and lie on a plane that makes equal angles with the *x*- and *z*-axis as shown.