

The University of Iowa
College of Engineering
53:236 Optimization of Structural Systems
Fall Semester 2004

Assignment #5:

Due: 11/16/2004

The objective of this and subsequent assignments is to implement the homogenization continuum structural topology optimization formulation of Bendsøe and Kikuchi using the techniques developed in Assignments 2 and 3. The objective of this particular assignment is to write a program, which given design variables (a_1, a_2, c) for a porous composite material, computes:

1. the effective elasticity tensor $\mathbf{E}^Y(a_1, a_2, c)$ and;
2. the derivatives of $\mathbf{E}^Y(a_1, a_2, c)$ with respect to a_1, a_2, c :

$$\frac{\partial \mathbf{E}^Y}{\partial a_1}; \frac{\partial \mathbf{E}^Y}{\partial a_2}; \frac{\partial \mathbf{E}^Y}{\partial c};$$

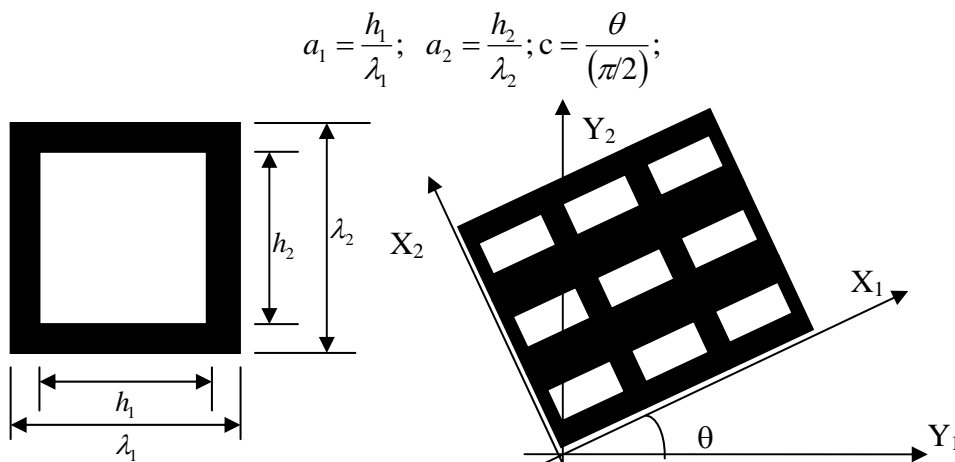


Figure 1: Unit cell of a solid-void composite in material coordinate system which the black region is solid ($E=100$ GPa; $\nu=0.30$) and the white region is void ($E=.01$ GPa; $\nu= 0.40$). Microstructure as oriented with respect to the global axes Y_1, Y_2

As you develop your program, bear in mind that it will eventually interface with the BESTOP program to manage both the structural analysis and sensitivity analysis computations.

When this multi-part assignment is completed, you will be using a software package of three integrated pieces:

- a) SLP will be the optimization driver which will call BESTOP with designs \mathbf{b} , and expect to obtain function values and their design derivatives in return;
- b) BESTOP will receive the design vector \mathbf{b} from the optimization driver, and it will then convert these into elastic moduli for individual finite elements in the analysis model.
- c) After these moduli are conveyed to the structural analysis program, BESTOP will execute the analysis program and then read the resulting vector of nodal displacements $\mathbf{u}(\mathbf{b})$. BESTOP will then compute the necessary function values and their design derivatives, and this information will be conveyed back to the optimization program SLP.
- d) FENDAC will serve as the analysis program. When it receives elastic moduli from BESTOP it will then solve the linear elastic structural analysis problem and write the solution $\mathbf{u}(\mathbf{b})$ in an ASCII results file which will in turn be read by BESTOP.