53:112 (58:112) Engineering Design Optimization
Spring 2006; J.S. ARORA

Project #4: Nonlinear Optimization

Assigned: 18 April 2006 **Due**: 27 April 2006

Optimum Design of a Tripod

Design a minimum mass tripod of height H =500 mm to support a vertical load W = 60 kN. The tripod base is an equilateral triangle with sides B = 1200 mm. The struts have a hollow circular cross-section.

The axial stress in the struts must not exceed the allowable stress in compression, and the axial load in the strut P must not exceed the critical buckling load P_{cr} divided by a safety factor FS = 2. Use consistent units of Newtons and centimeters. The minimum and maximum values for the inner and outer diameters are $2.0 \le D_i \le 10\ cm$ m and $2.5 \le D_0 \le 10.5\ cm$ cm. Material properties are given as follows:

Material: aluminum alloy 2014- T6
Allowable compressive stress, σ_a = 150 MPa
Young's modulus, E = 75 GPa
Mass density, ρ = 2800 kg/m^3

Formulate and solve the design optimization problem using a nonlinear programming algorithm such as in Excel Solver. Compare the solution with the graphical solution obtained in Project #2. Submit a word-processed final report.