SE 276B/MAE 232B Finite Elements in Solid Mechanics II **J. S. Chen**
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Final Project Due Friday, March 13, 2020

A hollow sphere initially at rest is subjected to an internal pressure as shown in Fig. 1. The sphere is made of a linear elastic material without body force. The internal pressure $P(t)$ follows a gas law:

$$P(t)r(t)^{3.75} = P_0 r_0^{3.75}$$

where $P_0 = 1.0$ and $r_0 = 10.0$ are initial pressure and inner radius, respective, and $P(t)$ and $r(t)$ are the pressure and radius at time *t*, respectively. The dimension and material properties of the sphere are: inner radius of the sphere $r_1 = 10.0$, outer radius of the sphere $r_2 = 20.0$, density $\rho = 0.01$, Young's modulus $E = 100.0$, Poisson's ratio $\nu = 0.3$.

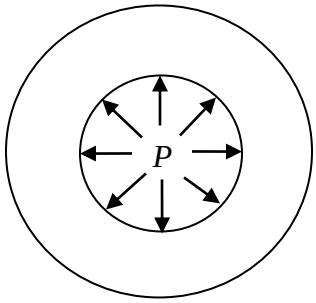

Figure 1. Ball subjected to an internal pressure

The objective of the project is to construct and implement finite element formulation to solve the above elastodynamic problem, and to study the stability and accuracy of explicit and implicit time integration methods. Linear one-dimensional finite element (2-node) along the radial direction with the following time integration methods are to be used:

1. Central difference method with lumped mass.
2. Average acceleration method with consistent mass.

The following numerical studies should be made:

1. Stability of central difference and average acceleration methods.
2. The effect of time step size on the stability.
3. The effect of element refinement on the numerical solution. Suggestions: use 10, 20, 40, and 80 elements.

For each study, plot the displacement and stress history at various locations. *Final report should contain problem statement, finite element formulation, numerical approaches, numerical results, and discussions. A copy of your program should be attached.*