SAND2008-0144C

TITLE:
Finite element analysis of seismic/acoustic interactions with SALINAS

Timothy Walsh, Jerry Rouse, and Garth Reese[1]
Department of Computational Solid Mechanics and Structural Dynamics, MS0380

Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185

Abstract:

The modeling of seismic and acoustic wave propagation is an important part of the analysis of underground tunnels and structures. Traditionally, finite difference time-domain (FDTD) approaches have been used in these types of analysis, due to their ease of implementation and fast solution times. However, these methods are not ideal for modeling complex geometries, such as underground tunnels/structures, as this would require an unstructured finite difference stencil. Finite element methods allow for a natural and more accurate representation of complex geometries, such as those encountered in underground structures. In addition, recent developments in finite element mesh generation software such as CUBIT, facilitates the mesh generation process. Although the time-domain approach is effective for problems with broad-band excitation, it is not ideal for the direct analysis of natural frequencies and frequency response of air-filled tunnels and seismic spaces, which are important for studying resonance and reverberation phenomena.

In this talk we will present an overview of SALINAS [1,2], a massively parallel finite element code for vibration and acoustic analysis code that is being developed at Sandia National Laboratories. We will compare and contrast this approach with traditional FDTD approaches, discussing the advantages and disadvantages of both methods. We will present an overview of the SALINAS capabilities, including eigenanalysis, direct frequency response, nonlinear acoustics, and implicit transient dynamic analysis, and also discuss future directions of research for the code development.

We will also present some recent use cases for SALINAS in the seismic/acoustic modeling, including the computation of natural frequencies (eigenvalues) of complex air-filled tunnels, and the assessment of coupled scattering effects from seismic waves impinging on air-filled tunnels.

[1] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.