

## Elastic wave interaction with underground cavities

### Abstract

This project focuses on understanding and modeling the propagation of elastic waves in media with internal boundaries, especially solid-gas, and potentially complex distributions of material parameters. The need for appropriate numerical methods for the approximation of this problem arises from needs in seismology, as the scientific problems underlying the verification of nuclear testing, which is the aim of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna. The primary goal of our project is to model the elastic wave propagation around an underground cavity as the one created by an underground nuclear explosion. For this coupled elastic-acoustic wave problem we plan to develop and analyze new and robust high-order discontinuous Galerkin finite element methods capable to comprehensively describe the entire wavefield, including reflected waves, interaction with surface waves, and cavity oscillations. The results of our research will facilitate the development of proper analysis techniques to detect the remnants of an underground nuclear test. The cavity detection problem is perhaps the single largest remaining scientific problem for the scientific operation of CTBTO. Our project will thus contribute substantially to bringing the future Comprehensive Nuclear-Test-Ban Treaty toward its diplomatic/political implementation.

Scientific disciplines:

101014 - Numerical mathematics (50%) | 105122 - Seismic (50%)

Keywords:

Partial differential equations, elastic wave propagation, seismology, heterogeneous media, nuclear verification, discontinuous Galerkin methods, coupled formulations, transmission conditions

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Further links about the involved persons and regarding the project you can find at

<https://archiv.wwtf.at/programmes/mathematics/MA14-006>