SciPy 2014 - SimPEG Abstract

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Brief Description

We present an open source package for Simulation and Parameter Estimation in Geophysics (SimPEG). SimPEG provides a framework for solving a variety of geophysical forward and inverse problems. We show SimPEG's utility and extensibility through diverse examples, and discuss our design and methodologies behind creating a modular framework that promotes integration of geophysical data.

Detailed Abstract

Geophysical surveys are powerful tools for obtaining information about the subsurface. Inverse modelling provides a mathematical framework for constructing a model of physical property distributions that are consistent with the data collected by these surveys. The geosciences are increasingly moving towards the integration of geological, geophysical, and hydrological information to better characterize the subsurface. This integration must span disciplines and is not only challenging scientifically, but the inconsistencies between conventions often makes implementations complicated, non-reproducible, or inefficient. A team of researchers at the Geophysical Inversion Facility at The University of British Columbia have developed an open source software package for Simulation and Parameter Estimation in Geophysics (SimPEG, http://github.com/simpeg), which provides a generalized framework for solving geophysical forward and inverse problems. SimPEG is written entirely in Python with core dependencies on SciPy, NumPy, and Matplotlib with the hopes that it can be used both as an effective research tool and a tool for use in education.

SimPEG includes finite volume discretizations on structured and unstructured meshes, interfaces to standard numerical solver packages, convex optimization algorithms, model parameterizations, and tailored visualization routines. The framework is modular and object-oriented, which promotes real time experimentation and combination of geophysical problems and inversion methodologies. In this presentation we will highlight a few diverse geophysical examples and discuss some of our challenges and successes in developing a flexible and extensible framework. Throughout development of SimPEG we have focused on simplicity, usability, documentation (http://simpeg.rtfd.org), and extensive unit-testing (https://travis-ci.org/simpeg/simpeg). By embracing a fully open source development paradigm, we hope to encourage reproducible research, cooperation, and communication to help tackle some of the inherently multidisciplinary problems that face integrated geophysical methods.