SimPEG:

An open-source framework for geophysical simulations and inverse problems.

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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. We have developed an open source software package for Simulation and Parameter Estimation in Geophysics (SimPEG), which provides a generalized framework for solving geophysical forward and inverse problems. SimPEG is written entirely in Python with minimal dependencies in the hopes that it can be used both as a research tool and for 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 geophysical examples, including direct-current resistivity and electromagnetics, and discuss some of the challenges and successes we encountered in developing a flexible and extensible framework. Throughout development of SimPEG we have focused on simplicity, usability, documentation, and extensive testing. 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.