Reproducible computational experiments using the Madagascar software package

Sergey Fomel
Bureau of Economic Geology, University of Texas at Austin
sergey.fomel@beg.utexas.edu

Abstract

Because of both practical constraints on computational resources and the inherent ill-posed nature, many of the practically important large-scale inverse problems require experimentation with parameters and algorithms in order to achieve acceptable solutions. A convenient software environment that enables fast experimentation as well as documentation and publishing of experimental results becomes an indispensable tool for a computational scientist. Such an environment is provided by the open-source "Madagascar" software package, developed by an open community and publicly available since June 2006. "Madagascar" re-implements and extends the functionality of SEPlib, a software library developed originally by Jon Claerbout and his students at the Stanford Exploration Project.

In this presentation, I will describe the main design principles of the "Madagascar" project, such as a universal data format and a three-level system of processing modules, data processing flows, and documentation. The system makes use of SCons, a Python-base software construction utility, for managing the information flow and documenting computational experiments. Keeping the experimental results reproducible is important both for robust and maintainable software development and for peer review of scientific results. I will show simple examples of using "Madagascar" for solving practically important inverse problems in seismic imaging and geophysical data analysis.