madagascar overview

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MADAGASCAR is an open-source software package for geophysical data processing and reproducible numerical experiments.

the technology developed using the MADAGASCAR project management system is transferred in the form of recorded processing histories, which become computational recipes to be verified, exchanged, and modified by users of the system.
open source (standard GPL)

freedom
- to use
- to study and modify
- to redistribute
- to improve

collaboration

peer review

reproducibility
The purpose of reproducible research is to facilitate someone going a step further by changing something. The first step that someone will want to make is to be sure that your work is reproducible before they change and improve upon it.

Jon F. Claerbout, *Reproducible research*
Within the world of science, computation is now rightly seen as a third vertex of a triangle complementing experiment and theory. However, as it is now often practiced, one can make a good case that computing is the last refuge of the scientific scoundrel... Where else in science can one get away with publishing observations that are claimed to prove a theory or illustrate the success of a technique without having to give a careful description of the methods used, in sufficient detail that others can attempt to repeat the experiment?

Randall J. LeVeque, Wave propagation software, computational science, and reproducible research, 2006
MADAGASCAR mission

- a powerful research environment
- a convenient technology transfer tool

for researchers working with digital image and data processing
MADAGASCAR system

software
http://rsf.sourceforge.org

blog
http://www.reproducibility.org/rsflog

- distributed development (academia/industry)
- version control subversion
- installation and flows by scons
MADAGASCAR development

release: 0.9.5. in October 2007

contributors

- University of Texas (Austin)
- Colorado School of Mines
- University of British Columbia
- ...
MADAGASCAR heritage

software system
  ▶ SEPlib (Stanford University)
  ▶ SU (Colorado School of Mines)
  ▶ DDS (Amoco/BP)

reproducible research
  ▶ SEP document system
MADAGASCAR architecture

- documents
- flows
- programs
MADAGASCAR architecture

- documents
- flows
- programs

- C, C++, F90, Python, Matlab ...
- communicate by pipes
- provide basic processing modules
MADAGASCAR architecture

- documents
  - Python (SCons)
  - combine processing modules
  - provide processing history
- flows
- programs
MADAGASCAR architecture

- documents
- flows
- programs

- LaTeX and SCons
- assemble text and numeric results
- provide reproducible documents
MADAGASCAR  programs

represent independent processing modules

- combined using pipes
- “sf” prefix
- program count: 411 on 11/14/2007
- documented by examples ("books")
MADAGASCAR file format

borrowed from classic SEPlib

header:
  ▶ text file (description of data)
  ▶ description of regularly-sampled format
  ▶ small, can be archived

binary:
  ▶ binary file (actual data)
  ▶ N-dimensional hypercube
  ▶ large, can be stored on a different file system
  ▶ path to binary set with environment variable DATAPATH
MADAGASCAR file format

home file system

header

data

scratch file system
MADAGASCAR demo

this is a reproducible document!

eexample
  ▶ ray tracing
  ▶ eikonal solver
  ▶ finite-difference modeling
velocity model

flow layer

sigs.getstrvel('velo',par)
Plot('velo',fdmod.cgrey('allpos=y bias=1.5',par))
Result('velo',['velo','ss','rr'],'Overlay')
ray tracing

flow layer

\[
\text{Flow}(\text{'hwt'}, \text{'velo'}, \\
\text{smooth rect1=150 rect2=150 repeat=5} | \\
\text{hwt2d verb=n xsou=\%(xsou)g zsou=\%(zsou)g} \\
\text{nt=\%(nt)d ot=\%(ot)g dt=\%(dt)g} \\
\text{ng=\%(ng)d og=\%(og)g dg=\%(dg)g} \\
\text{\% par}) \\
\text{fdmod.rayplot('hwt', 20, 10, 1, 200, '', par)} \\
\text{Result('hwt', ['velo', 'hwt', 'ss', 'rr'], 'Overlay')} 
\]
**eikonal solver**

**flow layer**

```python
Flow('fme','velo','eikonal zshot=%(zsou)g yshot=%(xsou)g' % par)
Plot('fme',fdmod.ccont('dc=0.25',par))
Result('fme',[ 'velo', 'fme', 'ss' ],'Overlay ')
```
finite-difference modeling

flow layer

fdmod.awefd('dat', 'wfl', 'wav', 'velo', 'dens', 'ss', 'rr', 'free=n', par)
fdmod.wom('wom', 'wfl', 'velo', 2.5, par)

Result('wom', fdmod.wgrey('pclip=97', par))
for i in range(0, par['nt']/par['jsnap'], 10):
    fdmod.wframe('wom−' + str(i), 'wom', i, 'pclip=97', par)

Result('dat', 'transp | ' + fdmod.dgrey('pclip=99', par))
MADAGASCAR resources

▶ introduction to MADAGASCAR

▶ guide to MADAGASCAR programs
   http://rsf.sourceforge.net/wiki/index.php/Programs

▶ guide to MADAGASCAR file format

▶ guide to MADAGASCAR API