http://www.ahay.org

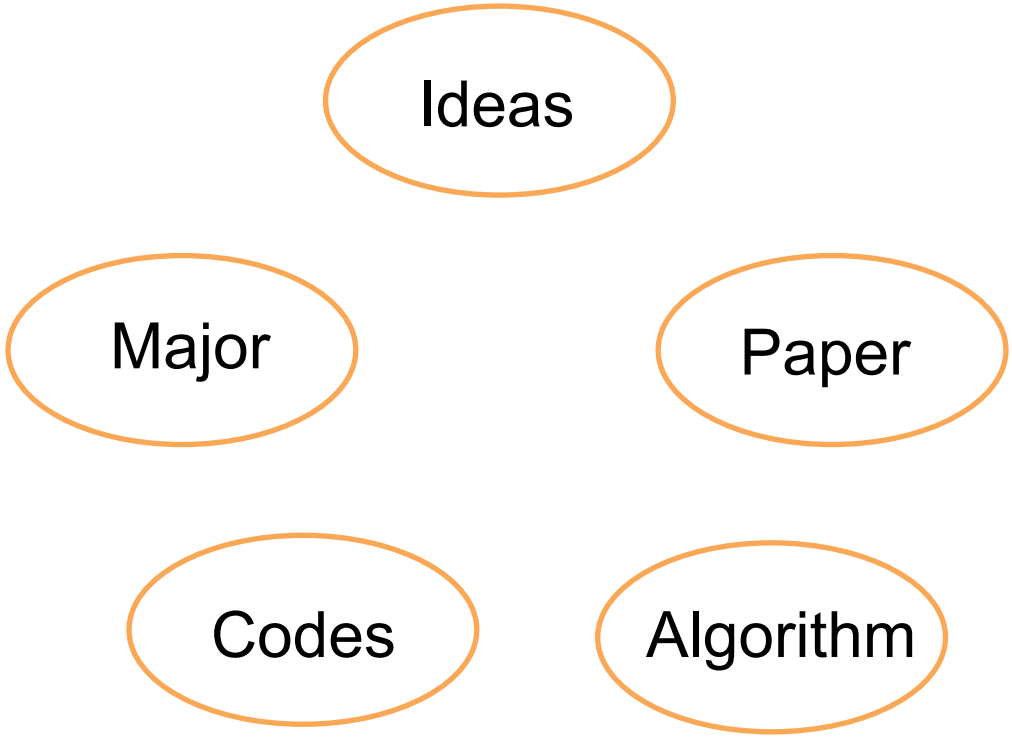
My travel along with Madagascar

Dong Han

Elastic wave exploration project

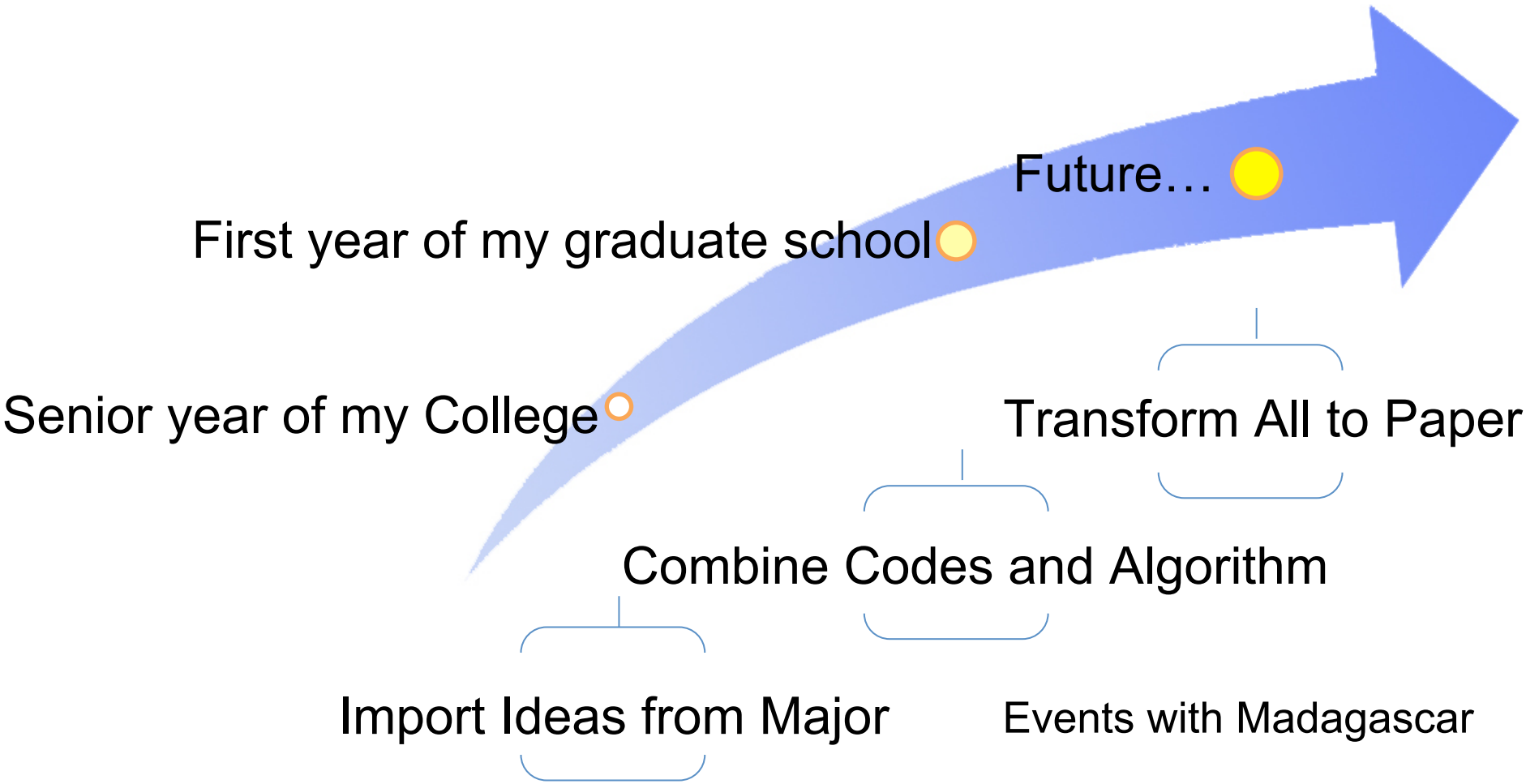
China University of Petroleum(East China)

My travel along with Madagascar



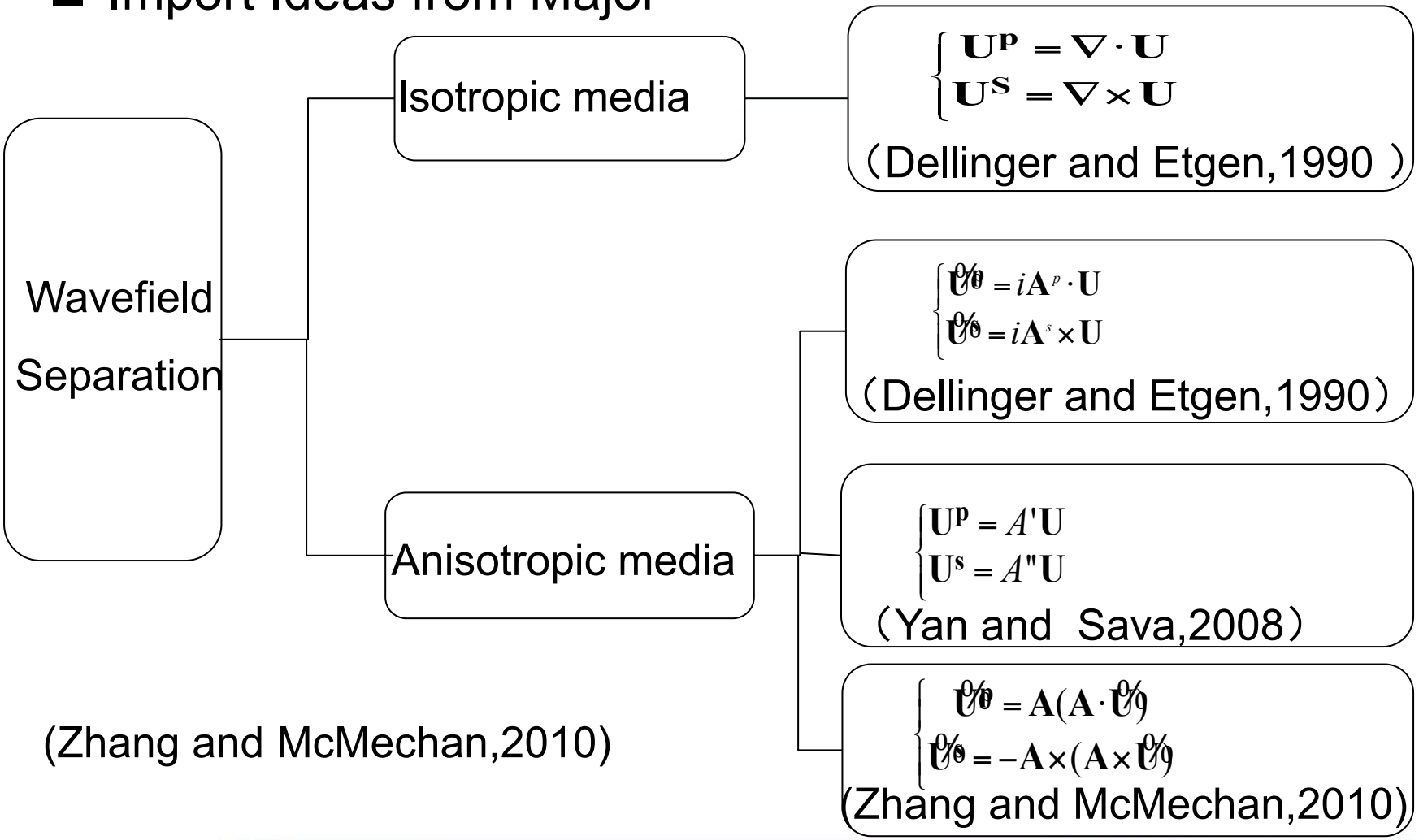
Study Life Segments (Const Segment Fault &Nope)

My travel along with Madagascar



My travel along with Madagascar

- Import Ideas from Major

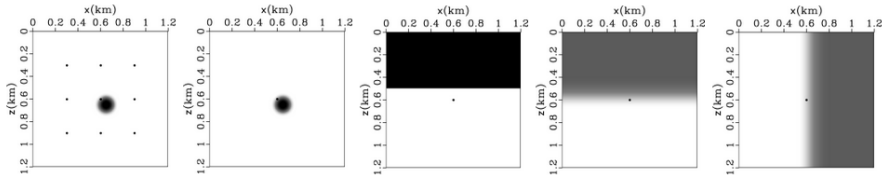


(Zhang and McMechan,2010)

My travel along with Madagascar

Import Ideas from Major

Figure 13(a) shows the vertical and horizontal components of one snapshot of the simulated elastic anisotropic wavefield, Figure 13(b) shows the separation to qP and qS modes using conventional isotropic $\nabla\cdot$ and $\nabla\times$ operators, and Figure 13(c) shows the mode separation obtained using the pseudo operators constructed using the local medium parameters. A comparison of Figure 13(b) and 13(c) indicates that the spatially-varying derivative operators successfully separate the elastic wavefields into qP and qS modes, while the $\nabla\cdot$ and $\nabla\times$ operators only work in the isotropic region of the model.



aoppos, vs, ro, epsilon, delta

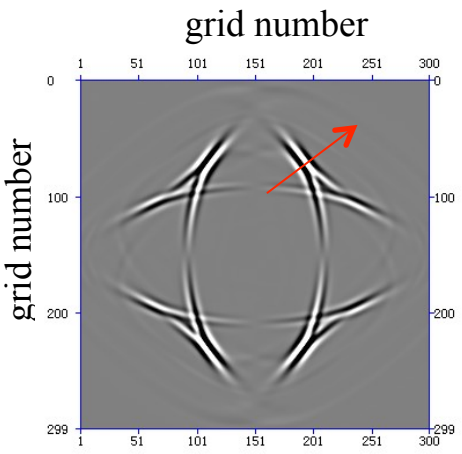
Figure 10. A 1.2 km $\times$ 1.2 km model with parameters (a) $V_{p0}=3$ km/s except for a low velocity Gaussian anomaly around $x=0.65$ km and $z=0.65$ km, (b) $V_{S0}=1.5$ km/s except for a low velocity Gaussian anomaly around $x=0.65$ km and $z=0.65$ km, (c) $\rho=1.0$ g/cm^3 in the top layer and 2.0 g/cm^3 in the bottom layer, (d) ϵ smoothly varying from 0 to 0.25 from top to bottom, (e) δ smoothly varying from 0 to -0.29 from left to right. A vertical point force source is located at $x=0.6$ km and $z=0.6$ km shown by the dot in panels (b), (c), (d), and (e). The dots in panel (a) correspond to the locations of the anisotropic operators shown in Figure 12 .

- Time-shift imaging condition in seismic migration by *Paul Sava and Sergey Fomel*: Geophysics, 71 , no. 6, S209-S217, (2006)
- Nonhyperbolic reflection moveout of P-waves: An overview and comparison of reasons by *Sergey Fomel and Vladimir Grechka*: Center for Wave Phenomena, CWP-372 (2001)

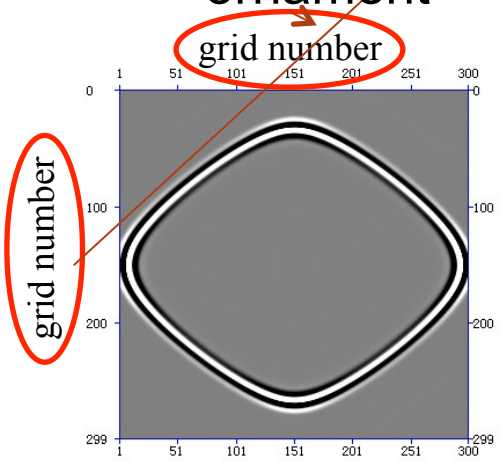
Obtian Information form Website

v_{p0} m/s	3000
v_{s0} m/s	1500
ρ kg/m^3	2000
δ	-0.29
ε	0.25

Homogeneous VTI Model



Additional ornament



My travel along with Madagascar

Combine Codes and Algorithm

- Command Line

sfspike

Generate simple data: spikes, boxes, planes, constants.		
sfspike > spike.rsf mag= nsp=1 k#=[0,...] l#=[k1,k2,...] p#=[0,...] n#= o#=[0,0,...] d#=[0.004,0.1,0.1,...] label#=[Time,Distance,Distance,...] unit#=[s,km,km,...] title=		
Spike positioning is given in samples and starts with 1.		
float	**d#=[0.004,0.1,0.1,...]**	sampling on #-th axis
ints	**k#=[0,...]**	spike starting position [nsp]
ints	**l#=[k1,k2,...]**	spike ending position [nsp]
string	**label#=[Time,Distance,Distance,...]**	label on #-th axis
floats	**mag=**	spike magnitudes [nsp]
int	**n#=**	size of #-th axis
int	**nsp=1**	Number of spikes
float	**o#=[0,0,...]**	origin on #-th axis
floats	**p#=[0,...]**	spike inclination (in samples) [nsp]
string	**title=**	title for plots
string	**unit#=[s,km,km,...]**	unit on #-th axis

```
[2]+  Done                    gedit run-plot.sh
[handong@AMAX dhan]$ vpconvert format=jpg bgcolor=white ahspike.vpl
/home/handong/madargarscar/madagascar-install/bin/jpegpen bgcolor=white ahspike.vpl > ahspike.j
pg
[handong@AMAX dhan]$ sfspike n1=5 n2=3 nsp=3 k1=1,3,4 k2=1,2,3 >ahspike.rsf
```

My travel along with Madagascar

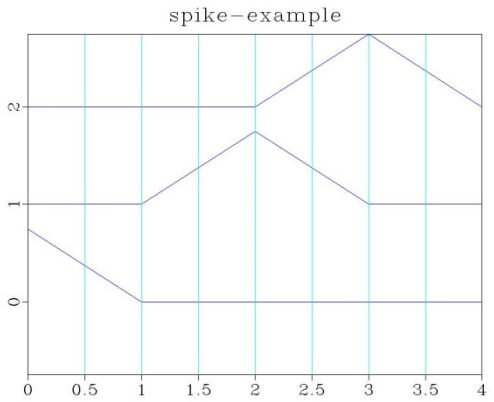
Combine Codes and Algorithm

- Command Line

```
[handong@AMAX dhan]$ vpconvert format=jpg bgcolor=white ahspike.vpl
/home/handong/madargarscar/madagascar-install/bin/jpegpen bgcolor=white ahspike.vpl > ahspike.j
pg
[handong@AMAX dhan]$ sfwiggle<ahspike.rsf >ahspike.vpl
```

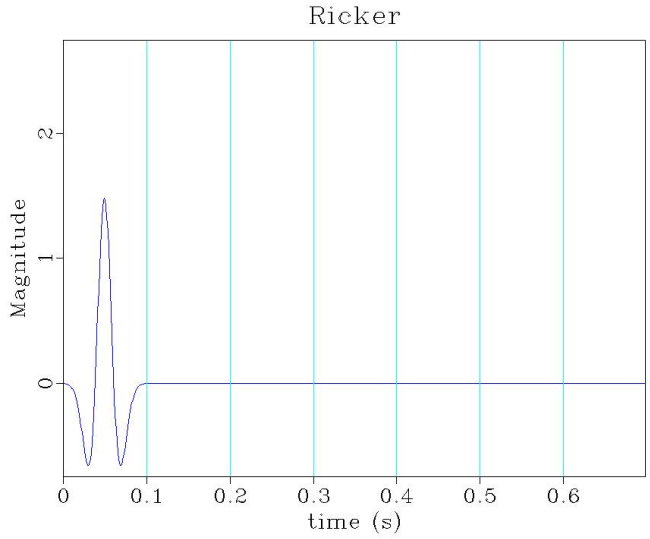
```
[handong@AMAX dhan]$ sfin ahspike.rsf
ahspike.rsf:
    in="./ahspike.rsf@"
    esize=4 type=float form=native
    n1=5            d1=1            o1=0          label1="" unit1=""
    n2=3            d2=1            o2=0          label2="" unit2=""
        15 elements 60 bytes
[handong@AMAX dhan]$
```

- sfwiggle
- sfgrey
- sfgrey3
- sfpen
- …



- Combine Codes and Algorithm
  - Command Line

```
sfspike n1=700  d1=0.001 k1=50 | sfricker1 frequency=35 | \
 sfscale axis=1> wavelet.rsf
sfput<wavelet.rsf label1='time' unit1='s' label2='Magnitude' \
tittle='Ricker' | sfwiggle xmax=2 > wavelet.vpl
vpconvert wavelet.vpl format=jpg bgcolor=white
```



My travel along with Madagascar

■ Combine Codes and Algorithm

Table 2.5 parameter of the media

layer	V_p m/s	ρ kg/m^3
1	1500	1000
2	3000	2000
3	3500	3000

Then, we can construct the depression model and describes the models as follow:

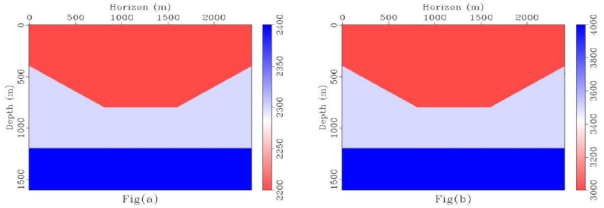


Figure2.16 model of density(a)and velocity(b)without debris

Table 2.6 model parameter

layer	V_p m/s	ρ kg/m^3
1	1500	1000
2	3000	2000
3	3500	3000
Debris	4000	6000

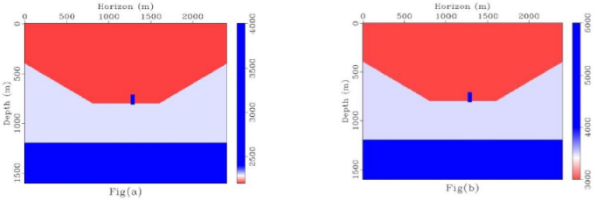


Figure2.17 model of density(a)and velocity(b)with debris

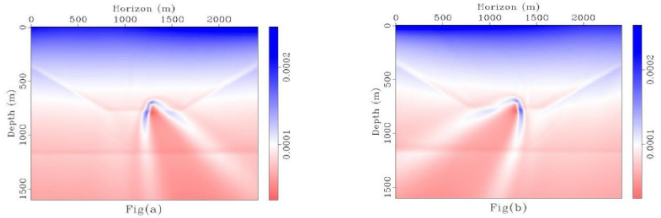


Figure2.18 illumination result (a) excitation on (50,0) of x-z section, (b) excitation on (200,0) of x-z section

Then we can gain the modeling results using models which describe as the Figure2.16and Figure2.17 shown:

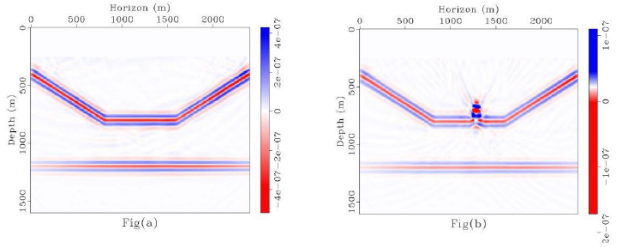


Figure2.19 modeling results: (a)the result without debris (b) the result with debris

Our Paper for Mathematic Contest in Modeling(My work→RTM part)

My travel along with Madagascar

■ Combine Codes and Algorithm

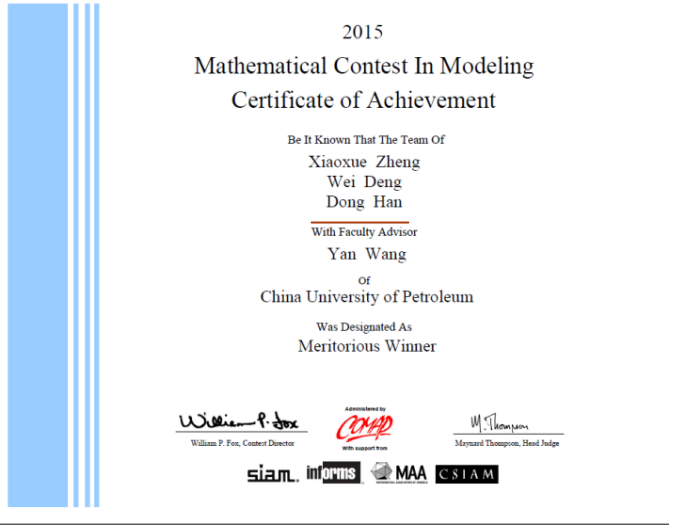
A Synthesized Analysis Method for Defining the Optimal Searching Area

Abstract

We try to shrink the searching area in the paper based on probability analysis and numerical simulation of wave equation, which is the innovation of this paper. We divide the work into two parts.

In the first part, our aim is to get the crashed plane's locations. Based on certain assumptions, we firstly build a dynamic model for the process of the crash, which is from falling point to seabed. Then we analyze the probability distribution of various cases which are the combinations of different environmental impact factors such as wind and current. With the Bayesian theory related to modeling probability and the real location, we obtain the maximum probability distribution and an optimizing-zone with the statistical data. Finally, we use different types of aircraft to test the model.

In the second part, we build two equivalent models of seabed with debris and without



2015

Mathematical Contest In Modeling

Certificate of Achievement

Be It Known That The Team Of

Xiaoxue Zheng

Wei Deng

Dong Han

With Faculty Advisor

Yan Wang

of

China University of Petroleum

Was Designated As

Meritorious Winner

William P. Fox, Contest Director

Maynard Thompson, Head Judge

siam. INFORMS MAA CSIAM

Honor to be Captain and Entitle Our Paper

My travel along with Madagascar

- Combine Codes and Algorithm
  - Shell Script and Program using C and C++ based on Madagascar Platform

```
[handong@AMAX user]$ ls
aklokov   chenyk  fomels   hsa       jingwei    karl      petsc     rickettj       slim      xuxin
bash      cram    gchliu   hzhu      jmonsegny  kourkina  poulsonj  rweiss         songxl    yliu
browaeys  cuda    gee      ivlad     jsun       lcasasan  psava     saragiotis     tariq     zone
chen      dhan    godwinj  jeff      jun        lexing    pwd       seisinv        tsai
chengjb   ediazp  hpcss    jennings  jyan       llisiw    pyang     seplib_compat  urdaneta
[handong@AMAX user]$ pwd
/home/handong/madargarscar/madagascar-1.6.5/user
```

Make My Subdirectory under $RSFSRC/usr

```
Manidemod.c          run-aniederiv2d.sh          run-plot.sh          SConstruct~
Manidemod.c~         run-animod.sh               run-plot.sh~         sfanidemod
Manidemod.o          run-animod.sh~              run-rsgfd2.sh        sfersgfdnonpml
Mersgfdnonpml.c      run-ernpml.sh               run-rsgfdmod.sh      sfersgfdwithnpml
Mersgfdnonpml.o      run-ernpml.sh~              run-sepomp.sh        sfersgfdwithnpmlBRI3Ec
Mersgfdwithnpml.c    run-ersgfdwithoutnpml.sh    run-sepomp.sh~       sfersgfdwithnpmljjFEVR
Mersgfdwithnpml.c~   run-esgfd2-ah.sh            run-sep.sh           sfersgfdwithnpmlKV2O1R
Mersgfdwithnpml.o    run-esgfd2.sh               run-sep.sh~          sfersgfdwithnpmlrVXCox
Mesgfdwithoupml.c    run-esgfd2withpml.sh        run-sgfd2.sh         sfersgfdwithnpmlsMb1yc
Mesgfdwithoupml.o    run-esgfdwithpml.sh         run-sglfd2.sh        sfersgfdwithnpmlwDYkix
Mesgfdwithpml.c      run-esgfdwithpml.sh~        run-sglfd2.sh~       sfesgfdwithoupml
Mesgfdwithpml.c~     run-expandmodel.sh          run-sglfdrtm2.sh     sfesgfdwithpml
Mesgfdwithpml.o      run-lrcoe.sh                run-smooth.sh        sfexpand
Mextract.c           run-lrcoe.sh~               run-smooth.sh~       sfextract
Mextract.c~          run-matrixdecline.sh        run-wave.sh          sfsep
Mextract.o           run-matrixdecline.sh~       SConstruct           sfsgfd2withoutpml
```

My Codes based on Madgascar

My travel along with Madagascar

- Combine Codes and Algorithm

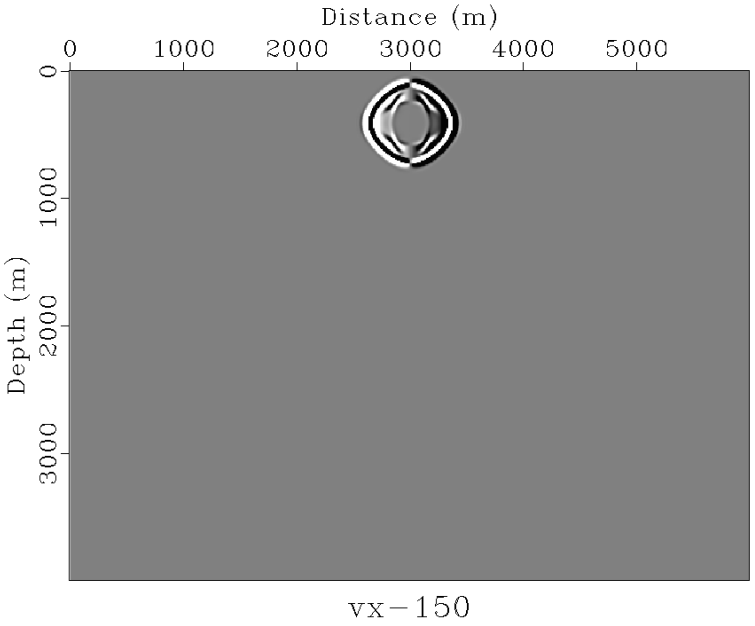
```
/*************************************************************************
 * * Forward propagating using 1-order Stress and Velocity elastic equation
 *   with RSGFD in VTI media(5/28/2015,Arthur Han)
 *
 * ************************************************************************/
/*
  Copyright (C) 2015 China University of petroleum(East China), Tsingtao, China
  Authors: Arthur Han (Dong Han<Chinese>)
  WorkPlace: YiFu Building,Room 328, Tsingtao,UPC,266580
  Contact: arthurhan328@gmail.com
#!/bin/sh
#Copyright (c) 2015 China University of Petroleum(EAST CHINA)
#All rights reserved
#Author                : Arthur Han(Dong Han<Chinese>)
#Data                  : 5/16/2015
#WorkPlace             : YiFu Building,Room 328, Tsingtao,UPC,266580
#Contact               : arthurhan_328@gmail.com
#Script Description:
#                        Script 1  Realize 2-D  staggered grid finite-difference wave extrapolation in isotropic media
#=======================================================================================================|
#inputfile             : Fden.rsf--> the density file
#outputfile            : Fsnapx.rsf --> the snapshots in x direction
#*******************************************************************************************************
#parameter of the commond
#
#c11                   : the c11 file
#c13                   : the c13 file
#c33                   : the c33 file
#c44                   : the c44 file
#wavelet               : the wavelet file
#size                  : the half order of FD
#spx                   : the source position in x direction
#spz                   : the source position in z direction
```

```
#!/bin/sh
#Copyright (c) 2015 China University of Petroleum(EAST CHINA)
#All rights reserved
#Author                : Arthur Han(Dong Han<Chinese>)
#Data                  : 5/16/2015
#WorkPlace             : YiFu Building,Room 328, Tsingtao,UPC,266580
#Contact               : arthurhan_328@gmail.com
#Script Description:
#                        Script 1  Plot the wavefield
file=fzdel-spacedomain
nx=64
nz=64
dx=1
dz=1
        sfwindow<$file.rsf j3=10|sfput title='(b)' label1=' ' unit1='' label2=' ' unit2=''   |sfgrey gainpanel=all n1=$nz d1=$dz n2=$nx d2=$dx o1=0 o2=0        pclip=99 \
        color=e scalebar=n mean=y >$file.vpl
        vpconvert format=jpg bgcolor=white $file.vpl
        sfpen $file.vpl
#sfgrey<$file.rsf gainpanel=all |sfpen
```

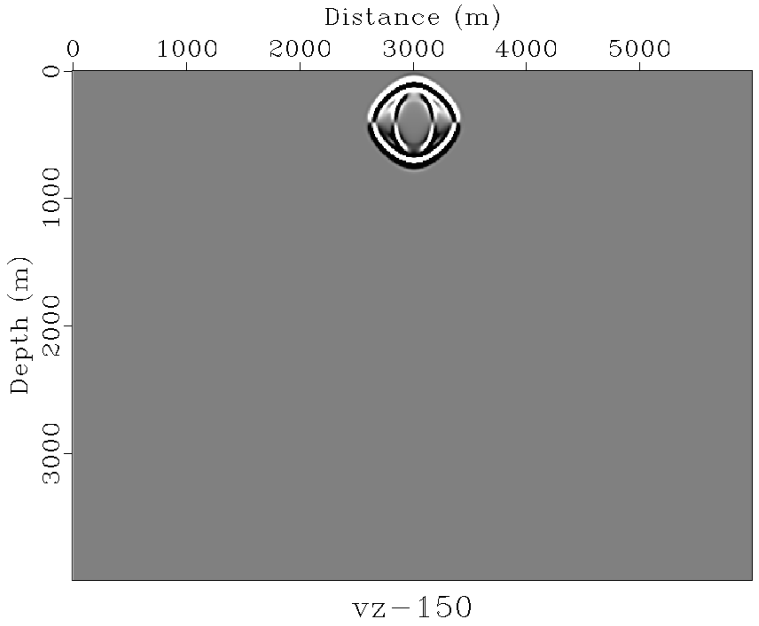
Fragments of Codes and Shell Scripts

My travel along with Madagascar

- Combine Codes and Algorithm
  - Snapshots of the particle velocities



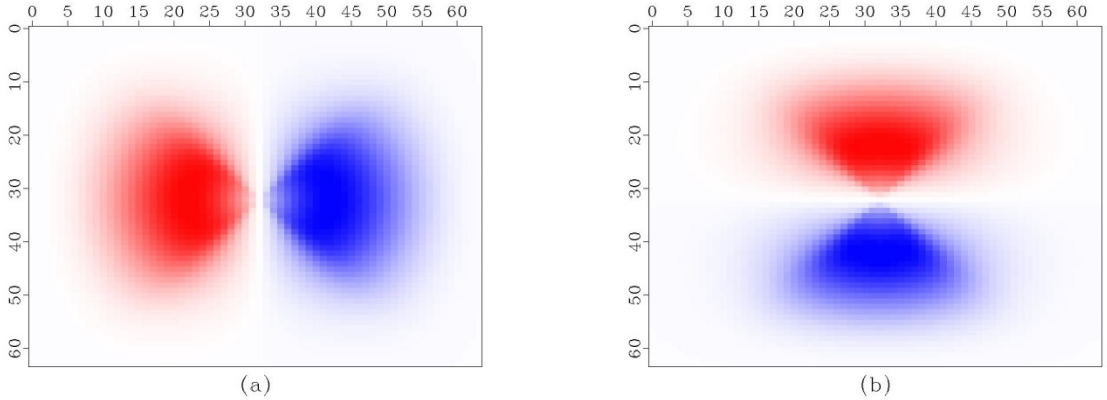
X-Component Snapshots



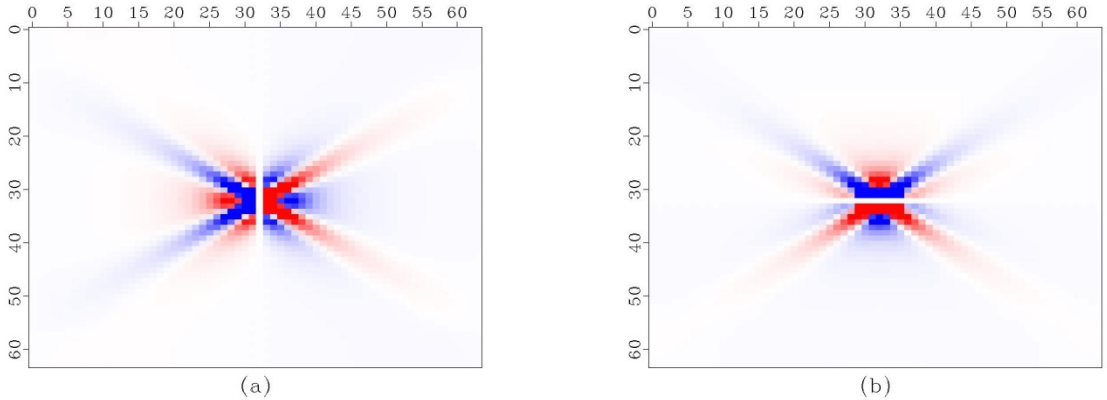
Z-Component Snapshots

My travel along with Madagascar

- Combine Codes and Algorithm
  - Separation operators



Wavenumber domain

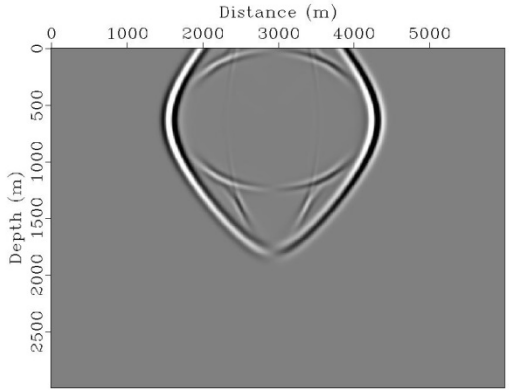


Space domain

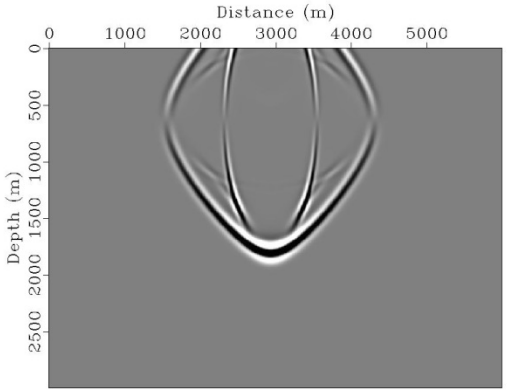
My travel along with Madagascar

- Combine Codes and Algorithm
  - Snapshots and Separation results

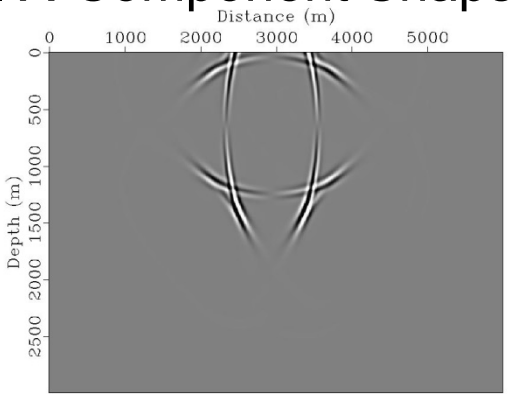
v_{p0} m/s	3000
v_{s0} m/s	1500
ρ kg/m^3	2000
δ	-0.29
ε	0.25



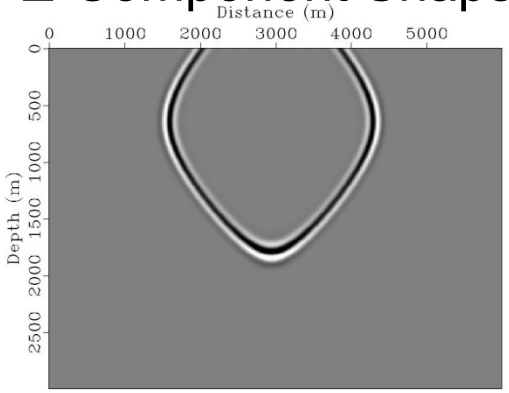
Homogeneous VTI Model X-Component Snapshot



Z-Component Snapshot



qS-Wave



qP-Wave

My travel along with Madagascar

- Transform All to Paper
  - Construct SConstruct File utilizing Python

```
##
 # elastic modeling; wavefield separation operators
 # with different combinations of epsilon and delta
 ##

from rsf.proj import *
import sys
import fdmod,fdd,apk,stiff
# ------------------------------------------------------------
par = {
    'nx':600, 'ox':0, 'dx':0.002,  'lx':'x', 'ux':'km',
    'nz':600, 'oz':0, 'dz':0.002,  'lz':'z', 'uz':'km',
    'nt':1601,'ot':0, 'dt':0.0002, 'lt':'t', 'ut':'s',
    'kt':150,
    'jsnap':200,
    'height':10,
    'nb':0,
    'frq':75,
    'ratio':1
    }
fdmod.param(par)
```

  - Write Some Papers based on Latex

- Suggestions
  - Write some Makefile just like Intel to Make Installment Easier

Thanks for your listening

Dong Han &

arthurhan328@gmail.com http://www.ahay.org