seismic imaging tutorial

“exploding reflector” modeling/migration

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assignment

modify the acquisition parameters to explore the illumination at different locations in the subsurface

import packages

```
from rsf.proj import *
import sigsbee
import rsf.recipes.fdmod as fdmod
```

import packages

- `sigsbee`: model-specific python module
- `fdmod`: generic modeling and plotting module

setup main parameters

```
par=sigsbee.paramwin() # Sigsbee2A parameters
par['nt']=2001         # time steps (samples)
par['kt']=100          # wavelet delay (samples)
par['dt']=0.001        # time sampling (ms)
par['nb']=100          # boundary (grid points)
fdmod.param(par)       # plotting parameters
```

setup main parameters

- `par`: dictionary containing all parameters
- override parameters in the `SConstruct`

source coordinates

```
# source coordinates (exploding reflectors)
fdmod.boxarray('ss',5,2,1,12,8,1,par)

# plot sources
Plot('ss',fdmod.ssplot('plotfat=10 symbol=.',par))
```

source coordinates

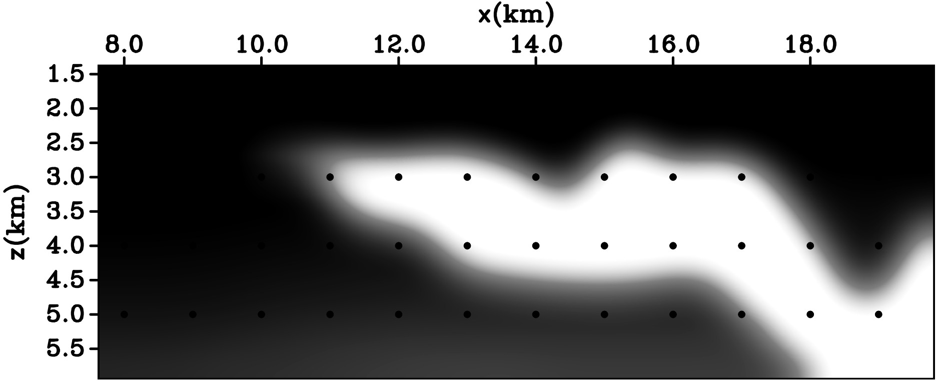
- `5,2,1`: *n*, *o*, *d* in the z direction
- `12,8,1`: *n*, *o*, *d* in the x direction

receiver coordinates

```
par['jr']=4    # receiver jump (grid points)
par['nr']=100  # number of receivers
par['fr']=500  # receivers origin (grid points)

# receiver coordinates
fdmod.horizontal('tt',par['oz']+par['dz'],par)
Flow('rr',
     'tt',
     'window n2=%(nr)d j2=%(jr)d f2=%(fr)d'%par)

# plot receivers
Plot('rr',fdmod.rrplot('plotfat=10',par))
```

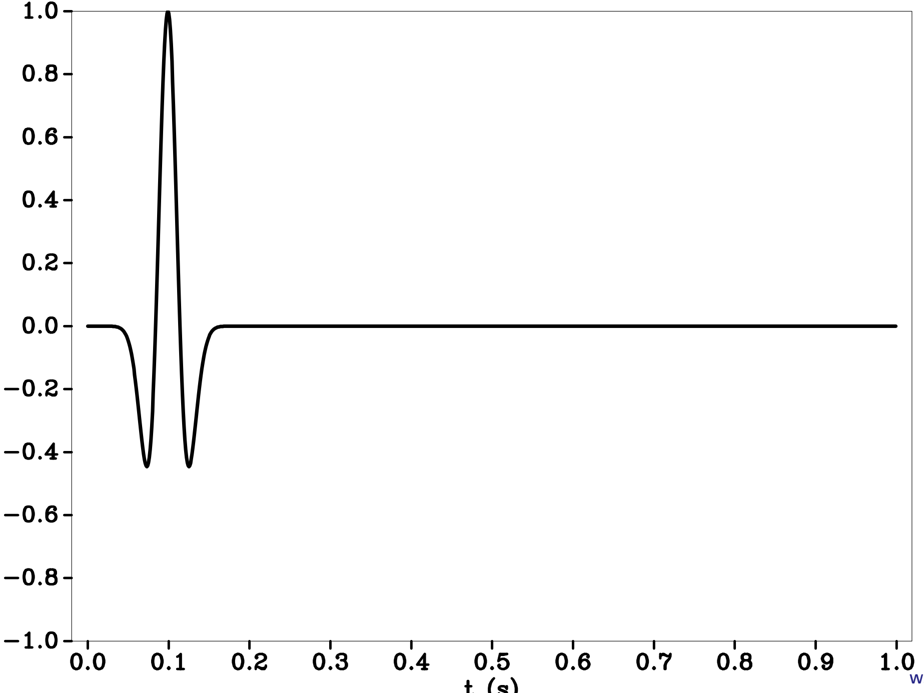
velocity/density models

```
# get velocity
sigsbee.getstrvelwin('vstr',par)
Flow(   'velo',
        'vstr',
        'smooth rect1=100 rect2=100 repeat=1')

# plot velocity
Plot(   'velo',fdmod.cgrey('allpos=y bias=1.43',par)
Result('velo',['velo','ss','rr'],'Overlay')

# density
Flow('dens','velo','math output=1')
```


x(km)
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

source wavelet

```
# construct wavelet
fdmod.wavelet('wav_',15,par)

# transpose wavelet
Flow(   'wav','wav_','transp')

# plot wavelet
Result('wav','window n2=1000 |'
        + fdmod.waveplot('',par))
```



WSI

FD modeling

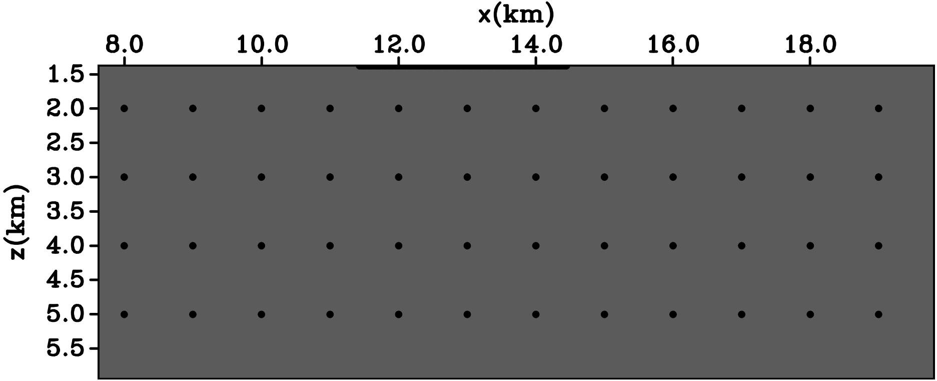
```
# run FD modeling
fdmod.awefd1('temp','wfld',
             'wav','velo','dens',
             'ss','rr',
             'free=n',par)
```

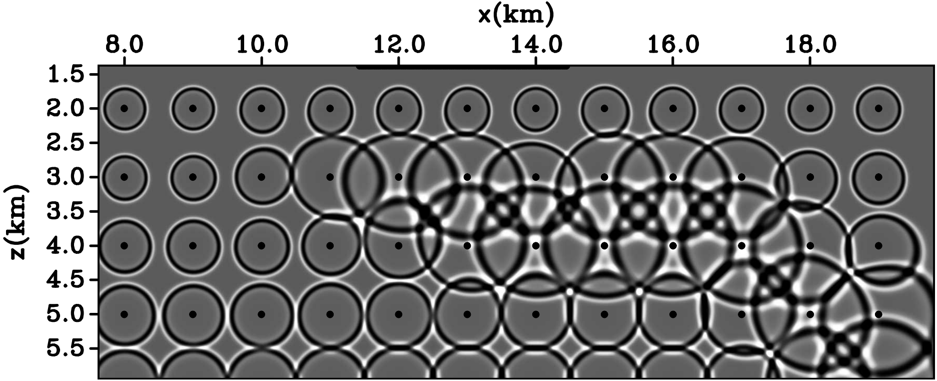
FD modeling parameters

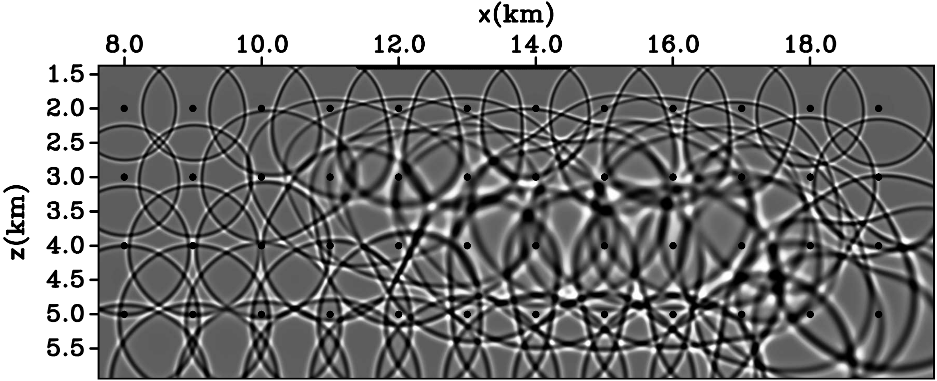
data,
wavefield,
wavelet,
velocity,
density,
source coordinates,
receiver coordinates,
optional parameters,
parameter dictionary

plot wavefield

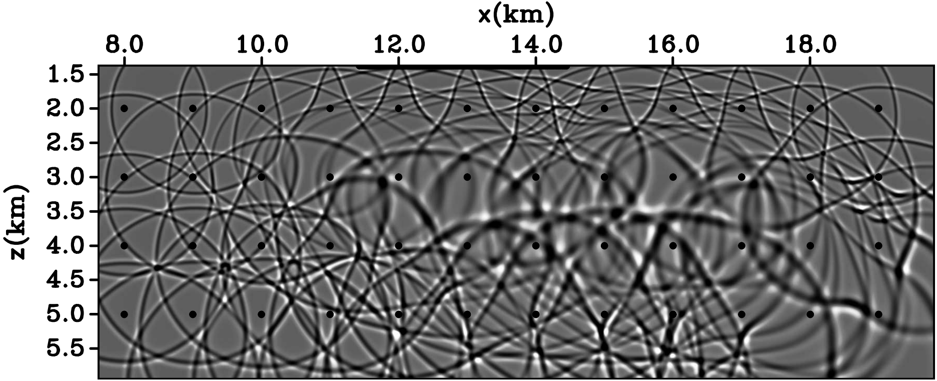
```
# generate wavefield movie
Plot('wfld',fdmod.wgrey('pclip=99',par),view=1)

# plot wavefield frames
for i in range(7):
    tag = '-%02d' %(i)
    fdmod.wframe('wfld'+tag,
                 'wfld',i,'pclip=99',par)
    Result( 'wfld'+tag,
           ['wfld'+tag,'ss','rr'],'Overlay')
```


x(km)
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5


x(km)
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5



WSI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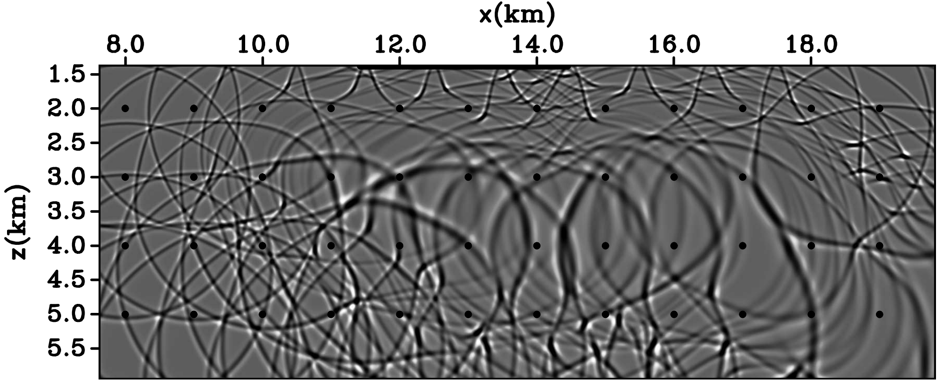
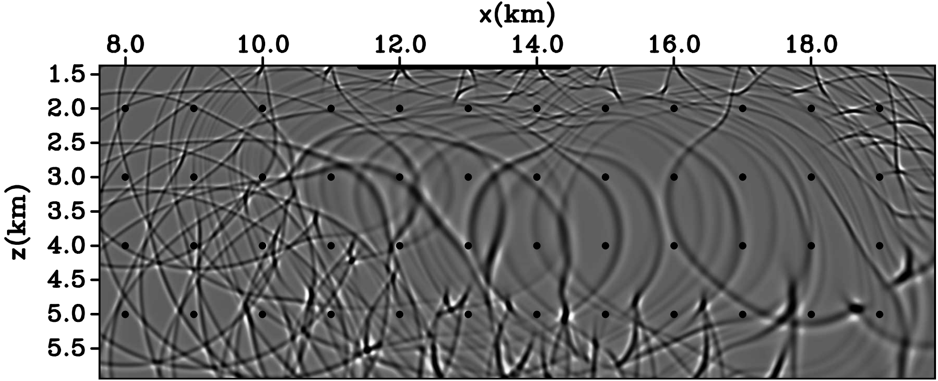
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5



WSI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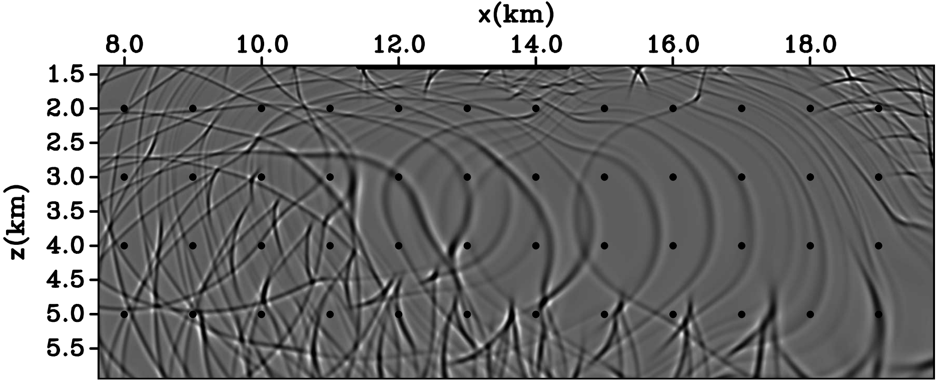
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5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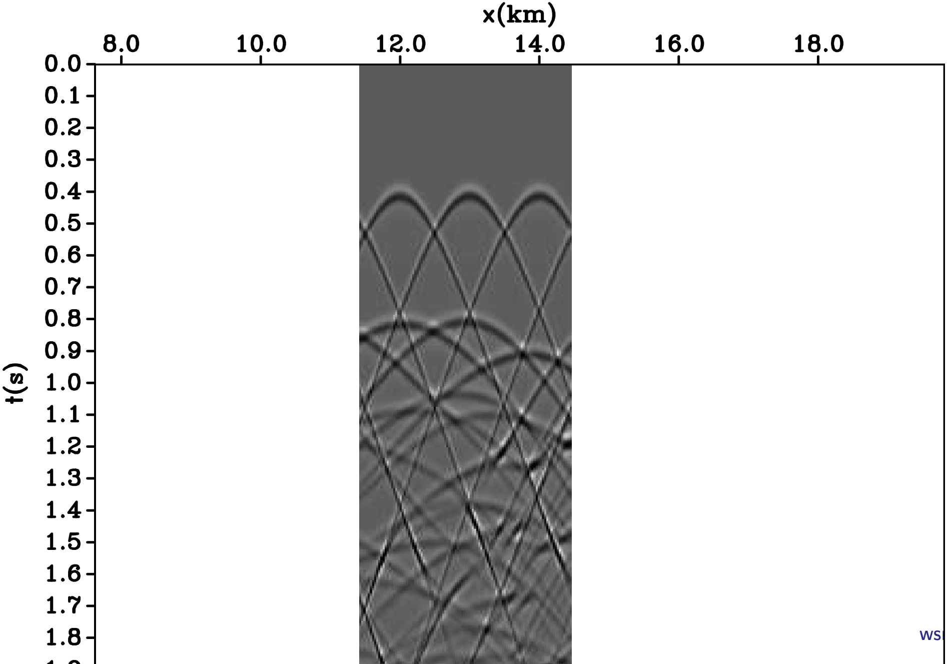
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

plot data

```
# undo wavelet delay
Flow('data','temp',
     '''
     window squeeze=n f2=%(kt)d |
     pad end2=%(kt)d |
     put o2=%(ot)g
     ''' %par)

# plot data
Result('data','window j2=4 | transp |'
       + fdmod.dgrey('',par))
```


x(km)
8.0
10.0
12.0
14.0
16.0
18.0
t(s)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8

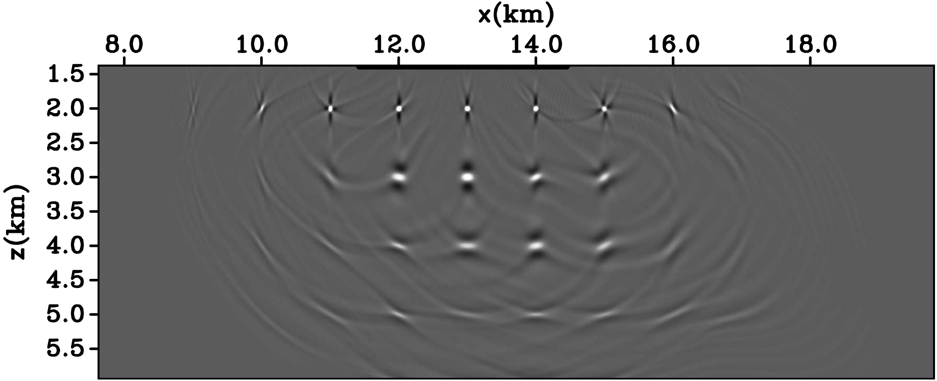
ws

FD migration

```
# run FD migration
fdmod.zom('imag','jdat',
          'data','velo','dens',
          'rr','rr',
          'free=n',par)
```

plot image

```
# plot image
Plot(    'imag','bandpass flo=2 |'
        + fdmod.cgrey('pclip=99.99',par))
Result('imag',['imag','rr'],'Overlay')
```


x(km)
8.0
10.0
12.0
14.0
16.0
18.0
z(km)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

closing rules

End ( )

the contest

Assuming that each receiver costs a fixed amount of \$, construct the receiver array that gives you the best image for the lowest cost.

- you can consider multiple arrays
- you can place the receivers anywhere on the surface

http://reproducibility.org

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