Accuracy of the DSR-PS stacking operator

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Introduction

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Define working folder, add links to Library and SeisLab

```
clear; close all; clc;
mlibfolder = '/home/zmaw/u250128/Desktop/MLIB';
path(path, mlibfolder);
addmypath;
current_folder = pwd;
```

Define model parameters (See table 4.1):

```
alpha = pi/6;               % radian
Rnip = 0.5;                 % km
Rn   = 1.0;                 % km
Vp   = 2.5;                 % km/s
Vs   = 1.8;                 % km/s
modelPS = [alpha, Rnip, Rn, Vp, Vs];
modelPP = [alpha, Rnip, Rn, Vp, Vp];

gamma = Vp/Vs;
sigma = (gamma-1)/(gamma+1);
upsilon = 2/(gamma+1);
```

Set offset and midpoint displacement

```
m = -0.5:0.010:0.5;
```

```
h = -0.0:0.010:2.0;

[M,H]=meshgrid(m,h);

%make gamma-CMP coordinates
tH = upsilon*H;
tM = M + sigma*H;
```

Part I: Calculate traveltimes of PP and PS waves

```
[TePP,~] = Get_traveltime_2D_exact(M,H,modelPP);
[TePS,~] = Get_traveltime_2D_exact(M,H,modelPS);
[T6PS,~] = Get_traveltime_2D_sixth_order(M, H, modelPS);
```

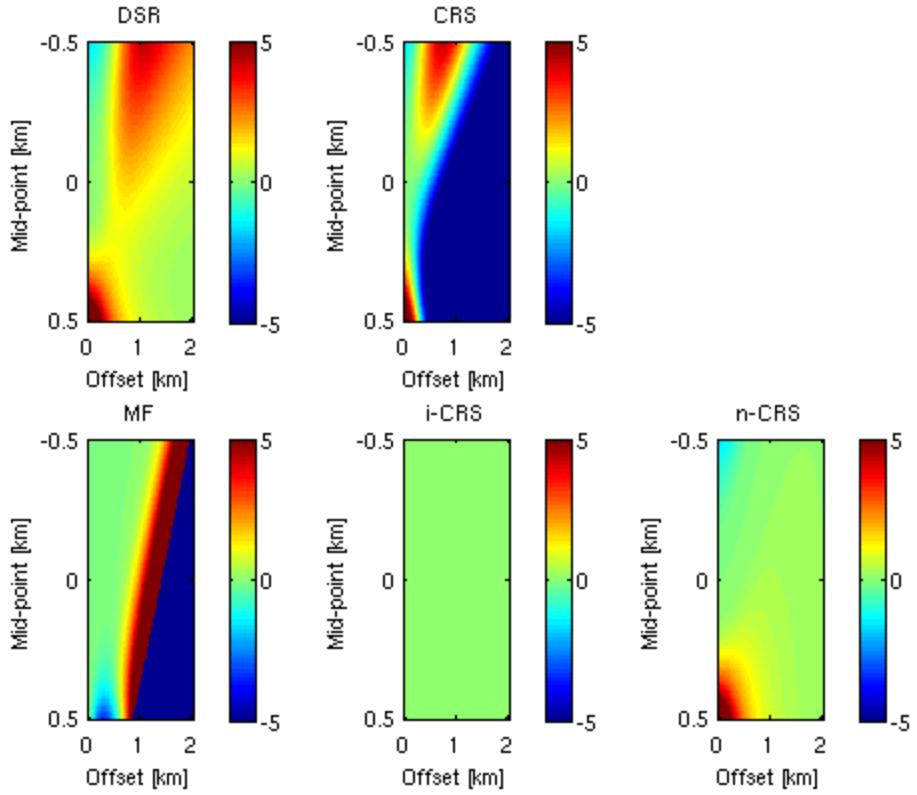
Part II: Find traveltime approximation for PP and PS waves

```
% PP approximations
T_CRS     = Get_traveltime_2D_CRS(M, H, modelPP);
T_MF      = Get_traveltime_2D_MF(M, H, modelPP);
T_iCRS    = Get_traveltime_2D_iCRS(M, H, modelPP);
T_nCRS    = Get_traveltime_2D_nCRS(M, H, modelPP);
T_DSR_PP  = Get_traveltime_2D_DSR_PS(M, H, modelPP);

% PS approximations
T_DSR_PS  = Get_traveltime_2D_DSR_PS(M, H, modelPS);
T_CRS_PS  = Get_traveltime_2D_CRS_PS(M, H, modelPS);
T_nCRS_PS = Get_traveltime_2D_nCRS_PS(M, H, modelPS);
```

Part III: Compare PP approximations

```
% Plot results
figure(1)
%
subplot(2,3,1)
data = (T_DSR_PP'-TePP')./TePP'*100;
imagesc(h,m',flipud(data))
title('DSR')
xlabel('Offset [km]');
ylabel('Mid-point [km]');
colorbar
colormap('Jet');
caxis([-5 5])
%
subplot(2,3,2)
data = (T_CRS'-TePP')./TePP'*100;
imagesc(h,m',flipud(data))
title('CRS')
xlabel('Offset [km]');
```

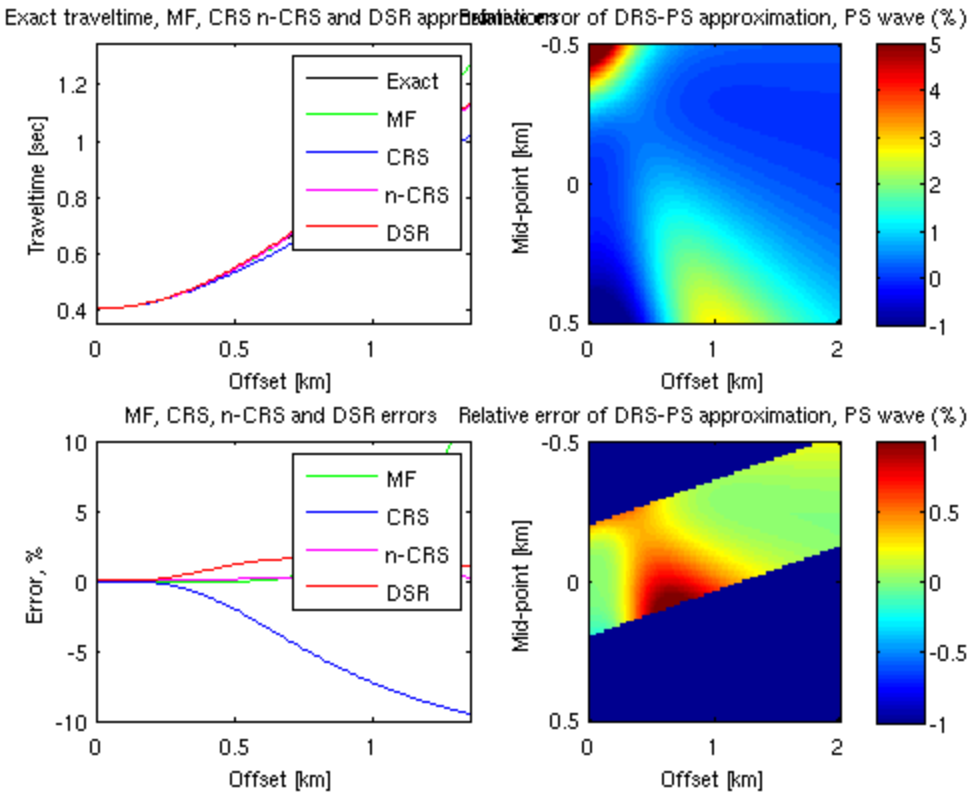
```
ylabel('Mid-point [km]');
colorbar
colormap('Jet');
caxis([-5 5])
%
subplot(2,3,4)
data = (T_MF'-TePP')./TePP'*100;
imagesc(h,m',flipud(data))
title('MF')
xlabel('Offset [km]');
ylabel('Mid-point [km]');
colorbar
colormap('Jet');
caxis([-5 5])
%
subplot(2,3,5)
data = (T_iCRS'-TePP')./TePP'*100;
imagesc(h,m',flipud(data))
title('i-CRS')
xlabel('Offset [km]');
ylabel('Mid-point [km]');
colorbar
colormap('Jet');
caxis([-5 5])
%
subplot(2,3,6)
data = (T_nCRS'-TePP')./TePP'*100;
imagesc(h,m',flipud(data))
title('n-CRS')
xlabel('Offset [km]');
ylabel('Mid-point [km]');
colorbar
colormap('Jet');
caxis([-5 5])
```



Part IV Compare PS approximations (old figure)

```
ind = (m==0);
texact = TePP(:, ind);
tMF    = T_MF(:, ind);
tCRS   = T_CRS(:, ind);
tnCRS  = T_nCRS(:, ind);
tDSR   = T_DSR_PP(:, ind);


figure(2)
subplot(2,2,1)
plot(h, texact, 'black');
hold on
plot(h, tMF, 'g');
plot(h, tCRS, 'blue');
plot(h, tnCRS, 'm');
plot(h, tDSR, 'r');
legend('Exact', 'MF', 'CRS', 'n-CRS', 'DSR');
axis([0, 1.35, 0.35, 1.35]);
xlabel('Offset [km]')
ylabel('Traveltime [sec]')
title('Exact traveltime, MF, CRS n-CRS and DSR approximations')
```

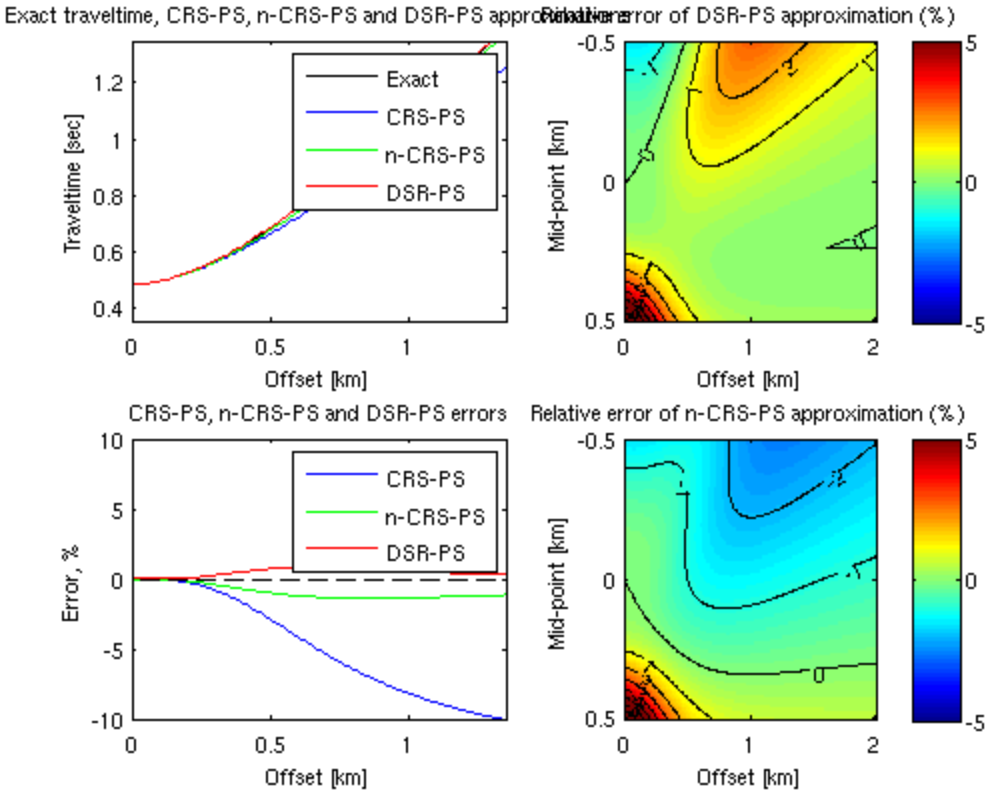
```
subplot(2,2,3)
plot(h, (tMF-texact)./texact*100, 'g');
hold on
plot(h, (tCRS-texact)./texact*100, 'blue');
plot(h, (tnCRS-texact)./texact*100, 'm');
plot(h, (tDSR-texact)./texact*100, 'r');
legend('MF', 'CRS', 'n-CRS', 'DSR');
axis([0, 1.35, -10, 10]);
xlabel('Offset [km]')
ylabel('Error, %')
title('MF, CRS, n-CRS and DSR errors')

subplot(2,2,2)
data = (T_DSR_PS'-TePS')./TePS'*100;
imagesc(h,m,data)
xlabel('Offset [km]');
ylabel('Mid-point [km]');
title('Relative error of DRS-PS approximation, PS wave (%)')
colorbar
colormap('Jet');
caxis([-1 5])

subplot(2,2,4)
filter = (abs(tM)<0.2);
data = (T_DSR_PS'-TePS')./TePS'*100.*filter';
data = data + 100*(filter'-1);
imagesc(h,m,data)
xlabel('Offset [km]');
ylabel('Mid-point [km]');
title('Relative error of DRS-PS approximation, PS wave (%)')
colorbar
colormap('Jet');
caxis([-1 1])
```



Part V Compare PS approximations (old figure)

```
ind = (m==0);
texact  = TePS(:, ind);
tCRSPS  = T_CRS_PS(:, ind);
tnCRSPS = T_nCRS_PS(:, ind);
tDSRPS  = T_DSR_PS(:, ind);

figure(3)
subplot(2,2,1)
plot(h, texact, 'black');
hold on
plot(h, tCRSPS, 'blue');
plot(h, tnCRSPS, 'g');
plot(h, tDSRPS, 'r');
legend('Exact', 'CRS-PS', 'n-CRS-PS', 'DSR-PS');
axis([0, 1.35, 0.35, 1.35]);
xlabel('Offset [km]')
ylabel('Traveltime [sec]')
title('Exact traveltime, CRS-PS, n-CRS-PS and DSR-PS approximations')

subplot(2,2,3)
plot(h, (tCRSPS-texact)./texact*100, 'blue');
hold on
plot(h, (tnCRSPS-texact)./texact*100, 'g');
```

```
plot(h, (tDSRPS-texact)./texact*100, 'r');
plot(h, (texact-texact)./texact*100, '--black');
legend('CRS-PS', 'n-CRS-PS', 'DSR-PS');
axis([0, 1.35, -10, 10]);
xlabel('Offset [km]')
ylabel('Error, %')
title('CRS-PS, n-CRS-PS and DSR-PS errors')

subplot(2,2,2)
data = (T_DSR_PS'-TePS')./TePS'*100;
imagesc(h,m',flipud(data))
xlabel('Offset [km]');
ylabel('Mid-point [km]');
title('Relative error of DSR-PS approximation (%)')
colorbar
colormap('Jet');
caxis([-5 5])
hold on
contour(h,m',flipud(data),'color','k','ShowText','on')

subplot(2,2,4)
data = (T_nCRS_PS'-TePS')./TePS'*100;
imagesc(h,m',flipud(data))
xlabel('Offset [km]');
ylabel('Mid-point [km]');
title('Relative error of n-CRS-PS approximation (%)')
colorbar
colormap('Jet');
caxis([-5 5])
hold on
contour(h,m',flipud(data),'color','k','ShowText','on')
```



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