

Procedures for testing the program

We take Fig. 5(b) in the manuscript as an example to illustrate how to test and use the program.

To reproduce Fig. 5(b), please follow the input introduced below and run the main function file “ASCIB3D.m”. We divided the inputs into different groups so that it will be easier for the users to remember. The procedures of input are

1) input the radius and trajectory of the borehole defined referred to the NED (North(x)-East(y)-Downward(z)) coordinate system.

```
rbh=0.1;% radius of borehole (unit, m)
```

```
traj=[45,45];%traj = [boreholeI boreholeA]: A 1 X 2 vector
```

```
% boreholeI -inclination of the borehole; boreholeA -azimuth of the borehole
```

2) input the far-field stress state applied to the borehole.

```
% Magitude of the stress components
```

```
sigmas=[20 0 0;% The far-field stress tensor in units of MPa (Eqn.8)
```

```
0 10 0;
```

```
0 0 30];
```

```
% Orientation of far-field stress frame defined referred to the NED (North(x)-East(y)-Downward(z)) coordinate system
```

```
orientS=[90,0,90];%orientS=[strikeS,dipS,rakeS]=( $\varphi_s, \delta_s, \gamma_s$ ):a 1 X 3 vector containing the strike,
```

```
dip, and rake of the stress tensor in degrees
```

```
% strikeS- strike of  $\sigma_{xx}-\sigma_{yy}$  plane; dipS- dip angle of  $\sigma_{xx}-\sigma_{yy}$  plane;
```

```
% rakeS- the angle of line rake indicating the direction of  $\sigma_{xx}$  within  $\sigma_{xx}-\sigma_{yy}$  plane
```

3) the borehole fluid pressure.

pw=5.0; % magnitude of wellbore pressure in units of MPa

4) the elastic property of the media.

%Cm is the elastic stiffness matrix in the material coordinate frame in GPa

Cm=[45.2,16.4,19.67,0,0,0;

16.4,45.2,19.67,0,0,0;

19.67,19.67,28,0,0,0;

0,0,0,7.05,0,0;

0,0,0,0,7.05,0;

0,0,0,0,0,14.4];

% Orientation of medium symmetry frame defined referred to the NED (North(x)-East(y)-

Downward(z)) coordinate system

orientM=[120,30,90];%orientM=[strikeM,dipM,rakeM]=(φ_m , δ_m , γ_m): a 1 X 3 vector

containing the strike, dip, and rake of the stiffness matrix in degrees.

%strikeM -strike of the foliation; dipM -dip angle of the foliation; rakeM -the angle of line rake

indicating the direction of lineation

5) the size and mesh of the medium.

geom=[4*rbh,181,361];%geom = [rmedia, n1, n2]: a 1 X 3 vector that describes the geometry

of the set of calculations to be performed

% rmedia -the maximum radial distance into the medium that the calculations are to extend;

% n1 -the number of points calculated along the radial distance;

% n2 -the number of points calculated along the azimuth.

After inputting the data shown above, please run the main function “ASCIB3D.m”. The outputs are the matrices showing the values of the stress components near the borehole including

- 1) sigmarr- n1 X n2 (equaling 181 X 361 in the example case) matrix containing the calculated values for σ_{rr} in MPa;
- 2) sigmass- n1 X n2 matrix containing the calculated values for $\sigma_{\theta\theta}$ in MPa;
- 3) sigmazz- n1 X n2 matrix containing the calculated values for σ_{zz} in MPa;
- 4) sigmasz- n1 X n2 matrix containing the calculated values for $\sigma_{\theta z}$ in MPa;
- 5) sigmarz- n1 X n2 matrix containing the calculated values for σ_{rz} in MPa;
- 6) sigmars- n1 X n2 matrix containing the calculated values for $\sigma_{r\theta}$ in MPa.

It should be noted that the output matrices are in cylindrical co-ordinate frame with the rows indicating the radius and the columns indicating the azimuth. The default setting is that the radius of the media equals four times that of the borehole. Therefore, row 46 in the output matrix of the stress component gives the stress distributed on the contour of the borehole. The stress components inside the borehole (referring to the rows with a number smaller than 46) are all set to be NaN.

The program outputs seven figures. The stress components on the contour of the borehole is plotted in Fig. 1. In the test of the program, this figure should be same to Fig. 6(b) in the manuscript. Fig. 2 to 7 are Pcolor images showing the distribution of stress near the borehole. All output matrices of the stress components referred to the testing case are collected in the six text files in the folder “outputs”. All the seven images referred to the test example produced by the MATLAB program are attached behind.

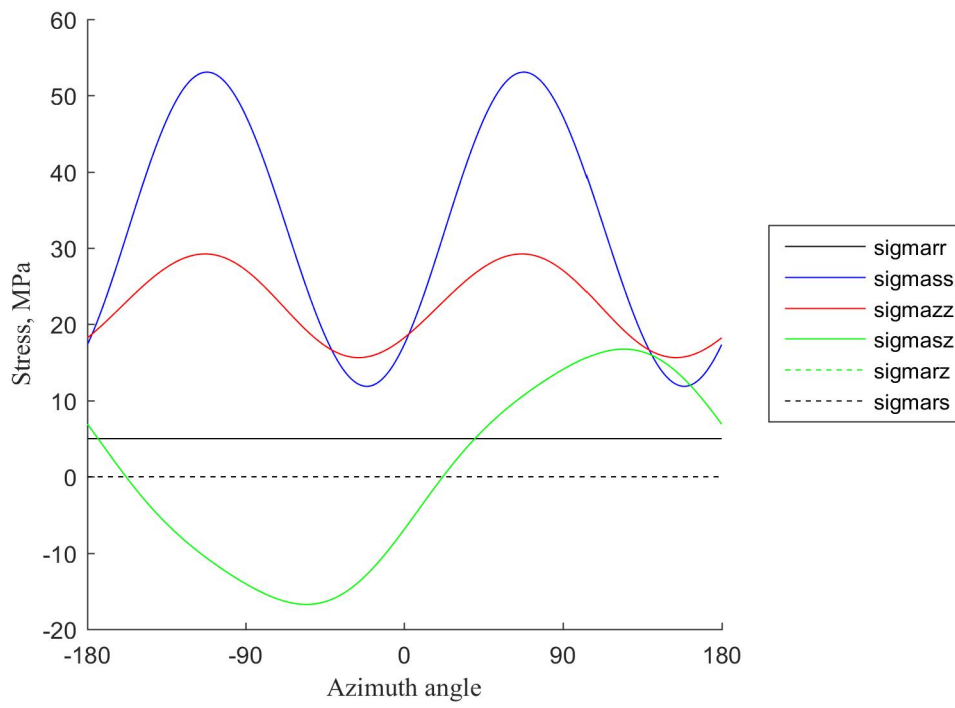


Fig. 1 plotted by the MATLAB program showing the stress components on the contour of the borehole.

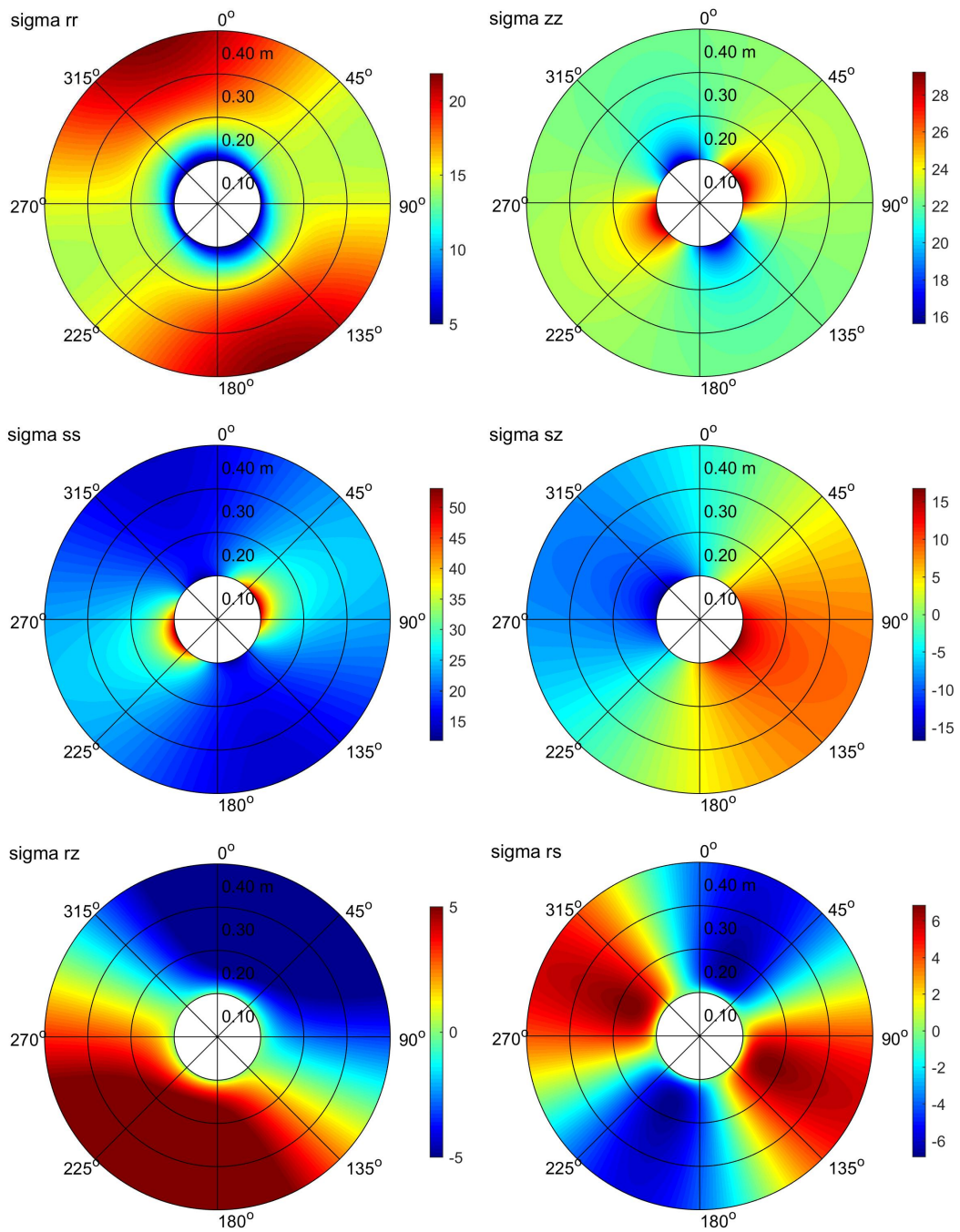


Fig. 2 to 7 plotted by the MATLAB program showing the stress components on the contour of the borehole.