A tutorial on PhiPsi

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This quick tutorial will familiarize new users with the basics of using PhiPsi. We'll start with a simple project by generating input files using Ansys, then creating the keywords file, carrying out the analysis through PhiPsi, and finally plotting contours by the Matlab-based post-processor. You can interact with the programs as we walk through this tutorial.

0. Description of the example

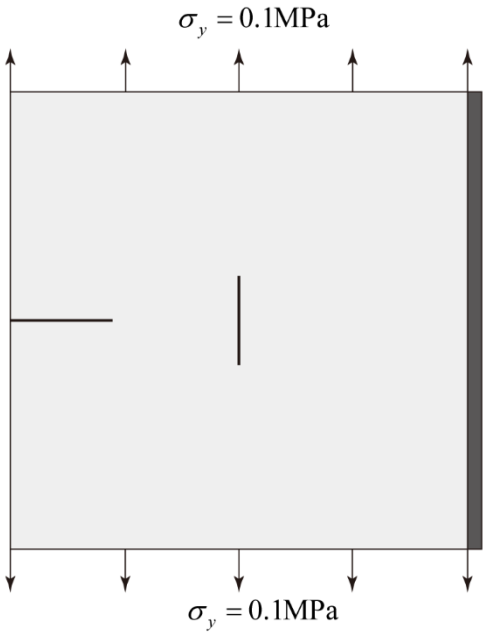

Figure.1. This figure represents a plane-stress plate with two initial cracks (an edge crack and a vertical crack) under the action of tensile stress σ_y *. The right edge is fixed.*

1. Pre-process: generate input files using Ansys

The name of the tutorial project we are going to present is "tutorial example". The input files (i.e., *tutorial example.node*, *tutorial example.elem*, *tutorial example.boux*, *tutorial example.bouy*, *tutorial example.focx* and *tutorial example.focy*) that contain the information of node coordinates, element-node information, boundary conditions, and external forces are suggested to be generated by the commercial finite element software Ansys. Once the finite element model has been created in Ansys, the input files can be automatically generated by running the macro file named *Ansys2PhiPsi_2D.mac*. The macro file should be copied into the working directory of Ansys so that is can be easily accessed and called. One thing has to be mentioned here is that forces and boundary constraints should be applied on nodes after meshing, rather than on lines or surfaces.

The Ansys APDL file (*tutorial_example.apdl*, this file can be opened and edited by any text editor) of this tutorial has been given in the "*Tutorial*" folder. The statement to call the macro file to generate the expected files can be found at the end of the

APDL file, namely

Ansys2PhiPsi_2D.mac, 'tutorial_example'

After running the APDL, six input files can be found in Ansys working directory. Create a new folder called "*tutorial_example*" on disk C (or any other disk, but the folder directory should be modified accordingly hereinafter) and copy the input files into it.

2. Create the keywords file

In PhiPsi, a keywords file defines information such as work directory, analysis type, coordinates of initial fractures, and others. The keywords file named "*kw_tutorial_example.kpp*" of this tutorial is listed as follows. The statement starts with "%" is comment.

```
% Keywords file of PhiPsi.
% Written by Fang Shi, USTC.
% Data: October 21,2016
% Website: phipsi.top

% Working directory.
*Work_Directory
C:\tutorial_example

% Filename of input files.
*Filename
tutorial_example

% Number of initial cracks.
*num_Crack
2

% Analysis type (Quasi-static).
*Key_Analysis_Type
1

% Plane strain.
*Key_Type_2D
2
```

% Contact checking (off).
**Key_Contact*
0

% Linear system solver (MUMPS).
**Key_SLOE*
6

*% Factor of propagation length (propagation length = factor * the average element size)*
**Factor_Propagation*
1.6

% Number of propagation steps.
**Num_Substeps*
15

% Crack propagation criterion.
**CFCP*
2

% Material(1-E,2-v,3-density,4-thick,5-St,6-KIc,7-Sc,8-15(blank))
**Material_Para_1*
20.0e9,0.2,2000.0,1.0,0.4e6,1.0e6,100.0e6,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0

% Coordinates of initial cracks.
**CRACK_1*
-0.1,0.925,0.35,0.925
**CRACK_2*
0.725,1.075,0.725,0.775

% Allow crack 1 and crack 2 to propagate.
**Cracks_Allow_Propa*
1,1

Copy the keywords file to root directory of disk C. At this point, we have six input files in "*C:\tutorial_example*" and a keywords file in "*C:*".

3. Perform the analysis

Run "PhiPsi_Win64.exe", when ask for the name of the keywords file, just type "*c:\kw_tutorial_example.kpp*" and press Enter to continue. After the finish of the

analysis, a lot of generated results files could be found in "*C:\tutorial_example*".

4. Post-process

The results file can be post-processed by the open-source Matlab program which is also written by the author of PhiPsi. The program can be adopted to generate the deformation figures, stress contours and displacement contours, and so on. The source codes of the post-processor can be download from http://phipsi.top/downloads.html. The main programs of the post-processor are "PhiPsi_2D_Post_1.m" and "PhiPsi_2D_Post_2.m", and they are used to generate static pictures and dynamic pictures, respectively. Usage can be found in the source codes.