MATLAB Exercise • Level 1

CHARLES J. AMMON
DEPARTMENT OF GEOSCIENCES
PENN STATE UNIVERSITY

The Normal Vector of A Fault Surface

FROM STRIKE & DIP TO A FAULT NORMAL

When visualizing a fault we are trained to think in terms of the fault strike and the fault dip. However, for some computations it is more convenient to define a plane using a vector normal to the surface. In this exercise I develop a simple script for converting from strike and dip to a fault normal. We need to choose a Cartesian coordinate system to specify the three components of our normal vector. We'll use north, east, and down (a typical seismology convention).

Let δ represent the fault dip (the angle between a horizontal surface and the fault) and ϕ represent the fault strike (measured clockwise from north). The fault normal vector is given by

$$\hat{n} = (n_n, n_e, n_d) = (-\sin\delta\sin\phi,\ \sin\delta\cos\phi,\ -\cos\delta)^T \qquad (1)$$

THE MATLAB SCRIPT

The forward computation requires simply that we perform the computation in (1). Here's a short script to do the trick

```
function [n] = fnormal(strike,dip)
%
% function to compute the fault normal vector
%    given the strike and dip (in degrees)
%
% the strike should lie between 0 and 360 (negative ok)
% the dip is restricted to lie between 0 and 90
%
% the dip should be measured in the direction such that
%    when you look in the strike direction, the fault
%    dips to your right.
%

%
deg_to_rad = pi/180;
%
strike = strike * deg_to_rad;
dip    = dip    * deg_to_rad;
%
n(1) = -sin(dip)*sin(strike); % north component
n(2) =  sin(dip)*cos(strike); %  east component
n(3) = -cos(dip);             % vertical component
```

To use the script, you have to place the file in your MATLAB path and then execute something like

```
>> n = fnormal(0,90)
>> n =
>>       0     1     0
>>
>>
>> n = fnormal(-120,45)
>> n =
>>      0.6124   -0.3536   -0.7071
```

EXERCISES

Exercise 1: Compute the fault normal vectors and complete the table for planes with the following strikes and dips:

Strike (°)	Dip (°)	North	East	Down
0	90			
90	45			
180	45			
45	90			
-45	50			
135	12			
43	56			
234	86			