5. Stereonets

I Main Topics
A Plotting a plane
B Plotting a line
C Measuring the angle between two lines
D Plotting the pole to a plane
E Measuring the angle between two planes

Plotting a Plane: Overview

- Key concepts
  - An inclined plane plots along a great circle.
  - The endpoints of the cyclographic trace of a plane with a non-zero dip are at diametrically opposed points on the primitive circle; these points define the line of strike for the plane.
  - Visualization of the plane.
Plotting a Plane: Step 1

- Lay tracing paper (blue) over stereonet
- In the example here, the plane plotted will strike 60° and dip 50°

Plotting a Plane: Step 2

- Trace primitive circle with a compass
- Add tick marks at 0°, 90°, 180°, and 270° for reference.
- Label the tick mark at 0° with an “N” to represent “north”.
Plotting a Plane: Step 3

- Plot a tick mark in on the primitive circle in the direction of the strike of the plane
- In the example here, the strike is 60°

Plotting a Plane: Step 4

- Now rotate the tracing paper such that the tick mark for the strike lies at the “north pole”. This is where all the great circles converge.
Plotting a Plane: Step 5

- Draw the plane along the great circle with the appropriate dip (in the example here, the solid violet curve is a plane with a dip of 50°).
- The dashed construction line shows the strike of the plane; it is shown here for illustration only. It does not need to be plotted.

Plotting a Plane: Step 6

- Remove the stereonet to see the results
- Visualize the results, and check to see if they make sense.
- In the example,
  - The violet curve represents a plane that strikes 60° and dips 50°.
Plotting a Line: Overview

• Key concepts
  – A line lies at the intersection of two planes:
    • A vertical plane (magenta) with a strike that matches the trend of the line.
    • An inclined plane (violet) with a dip that matches the plunge of the line and that dips in the direction the line plunges
  – Visualization

Plotting a Line: Step 1

• Lay tracing paper over stereonet
• In the example here, the line plotted will trend 60° and plunge 50°
Plotting a Line: Step 2

- Trace primitive circle with a compass
- Add tick marks at 0°, 90°, 180°, and 270° for reference.
- Label the tick mark at 0° with an “N” to represent “north”.

Plotting a Line: Step 3

- Plot a tick mark in on the primitive circle in the direction of the trend of the line.
- In the example here, the line trends 60°.
Plotting a Line: Step 4

- Now rotate the tracing paper such that the tick mark at the trend lies along the small circle that projects as a straight line (i.e., the “equatorial line”)
- The dashed pink line represents a vertical plane containing the line.

Plotting a Line: Step 5

- Mark off the plunge, counting from the primitive circle towards the center of the plot.
- The dashed violet curve is a plane with a dip that matches the plunge of the line. This plane dips in the direction the line trends, and it strikes perpendicular to the trend of the line.
- The line of interest is at the intersection of the vertical pink plane and the plunging violet plane.
- The dashed construction lines are shown here for illustration only. They do not need to be plotted.
Plotting a Line: Step 6

- Remove the stereonet to see the results.
- Visualize the results, and check to see if they make sense.
- In the example,
  - The line (marked by the small red circle) trends 60° and plunges 50°.
  - The dashed pink line represents a plane that strikes 60° and dips 90°.
  - The violet dashed curve represents a plane that strikes 330° and dips 50° towards the northeast.
  - The planes intersect at the line.
  - The planes (dashed) are shown for illustration purposes only. They typically would not be shown if only the line is of interest.

Measuring the Angle Between Two Lines

- Key concepts
  - The angle between the lines is measured along the cyclographic trace of the plane that contains the lines.
  - The procedure is exactly analogous to measuring the angle between two lines with a protractor.

“Colored protractors of different dip”
Measuring the Angle Between Two Lines

• Plot the lines
• In the example, one line trends 78° and plunges 36°; the red circle marks this line.
• The other line trends 146° and plunges 49°; the blue circle marks this line.

Measuring the Angle Between Two Lines

• Find the plane that contains both lines
  – Rotate the tracing paper such that both lines lie on a single great circle. This requires care.
  – Measure the angle along the great circle between the two lines. Here, the angle is 50°.
  – By coincidence, the common plane (green) dips 50°.
Measuring the Angle Between Two Lines

- Here is the plot restored to its original orientation.
- The common plane (green) has a strike of 40°.

Measuring the Angle Between Two Lines

- Here is the plot without the stereonet
  - Check to see whether the plot looks correct (i.e., visualize).
Key concepts

- The pole to a plane is a line that can be plotted like any other line.
- The pole to a plane of interest lies in a vertical plane perpendicular to the plane of interest.
- The pole also makes a 90° angle (as measured in the vertical plane) with respect to the “dip vector” of the plane of interest.

Example

Consider a plane of interest that strikes 330° and dips 50° to the NE. It is plotted in blue.

- Its pole can be found by simple calculations. The pole trends 240° and plunges 40°. This is plotted at the red circle.
- The pole to a plane lies in a vertical plane perpendicular to the plane of interest.
- The pole also makes a 90° angle (as measured in the vertical plane) with respect to the “dip vector” of the plane of interest.
Measuring the Angle Between Two Planes

• Key concepts
  – The angle between two planes (blue and red) is the angle between the poles to the planes.
  – The angle between the planes is measured in the plane (green) containing the poles.
  – The angle between tangents to the cyclographic traces on an equal area projection also gives the angle between the planes, but drawing the tangents accurately is difficult.

• Plot the planes and the poles

• Example
  – The blue plane strikes 330° and dips 50° to the NE.
  – The red plane strikes 30° and dips 20° to the SE.
  – The blue pole trends 240° and plunges 40° to the SW.
  – The red pole trends 300° and plunges 70° to the NW.
Measuring the Angle Between Two Planes

- Measure the angle between the poles in the plane containing the poles
  - Rotate the tracing to find the common plane (green) that contains the two poles.
  - The angle between the planes is measured in the plane (green) containing the poles.
  - The angle determined graphically is 43° (measured to the nearest degree).

Measuring the Angle Between Two Planes

- Appearance of plot without stereonet
  - The plot is busy.
  - The angle between tangents to the cyclographic traces on an equal are projection also gives the angle between the planes, but drawing the tangents accurately is difficult.
Measuring the Angle Between Two Planes

Accuracy

\[
\begin{align*}
&> Tr = 300*\pi/180; \\
&> Tb = 240*\pi/180; \\
&> Pr = 70*\pi/180; \\
&> Pb = 40*\pi/180; \\
&> [bx, by, bz] = sph2cart(Tb, Pb, 1); \\
&> [rx, ry, rz] = sph2cart(Tr, Pr, 1); \\
&> blue = [bx, by, bz]; \\
&> red = [rx, ry, rz]; \\
&> angle = \text{acos(dot(blue, red))}\times180/\pi
\end{align*}
\]

This angle is consistent with the graphical solution