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A multi-component rose diagram

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Abstract—Rose diagrams and circular histograms have long been standard graphics for the display of directional data. One problem using the traditional graphics is the limited number of attributes that may be incorporated into the one display. A hybrid of the rose diagram and circular histogram allows several attributes of directional data to be displayed simultaneously. This hybrid graphic has been termed the multi-component rose diagram.

DISCUSSION

This Short Note discusses a useful hybrid of the rose diagram (Figs. 1a & b), which compresses four measurements from a directed dataset, onto a single multi-component diagram, so as to maximize data content while making redundant the need for further graphical displays. The hybrid or multi-component rose diagram incorporates elements of the circular histogram and rose diagram, to describe several attributes of spatially located or orientated datasets within the one graph.

Methods for displaying directional data have been discussed by many authors including Watson (1996), Mardia (1972), Gaile & Burt (1980), Cheeney (1983), Schuenemeyer (1984), Davis (1986) and Rock (1988). Through all previous discussions the main theme has been the graphical representation of oriented or spatially located data in a form that is both conventional and easy to interpret.

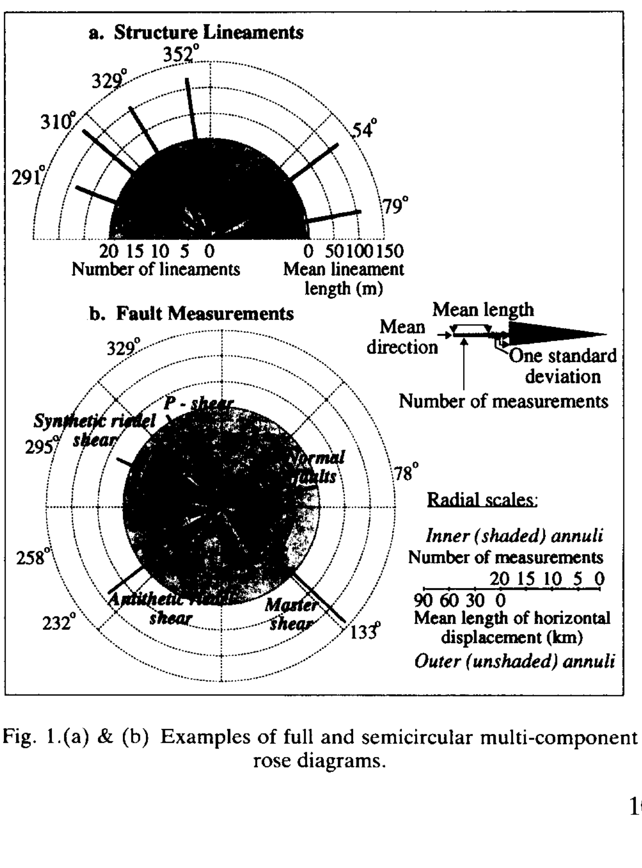

Fig. 1.(a) & (b) Examples of full and semicircular multi-component rose diagrams.

Figure 2 represents standard forms of the circular histogram and the rose diagram. Cheeney (1985), Rock (1988) and others suggest the two graphical forms are synonymous; however Mardia (1972) and Gaile & Burt (1980) note differences. Circular histograms represent frequencies of classes by developing a series of concentric circles around a similar origin, with data measurements (class frequency) represented by divisions extending from the origin. The divisions vary in length as a result of changes between values among the classes. The rose diagram is developed by plotting radii or areas, made proportional to the class frequencies, from the origin of a circle (Rock 1988). The resultant is a series of sectors representing the frequency for the recognized classes, constructed with their apexes at the centre of the plot.

Schuenemeyer (1984) divides directional data into two main groups, directed and undirected. The directed group incorporates a sense of orientation within the data, such as fold dips and palaeomagnetic measurements. The second group is described as axial data such that it is not possible to distinguish between an angle, θ, and $180° + \theta$. This group includes lineament and fold axes measurements. For undirected datasets the semi-

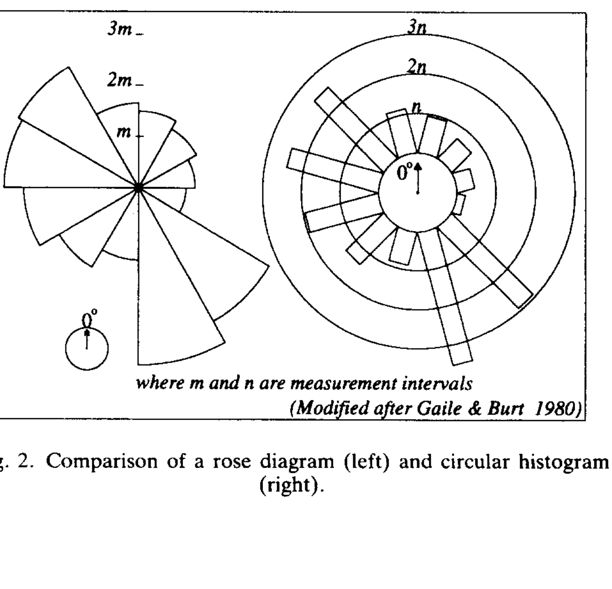

Fig. 2. Comparison of a rose diagram (left) and circular histogram (right).

circular diagram (Fig. 1a) is adequate for display and analysis since measurements between 180° and 360° are a reflection through the origin of 0–180° measurements. Directed data requires a circular diagram (Fig. 1b) to fully represent the data.

The components measured, as exemplified in Figs. 1(a) & (b) are: a measure of central tendency of a class, a measure of the class variance, the number of measurements within a class, and a fourth measurement related to the measure of central tendency (such as mean vector length or sum of vector lengths). The classes are defined on an *a priori* basis. The measure of central tendency of a class is described by a preferred direction expressed as an angular distribution around a circle or semicircle based upon the value of the measurement. On Fig. 1(a) this measurement is illustrated by the mean length of six surface lineament classes. The degree of dispersion, or the class variance, around the preferred orientation vector is represented as a sector or window. The cord to the sector records the variance. The sector width is one standard deviation either side of the preferred lineament direction: however other forms of deviation estimation could be used. The number of measurements or data points within a class is measured by the radius of the variance sector. In Fig. 1(a) this measurement relates to the number of lineaments associated with a given orientation. The fourth measurement relating to the central tendency vector, as in Fig. 1(a) is a record of the mean length for all lineaments associated with that class. The number of measurements and data points relating to the central tendency vector are measured on two separate scales. The scales are chosen such that the latter scale is always greater than the former. The logarithm of measurements may be used where the values between, or within, classes are dominated by a few groups to the detriment of lower magnitude classes.

CONCLUSION

The problem of display becomes important when using directional datasets containing thousands to millions of information points, such as in structure, mining or in GIS databases. Each information point may be associated with several attributes, such as fault length and direction, spatial distribution of tunnel width vs ore grade, or street lights per unit length of main road for differing directions. Using single attribute rose diagrams, the relevancy of interpretations may require pages, with meaningful results quickly becoming indistinct. By integrating the diagrams through the process discussed above, significant features involving single, or a combination of, attributes are quickly highlighted.

The resultant plot is more complex than traditional sector or line rose diagrams. However, as a summary plot to aid interpretation and display, the multi-component rose diagram is a highly descriptive means of representing several attributes of directional datasets.

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