Radial Visualization of Multidimensional and Multivariate Data

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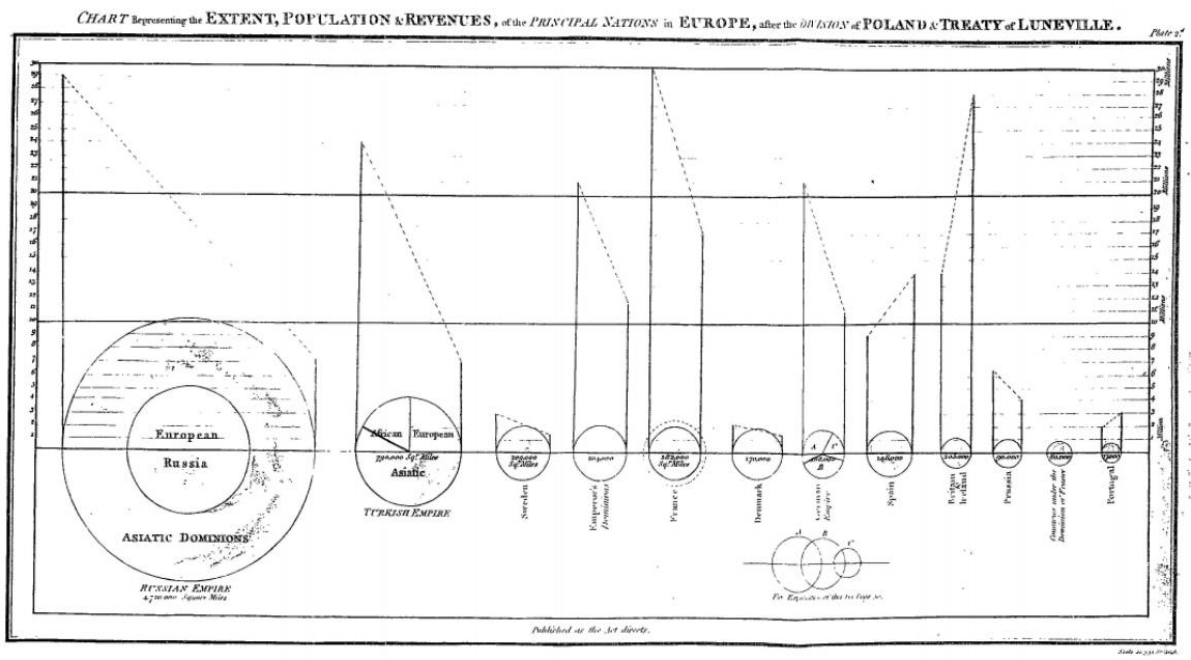
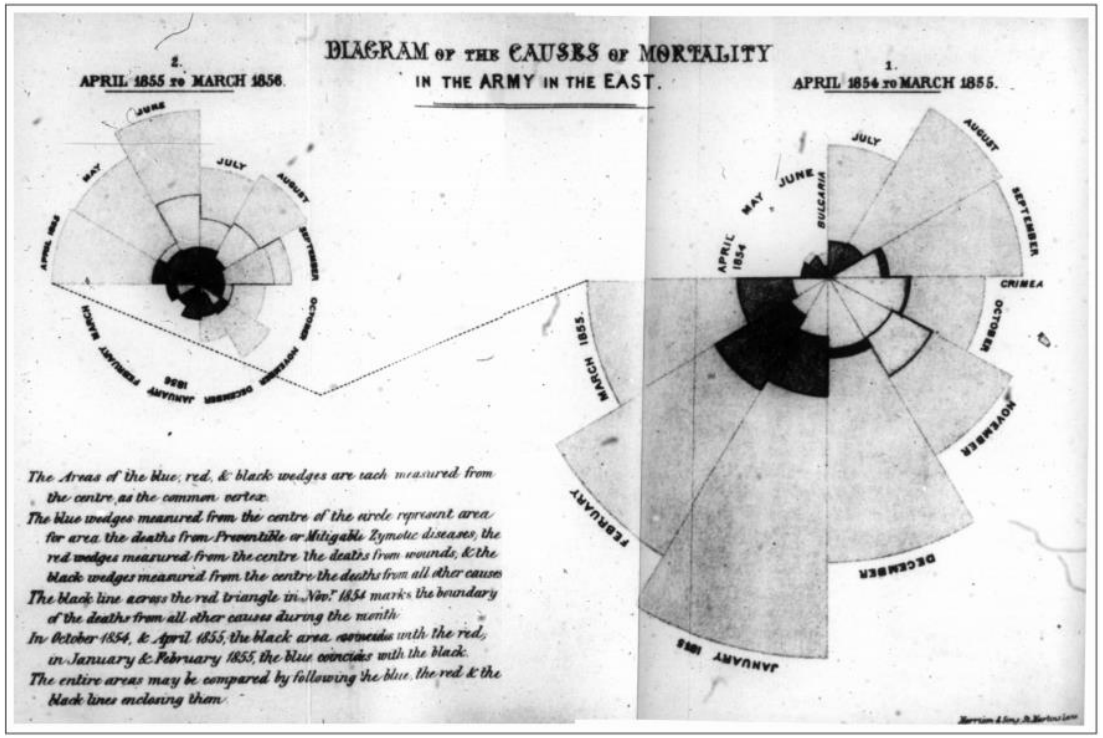
MULTIDIMENSIONAL/MULTIVARIATE

- Key attributes and value attributes
- Key attributes act as index to look up value attributes
- Multidimensional – multiple key attributes
- Multivariate – multiple value attributes

RADIAL VISUALIZATION

- Radial Visualization: information is rendered in a circular or elliptical fashion
- "Radial Visualization" was first mentioned by Hoffman in 1997
- Earliest use of radial display: pie chart by William Playfair in 1801
- Florence Nightingale in 1850s: polar area chart

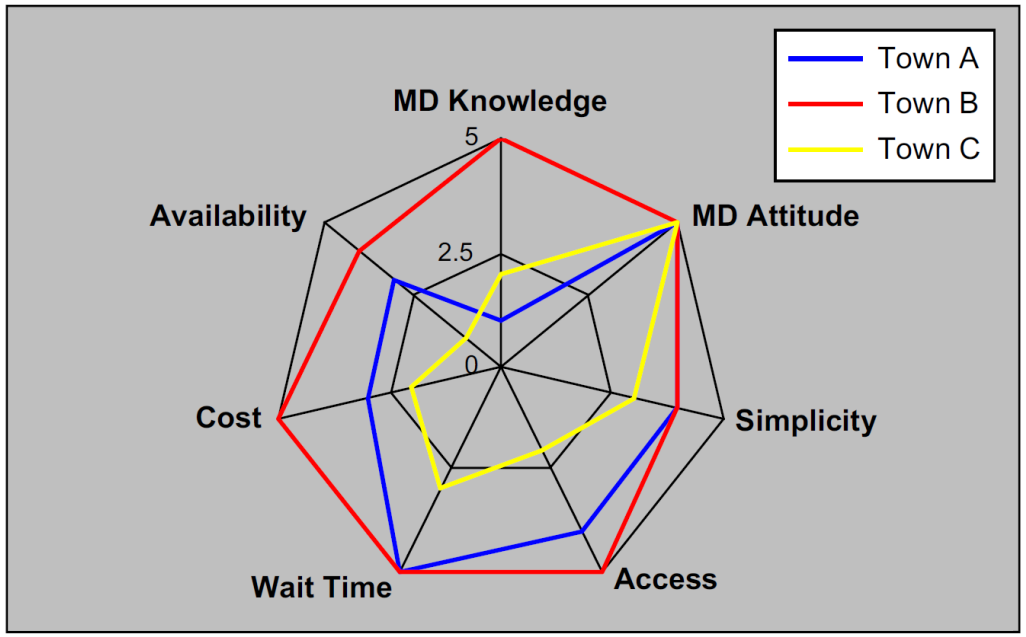




THREE TYPES OF RADIAL VISUALIZATION TO PRESENT MULTIDIMENSIONAL/MULTIVARIATE DATA

- Axis Based
- Segment Based
- Spatial Based

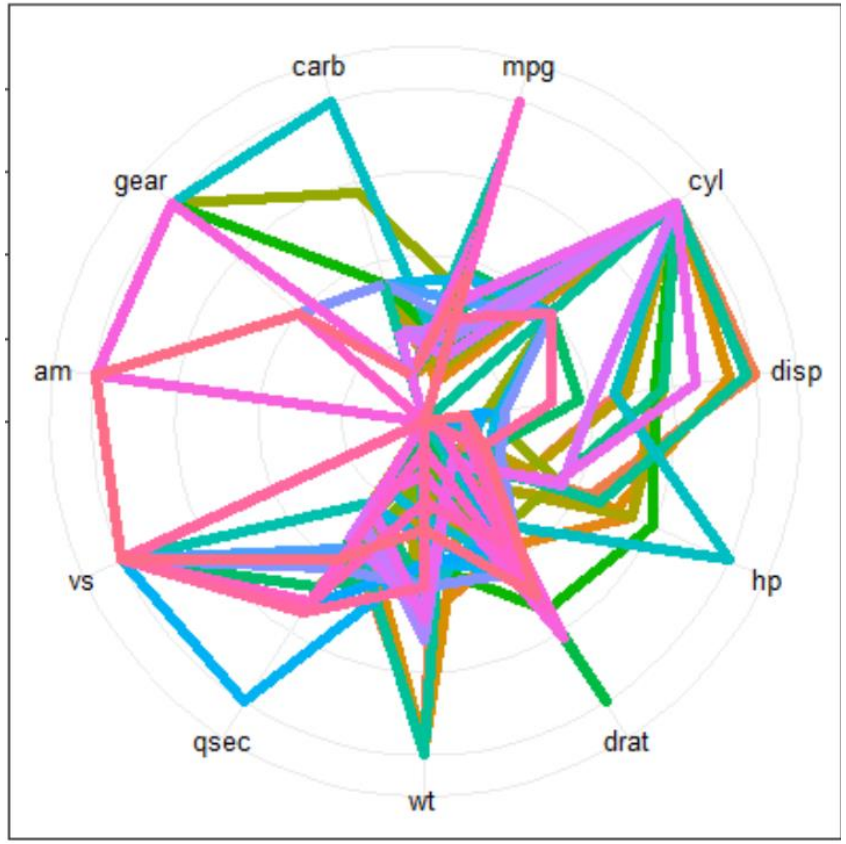
Radar Chart



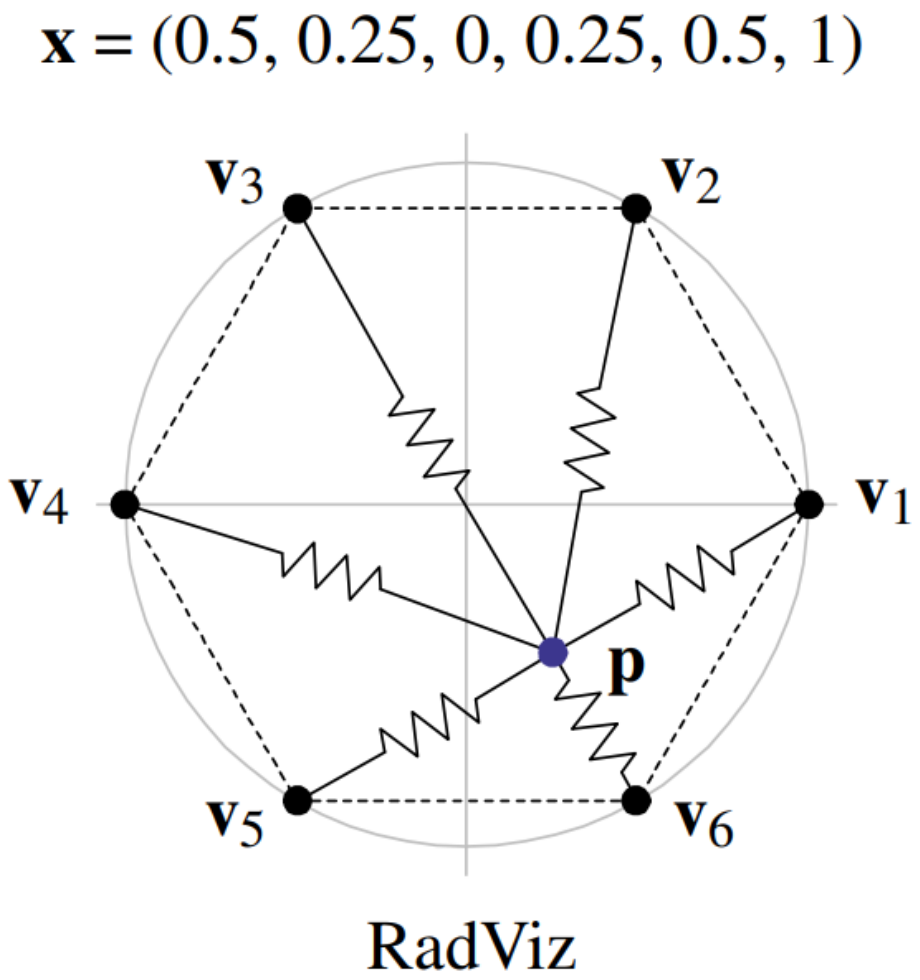
- A series of spokes or rays projecting from the center point, with each ray representing a different attribute
- The value of the variables are encoded with the lengths of the rays, the values so plotted are sometimes connected to form an enclosed figure
- Dominant perceptual properties often include size and shape of resulting figure
- Parallel coordinates in a radial layout

Radar Chart Limitation

- Scalability issue (just like parallel coordinates)
- Comparison across axes
- Misleading to cross-axes comparison when its meaningless
- Size and shape depend on axis sorting



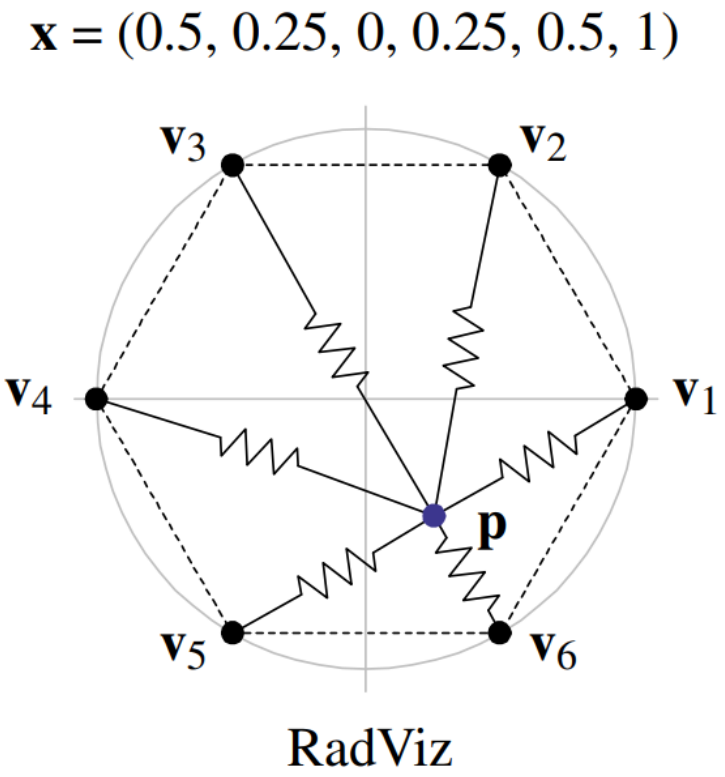
RadViz

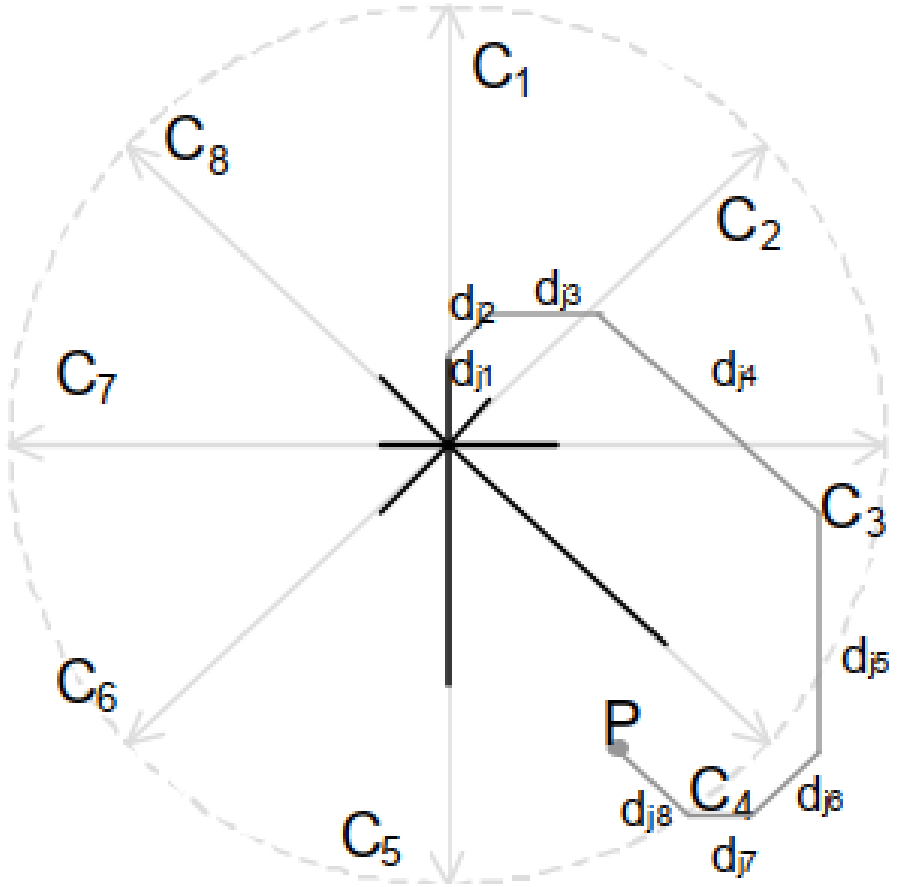


- 1997 by Hoffman
- N-dimensional data points are laid out as points equally spaced around the perimeter of a circle
- Imaginary springs (invisible) connecting perimeter points and the data point
- Spring constant of each spring equals to the value of the data in that coordinate
- All data points values are usually normalized to have values between 0 and 1

RadViz Limitations

- All dimensional points with difference by a scale number that map into the same position, all points separated on the original space cannot distinguished on the visual space
- Ordering of dimensional anchors is vital, difficult to find the optimal order for a good visualization view



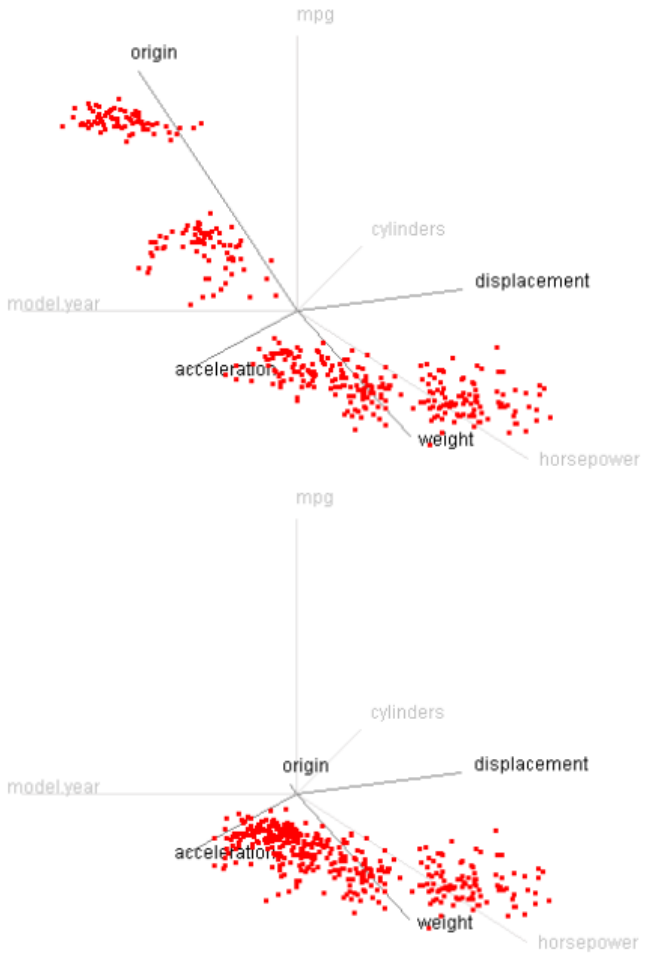


Star Coordinates

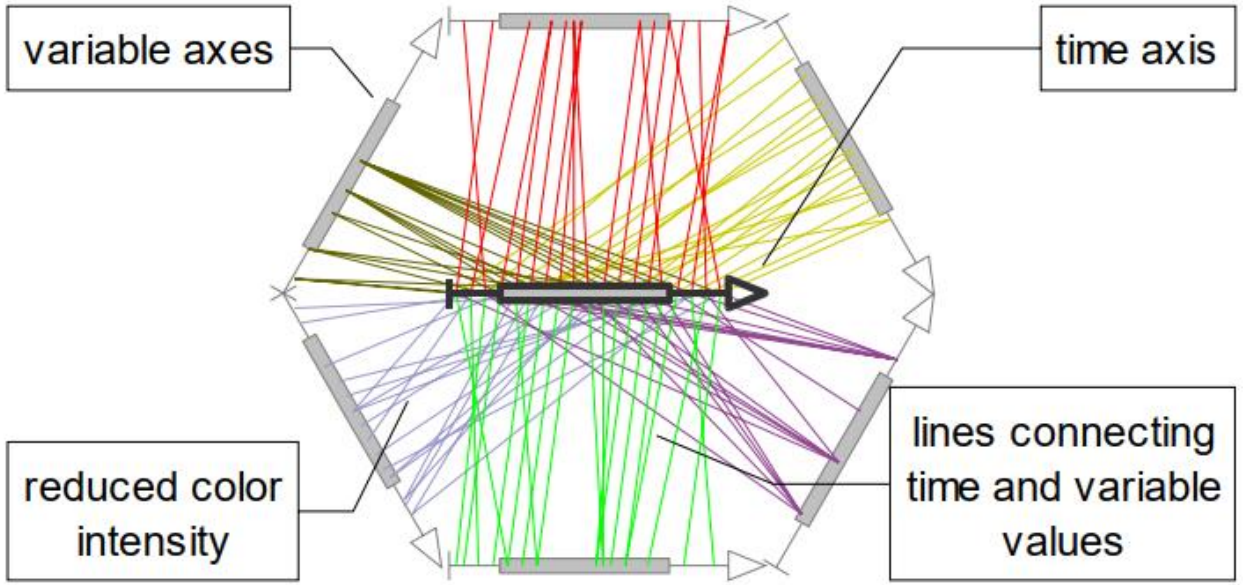
- An extension of typical scatterplots to higher dimensions
- Arrange the coordinate axes on a circle with equal angles and equal length (initially)
- The mapping of a data element is determined by the sum of all unit vectors on each coordinate multiplied by the value of the data element for that coordinate

Star Coordinates Limitations

- Ambiguity (similar issue as RadViz)
- Can be solved (reduced) by interactions
- Scaling:
  - changing the length of axes
  - Increase or decrease the contribution of a particular axis on the resultant visualization
- Rotation:
  - changing the direction of axes
  - Changing the correlations of a particular data axis to other axes

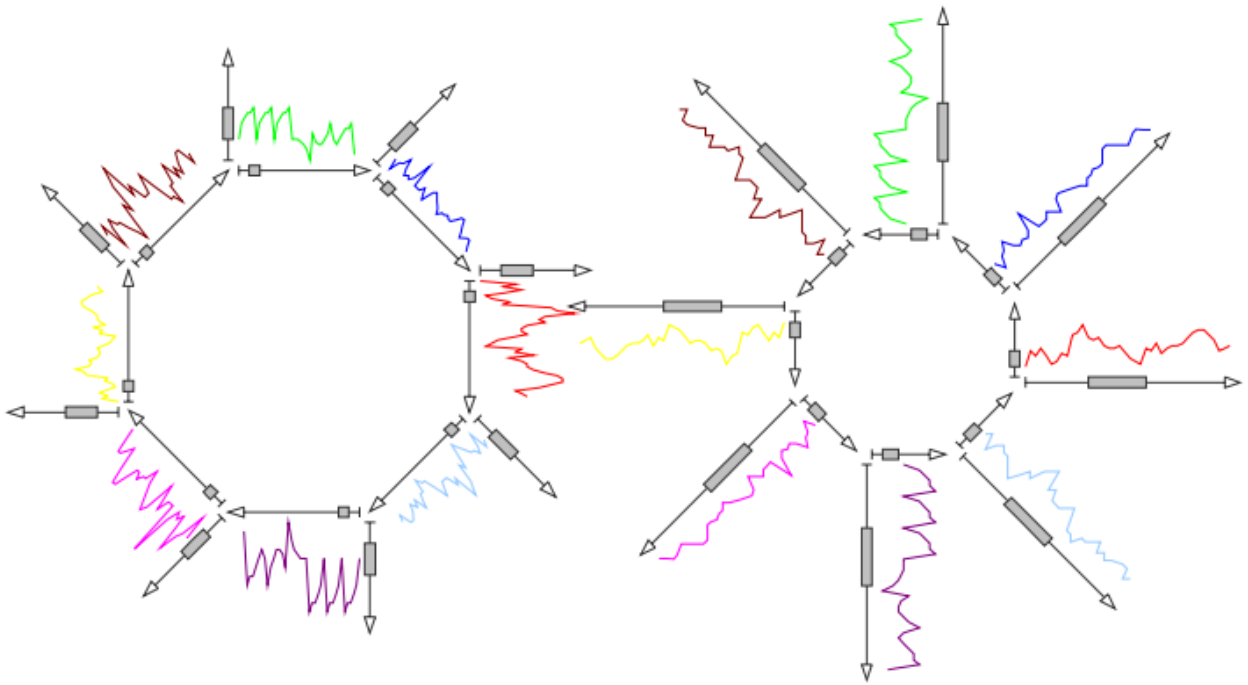


TimeWheel and MultiComb



- Present the axis of reference (usually time) in the center of the display, and to circularly arrange the depending axes around it
- A single colored line segment makes a connection between a time value and the corresponding variable's value

TimeWheel and MultiComb



- Different variable plots are arranged circularly on the display
- Two possibilities when arranging the plots
- In one case (left) the variable plots are arranged circularly on the screen
- In the second case (right) the variable plots extend outwards from the center of the display

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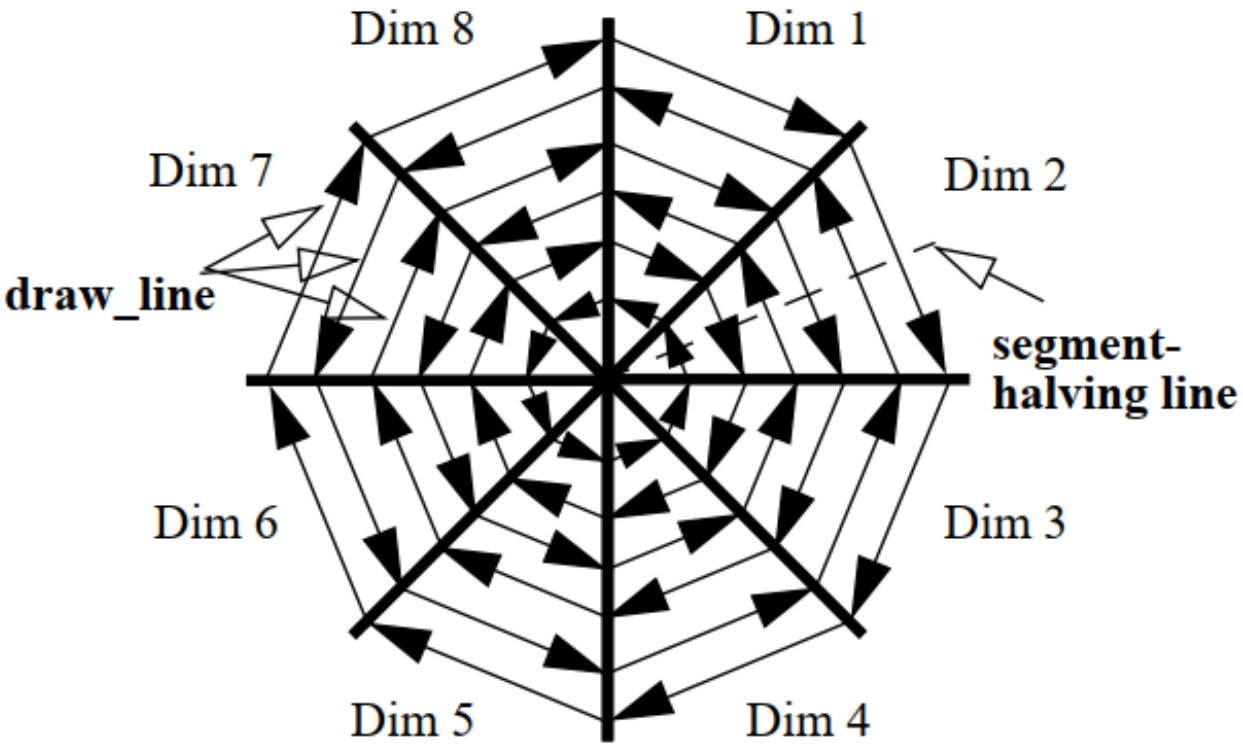
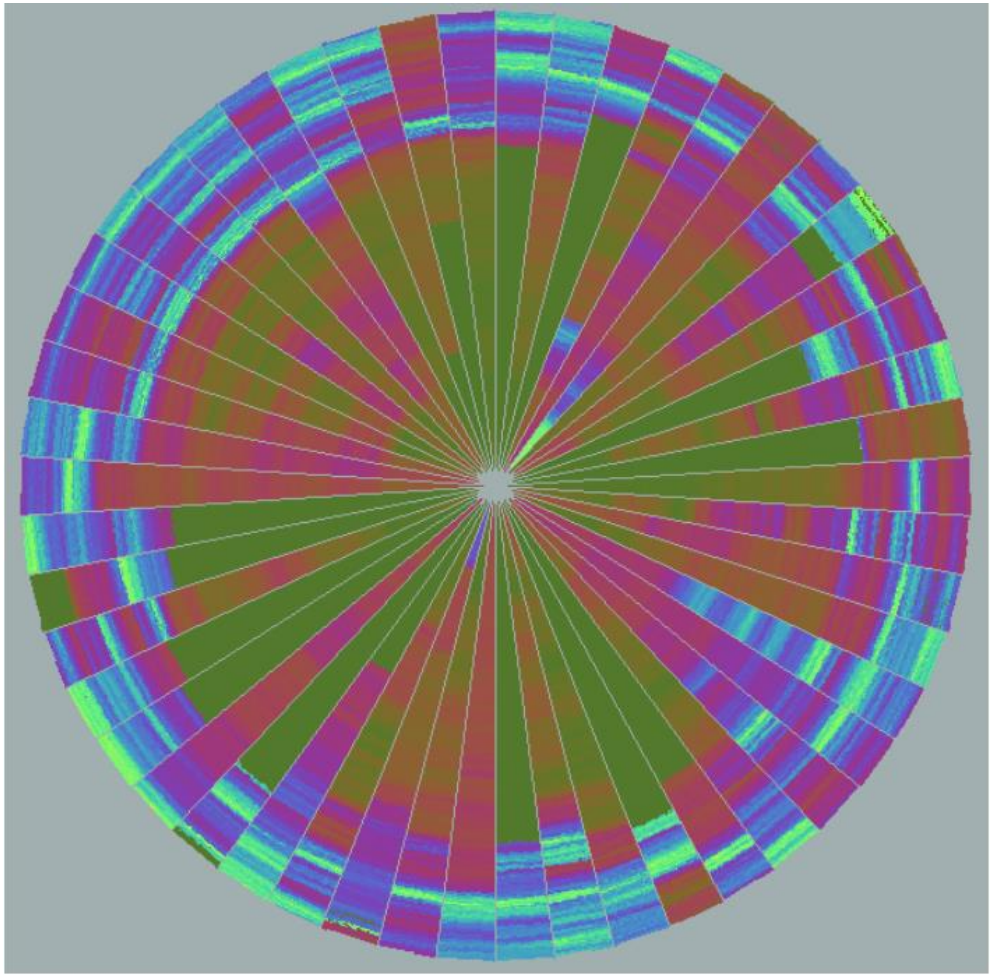
Circle Segment

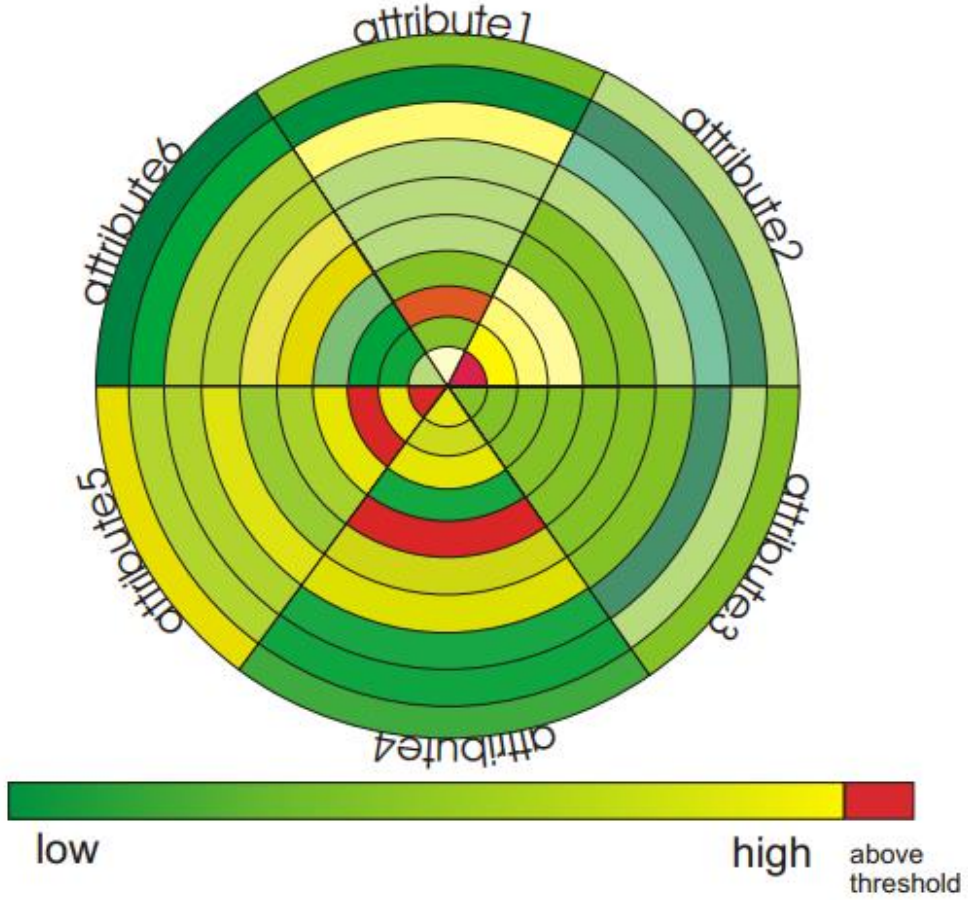


- Pixel per value technique
- Display the data dimensions as segments of a circle
- The data items within one segment are arranged in back and forth manner along “draw line”
- Coloring maps high data values to light colors and low data value to dark colors

Circle Segment Limitations

- Outer data may receive undue emphasis due to their greater radius (arc length is derived directly from the radius)





CircleView

- The circle is partitioned into *k* segments
- Each segment is then divided in subsegments in order to visualize the distribution and changes of the time dependent data
- The color of each subarea shows the aggregated value of an attribute at a certain point in time
- When visualizing continuous data stream, the time slots are shifted and new elements are inserted

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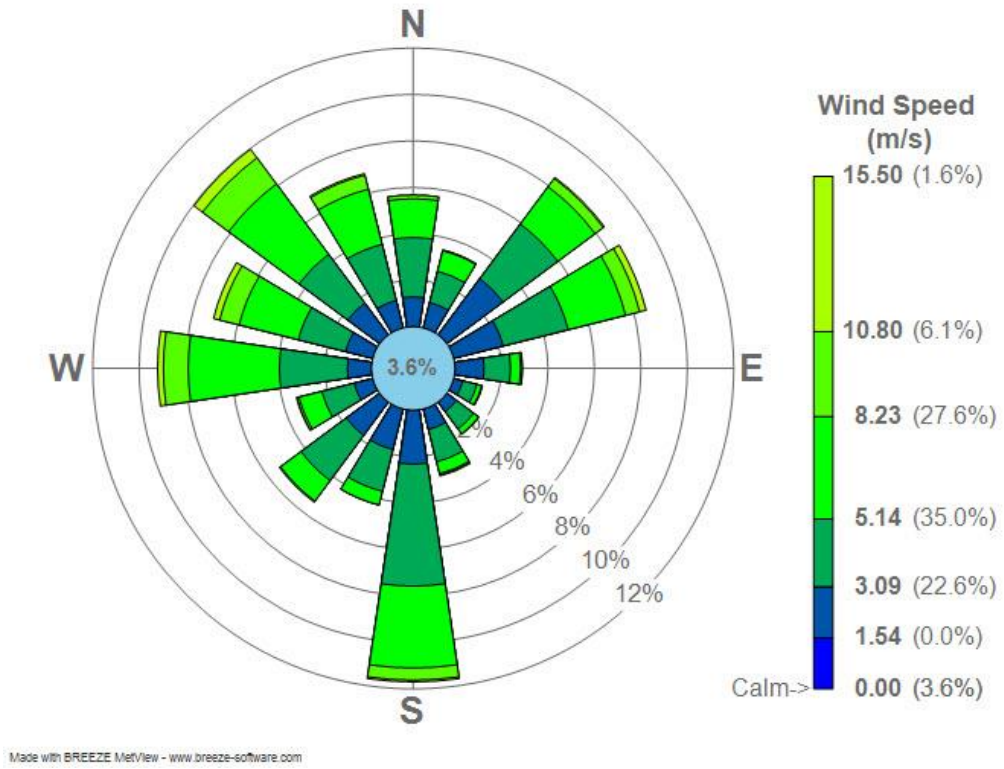
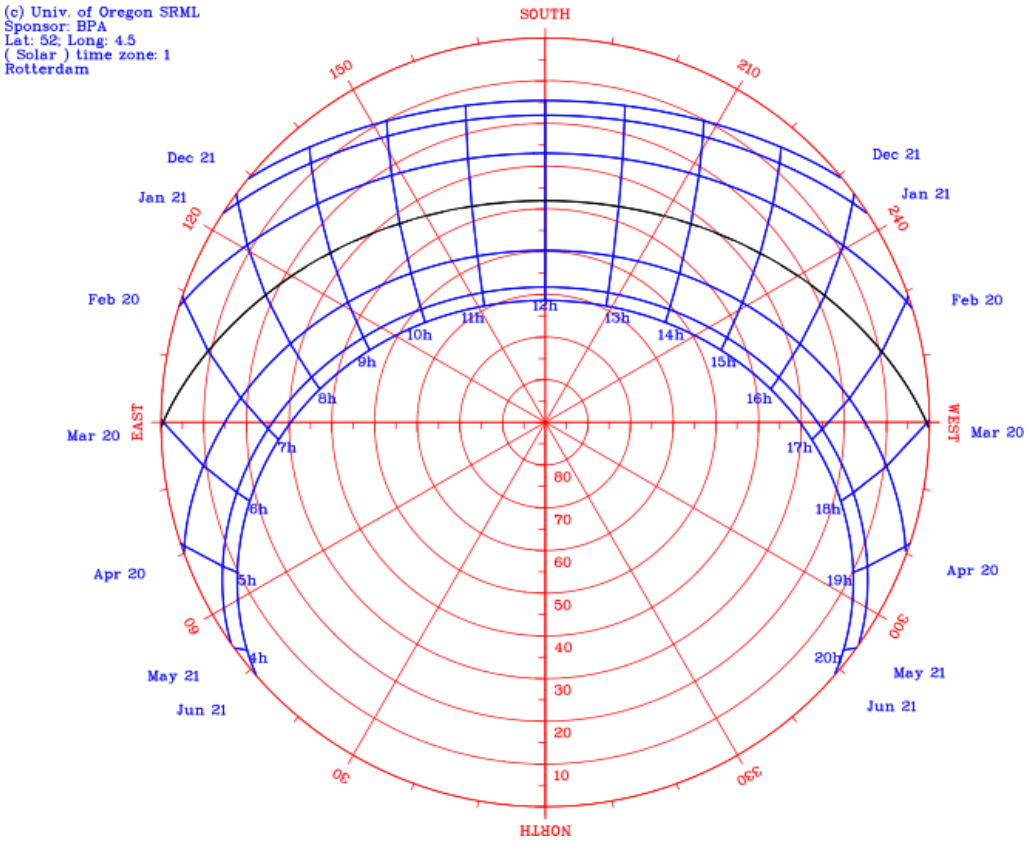
Wind Rose



- Predecessors of the compass rose
- Frequency of winds over a time period is plotted by wind direction
- Color bands showing wind speed ranges

Sun Path Polar Plot



- Locate the position of the sun at any time of the year at a specified location
- Project the 3D sphere (earth) in 2D, with observation location at the center
- Polar angel to the azimuth angle indicates the direction of the sun in the horizontal plain from a given location.
- Polar radius to the altitude angle measures the height of the sun in the sky from the horizon
- Vertical arcs as hours and horizontal arcs as the sun paths