

Read-me file accompanying VSL reference data pairs

This file accompanies the file 'VSL-Geometric-Elements.zip' containing example reference data pairs for fitting geometric elements to data based on the least squares criterion. The eight considered geometric elements are: plane, sphere, 2D-line in plane $z=0$, 3D-line, 2D-circle in plane $z=0$, 3D-circle, cylinder and cone. The 3D-circle fit concerns a full 3D circle fit, not a least squares plane fit followed by a 2D-circle fit to the projected points onto the plane. The first part of the file name identifies the geometric element. For each element one dataset and one result file is included.

The text files with name ending on 'xyz-data' have on the first line the number n of data points in the file, and subsequently n lines with x -, y - and z -coordinates of the points. All numbers are given with 8 digits. An arbitrary number of trailing zeros may be assumed.

The text files with name ending on 'result' contain a column with the fit results. For all elements the first number is the *RMS* (Root-Mean-Square) value of the fit. Let $\mathbf{d} = (d_1, \dots, d_n)$ represent the vector of residuals of the fit. The residuals are signed except in the case of the 3D-line and 3D-circle, where the residuals are all non-negative. The *RMS* value is

defined as $RMS = \sqrt{\frac{1}{n} \sum_{i=1}^n d_i^2}$, and is the value that is minimized by the parameter values of the best fit element. The second number in the result file is the *PV* (Peak-Valley) value. It is defined as $PV = \max(d_i) - \min(d_i)$, except for the cases of 3D-line and 3D-circle where it is defined as $PV = \max(d_i)$. From the third number on the element specific parameters are given, which are:

- Plane: direction cosines of the normal to the plane and distance of the plane from the origin,
- Sphere: sphere centre and sphere radius,
- 2D-line: 2D point on the line and 2D direction cosines of the line,
- 3D-line: point on the line and direction cosines of the line,
- 2D-circle: 2D circle centre and circle radius,
- 3D-circle: circle centre, direction cosines of the normal of the plane containing the circle and the circle radius,
- Cylinder: point on cylinder axis, direction cosines of the cylinder axis and the cylinder radius,
- Cone: point on cone axis, directions cosines of the cone axis pointing in the direction of increasing radii, half the apex angle (between 0 and $\pi/2$) and the orthogonal distance from the reported point on the axis to the surface of the cone.

The reference results are given with 15 digits. All digits are believed to be correct, except the last one which may slightly change due to rounding effects when we saved the data to file.

Other fit results to the data may give different parameter values, while representing the same geometric element. E.g. the point on the plane may be different or the normal may point in the opposite direction. In case of a sphere fit the diameter may be given as output instead of the radius. Such issues have to be kept in mind when comparing fit results with our reference results.

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