

1 - 3 3D measured data with standard geometry approximations.

SOFTWARE LIBRARY FOR MEASURED 3D DATA PROCESSING

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Non-contact optical methods of 3D digitization have replaced conventional methods in many applications. Regardless of whether the triangulation sensors are operating with points, lines or planes – many millions of measured 3D data are generated in a few seconds. These data deliver a description of a digitized component's surface topography. Verification of a component's dimensional accuracy based on these data, e.g. for quality assurance tasks, requires methods and algorithms that evaluate and analyze the 3D data in order, for instance, to determine deviations in dimensions, shape and position from a standard model.

Established point cloud processing programs that determine the desired geometric parameters manually and interactively are available for offline analysis.

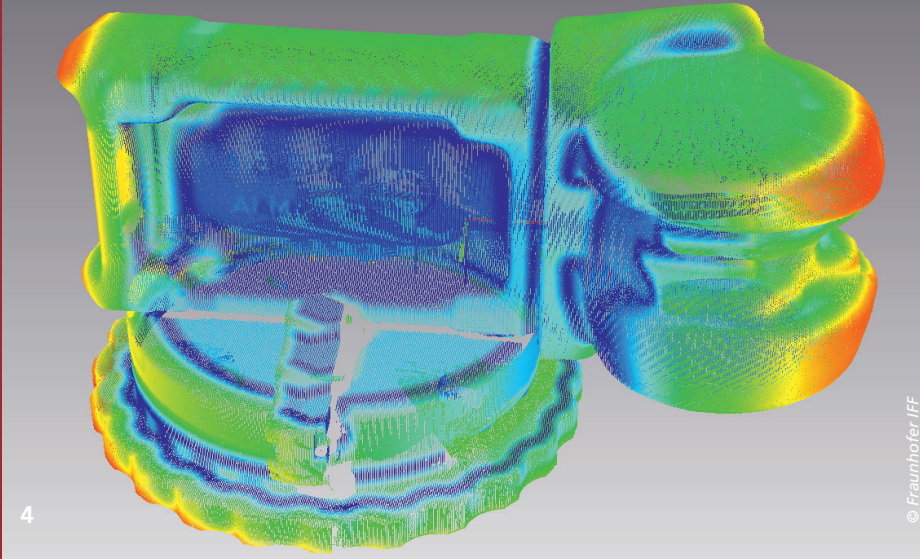
In-line systems require rapid, automatic and integrated data evaluation. The measured

3D data processing package OptoInspect3D was developed for this purpose. It consists of the OptoInspect3D Alg3DLib function library and the OptoInspect3D Invent graphic development and test environment.

Overview of the Library Methodology

- Registration of 3D data sets to compare CAD and compute deviations
- Approximation of standard geometries in measured 3D data and derivation of measured variables
- Distances, intersections and projections with standard geometric elements
- Automatic data segmentation
- Thinning/homogenization and smoothing of large 3D data sets

Free trial version:
www.iff.fraunhofer.de/invent



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Library Features

- Algorithms for measured 3D data processing
- C++ template implementation
- Additional C-interface available
- Rapid algorithms optimized by multicore support and an efficient data structure
- Development and test environment with visualization based on OpenGL

Methods of Measured 3D Data Processing

Registration

The registration function determines the alignment of two sets of points to one another or rather one point cloud to a CAD model. One data set acts as a static reference and remains unchanged. The translation and rotation of the second dynamic data set are varied until a predefined minimum deviation between the two is obtained.

This functionality can, for instance, be employed to compare measured data with a CAD reference or a golden sample or to link the data from independent partial measurements. A point distance calculation (proximity search) can determine the degree of the data sets' congruence.

Approximation of Standard Geometric Elements

The description of the quality of component's geometry is based on standard geometric shapes, e.g. straight lines,

circles, ellipses, planes, cones, spheres and cylinders, which serve as reference elements. Deviations in dimension, shape and position are determinable from the standard geometry's parameters or the parameters' interrelationship. In addition, standard geometries are employed to define component or reference coordinate systems.

A standard geometry is stipulated by selecting the pertinent domains of the digitized 3D data. The latest numeric methods that minimize the deviations between the measured points and the standard geometry are employed to produce the best fit. The parameters are selectively definable. Thus, for example, the spatial position of a cylinder with a defined radius can be determined once it has been fit.

An iterative best fit automatically segments or selects the set of points belonging to the standard geometry. This eliminates interfering points and removes points not belonging to the geometry from the calculation. All best fit methods utilize intelligent error weighting, which ensures that the tolerance toward interfering data is particularly high. A function that locates adjacent regions of point data can also be used to eliminate interfering data.

Additionally the library provides established functionality to determine deviations, distances, intersections and projections with geometric elements.

Thinning/Homogenization

Different surface topologies and scanning strategies produce sets of points of differing density and redundancy. A thinning function eliminates and redistributes redundant points after the analysis of local proximity so that the resulting set of points has a homogeneous density. Both the density and an acceptable displacement tolerance are specifiable. In addition, weighted smoothing of the points minimizes high frequency noise. Data corruption is preventable by specifying a tolerance margin..

Graphic Development Environment

The OptoInspect3D Invent development environment is a graphic interface to the OptoInspect3D Alg3DLib function library. It furnishes an intuitive option to test and parameterize functions based on proprietary measured data. A selection mode additionally allows applying individual algorithms to a predefined subarea of the total volume of data.

The OptoInspect3D Alg3DLib function library is constantly being refined and optimized.

For more information on this topic, visit www.iff.fraunhofer.de/en/mpt

4 *Color coded representation of the deviation of measured and reference data.*