The Universal Software for 3D-metrology, Reverse Engineering and Surveying

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www.innovmetric.com
What is PolyWorks®?

PolyWorks is the universal 3D Metrology Software Platform for processing and analyzing three-dimensional datasets.

The future of metrology depends on the complete and highly accurate acquisition of surfaces. In addition to single point measurements PolyWorks improves the analysis and inspection of entire surface models. This incorporates the whole process from capturing point clouds to processing and modelling surfaces.

As a universal software platform PolyWorks integrates a wide range of optical and tactile 3D-digitizers. Whether in design, quality assurance or surveying: The application range of the software in combination with 3D-measuring devices is almost unlimited.

PolyWorks is being developed by the Canadian company InnovMetric Inc. Due to the large customer focus in the development process over the last 15 years, PolyWorks has proven itself in countless industries. In the automotive and aeronautic business PolyWorks has become the standard point cloud engineering software solution worldwide.

As the European partner of InnovMetric Software Inc. Duwe-3d supports the numerous PolyWorks users and sensor manufacturers throughout Europe. We offer consulting on the introduction of new measurement strategies with PolyWorks and provide individual training and professional support.
PolyWorks implements direct interfaces for all tactile and optical digitizers.

The application range of PolyWorks in combination with modern 3D digitizing devices is almost unlimited.
Interactive Positioning

Even the positioning of physical components can be conducted with the help of PolyWorks. In build-inspect mode the 3-dimensional distance of a part to its target position is calculated in realtime. The deviation can then be displayed graphically or numerically. In combination with point based devices, such as laser trackers, PolyWorks will allow you to precisely position machines, fixtures and tools for assembly.

Virtual Assembly

PolyWorks can quickly analyze the accuracy-of-fit of components of an assembly unit. For this purpose the software aligns the 3-dimensional datasets and simulates the ability to incorporate components in production before the actual assembly.

Measurements in three dimensions

By digitizing surfaces with high-density point cloud digitizers, the full geometrical shape of a part can be virtually captured and saved.

On the basis of such a dataset PolyWorks can perform all sorts of measurements, non-destructive and repeatable. The software extracts regular shapes, such as circles, lines, planes or cylinders from point clouds and determines relevant dimensions such as length, width, height and angle. Features can also be probed directly with the help of tactile digitizing devices.

By combining existing entities PolyWorks allows you to create totally new geometries while storing their relationships to other objects. This creates a whole set of new opportunities for dimensional verification.

The evaluation tools in PolyWorks are:
• Collision detection and analysis
• Analysis of problematic intersections
• Analysis of distance between components
Alignment

In order to compare three-dimensional datasets they need to be aligned to each other and transferred into a common coordinate system.

The result of the comparison is closely dependent on the chosen alignment strategy. PolyWorks supports a variety of alignment options and techniques, and thus adapts to the requirements of your measurement task.

All supported alignment strategies can be more closely specified by applying additional constraints.

- Best-Fit Alignment
  PolyWorks calculates the fit with the smallest total deviation (least-squares approximation). Existing tolerance zones are considered when required.

- 3-2-1-Alignment
  Gradual reduction of the degrees of freedom by aligning features like planes, vectors and points.

- Alignment based on a given reference point system (RPS), common in sheet metal inspection.

- Datum reference frame alignment according to GD&T specifications (DIN ISO 1101 and ASME Y14.5M).

- Optimized Flush & Gap Gauges alignment

- Variable alignments using n-pairs of centerpoints.

- Manual alignments

Comparison

PolyWorks allows you to compare measured datasets to CAD surfaces or a second measured reference.

The results of the comparison of surfaces can, for example, be visualized in customizable color maps, allowing the identification of areal deviations at a glance.

A pass-fail analysis can be conducted by specifying local surface tolerances. For a detailed analysis PolyWorks also derives single comparison points from the surface or analyzes whole cross-sections in detail.

In addition PolyWorks enables you to compare all kinds of geometries like circles, cylinders or planes to their respective reference. The measured geometries are automatically assigned to the matching geometries in the CAD-Reference and evaluated in all relevant dimensions.
Geometric Dimensioning and Tolerancing

Tolerance specifications in technical drawings are increasingly being replaced by modern GD&T standards.

The uniform symbolic GD&T language describes the functional properties and dimensions of parts and assemblies in detail.

PolyWorks/Inspector™ contains a complete set of analysis tools for geometric dimensioning and tolerancing standards. In collaboration with Multi Metrics Inc., the SmartGD&T™ technology was implemented. This permits the uniform encoding and decoding of GD&T descriptions according to the standards ISO 1101 and ASME Y 14.5M directly in PolyWorks.

PolyWorks permits:
- The creation and evaluation of datums between points, lines and planes
- Consideration of maximum/minimum material conditions
- Automatic extraction of related features
- Analysis of surface profile tolerances
- Datum based alignment

Statistical Process Control

PolyWorks offers an embedded statistical process control (SPC) to quickly analyze multiple digitized instances of a part or product.

During multi-piece inspection tasks the measurement data of multiple parts can easily be compared to each other or to CAD. Statistical parameters such as variance of point clouds or polygonal meshes can be displayed in a deviation color map. This colorful 3D visualization in PolyWorks is ideally suited to control and optimize production processes as it monitors changes in the production quality.

Range of functions:
- Generation of an averaged polygonal mesh on the basis of all digitized parts (golden template)
- Color map representation of the average and maximum error, the standard deviation and the RMS-Error
- Calculation of process capability ratios (Cp and Cpk)
- Trend analysis and reporting functionalities

Range of functions:
- Import of single measurements
- Statistical analysis of surface points, cross sections, geometries, distances and other measures as well as flush & gap analysis
Airfoil, Profile & Radius Gauges

Aircraft wings, turbine blades, ship propellers, wind turbines and other hydro- and aerodynamic components are described by a characteristic profile.

PolyWorks uses freely definable cross-sections in order to derive geometric parameters and to describe and evaluate these profiles.

- Extraction of "Camber-Line", "Stagger-Line", "Leading-" and "Trailing-Edge"
- Extraction of many other relevant parameters and radii
- Implementation of the special alignment requirements for aerodynamic profiles
- Advanced 2D representation of the results
- Possibility for automation of repetitive measurements

Flush & Gap Analysis

Where parts are joined in a functional way, the detailed analysis of Flushes and Gaps gains more and more importance.

In the automotive industry the transitions between doors and side frames for example are qualified by the Gap, i.e. the distance, and the Flush, i.e. the offset. Narrow gap dimensions optimize the aerodynamic characteristics of a vehicle, reduce driving noises and attest high quality of workmanship. Traditionally Flush and Gap were measured with simple mechanical caliper gauges and analysed locally. By digitizing with optical systems however, the complete profile of a gap transition can be derived in PolyWorks. This allows you to analyse the flush & gap at any number of positions simultaneously.

Range of functions:
- Determination of distances, radii as well as radius entry and exit points
- Classification of characteristic radius curves
- Customization on the basis of templates
- Assessment of other distinctive design elements and character lines (e.g. tornado line)
Company-Specific Inspection Plans

The software D3D++ lets users import their company-specific inspection plans into PolyWorks.

In many companies quality characteristics, measurement instructions and nominal values as defined by the construction department. They are saved in company specific, mostly text-based file formats. These nominal values can be sent to PolyWorks with the help of D3D++, an independent software tool developed by Duwe-3d. The measured geometries can then be re-exported via D3D++ to databases or the company-specific file format. This facilitates a completely automated inspection process according to the specifications of the construction department.

Company-Specific Input Format

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Reporting

PolyWorks allows you to easily create meaningful measurement reports to visualize your measurement data.

Result tables, text descriptions and screenshots of the 3D scene can be combined and arranged freely. There is also the possibility to create company-specific report templates and reuse them for later reports. All created measurement reports are linked with the respective project and can be easily updated when new measurement results are created. This is especially handy for multi-part measurement projects as the whole report only needs to be created for the first part but gets updated with every measurement of a new one. Measurement reports can be fully or partly exported as PDF files and in many other formats (HTML, MS-Office, Text etc.). For the visualization of a measurement project there is also a free PolyWorks 3D Viewer which allows you to share measurement results with colleagues or customers.

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From Point Clouds to Polygonal Meshes

With the help of optical digitizing devices models or parts can be digitized as 3D point clouds for various applications, such as design, mold making and tooling.

In order to use the recorded data for visualization, simulation, rapid prototyping or for milling, these point clouds have to be converted into a polygonal model. PolyWorks supports the entire process of data acquisition and processing through a comprehensive set of functionalities. The software lets you create polygonal meshes by connecting the single points of a point cloud. This process is called triangulation. A single virtual object surface (topology) is formed. PolyWorks always tries to generate triangle meshes with a hexagonal structure whenever possible. The resulting meshes can be saved in STL format for further use.

- Best-Fit-alignment of scan data and overlapping point clouds
- Noise filter and reduction of point clouds
- Quick generation of polygonal meshes with adjustable resolution and accuracy, even with large amounts of data.

PolyWorks: Smoothing and Filtering

PolyWorks offers a range of customizable and flexible functions that let you process and optimize existing polygonal surface models.

The software offers a tolerance-based reduction of the number of triangles in order to reduce the file size and accelerate further processing steps. Multiple meshes can also be combined and merged into a single polygonal mesh. Even converting imported CAD data into watertight meshes is a fast and easy process in PolyWorks. Furthermore the triangle topology can be optimized and polygonal meshes can be smoothed and filtered as required.

PolyWorks allows you to modify the size and structure of a polygonal mesh for:
- High-speed milling
- Aerodynamic simulation (CFD)
Advanced Modeling

The possibilities for editing meshes in PolyWorks are almost unlimited.

Weather you need to correct the topology, close holes with one of the numerous algorithms or rebuild specific areas completely: PolyWorks offers automatic and interactive methods that get the job done. By fitting curves into the polygonal mesh, boundaries can be trimmed and reconstructed. PolyWorks detects round corners and feature lines of parts automatically and reconstructs them as sharp edges. In addition geometric shapes such as cylinders or circles can be fitted into the polygonal mesh and surfaces can be modeled freely. With boolean operations it is furthermore possible to combine and intersect existing polygonal models.

Additional features:
- Extraction of curves and character lines
- Modification and optimization of curves
- Morphing functionalities to update existing CAD data
- Creation of regular „Quad-Mesh“-structures from existing triangle meshes, e.g. for FEM simulation (NASTRAN-format)

Reverse Engineering

Polygons meshes cannot directly be used for construction and design in CAD software as they lack parametric information. Therefore, a further processing step is necessary in order to use digitized datasets in modern CAD applications.

PolyWorks can transfer the polygonal mesh structure into regular geometries and freeform surfaces. By using spline curve networks, NURBS patches are fitted onto an existing polygonal mesh. The adjustment of the surfaces can be varied to compensate for local inaccuracies in the original data. The fitted NURBS surfaces can be exported as a CAD model. In addition Polyworks lets you update and correct existing CAD models.

• Support for G1 and G2 continuity between surfaces
• Export to CAD systems in IGES and STEP format
Precision – this is what we put in everything we do. In our core business, the distribution and support of PolyWorks that means providing our customers with individual solutions and measurement strategies with PolyWorks. But no matter where PolyWorks is in use: Thanks to the revolutionary technology the applications of the software are almost unlimited. PolyWorks is always the first choice for processing and inspecting three-dimensional data sets. We are glad that our customers feel the same.

Our Customers:

ABB
Airbus
Audi
BASF
Benteler
BMW
Bosch
Continental
Daimler
DLR
Eurocopter
Ferrari
Fiat
Ford
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Miele
MTU
Palfinger
Porsche
PSA Peugeot-Citroën
Renault
Rolls-Royce
Seat
Siemens Windpower
Stihl
Toro Rosso
Toyota
Volkswagen
u. v. m.

Parametric Sketching

For parts, which are composed of primitives, it can be useful to take a parametric reverse engineering approach.

PolyWorks allows you to extract geometries and spline curves from polygonal models on the basis of cross sections and describe them parametrically. Constraints on object relations such as parallelism or squareness can also be defined within PolyWorks. The extracted sketches and parametric outlines can easily be processed in professional CAD software which accelerates the reverse engineering process significantly.

The parametric sketcher supports:

• Parametric extraction of arc, line, circle and spline entities
• Interactive entity creation and editing
• Relational constraints between entities (horizontal, vertical, tangent, perpendicular)
• Dimensional constraints between entities
• Export to IGES, STEP and SolidWorks

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