

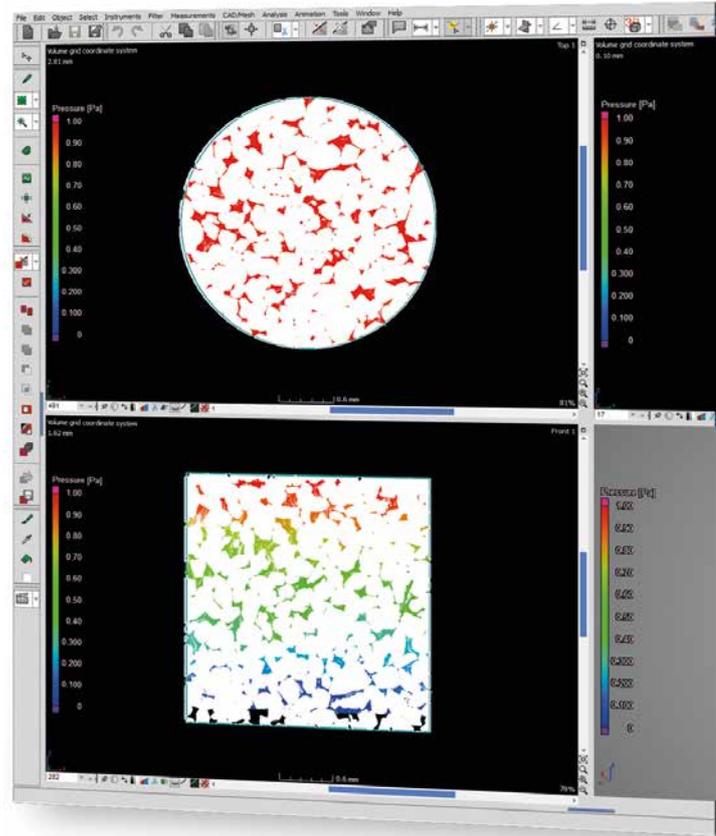
VGStudio MAX 3.0

High-End Industrial CT Software



VOLUME
GRAPHICS

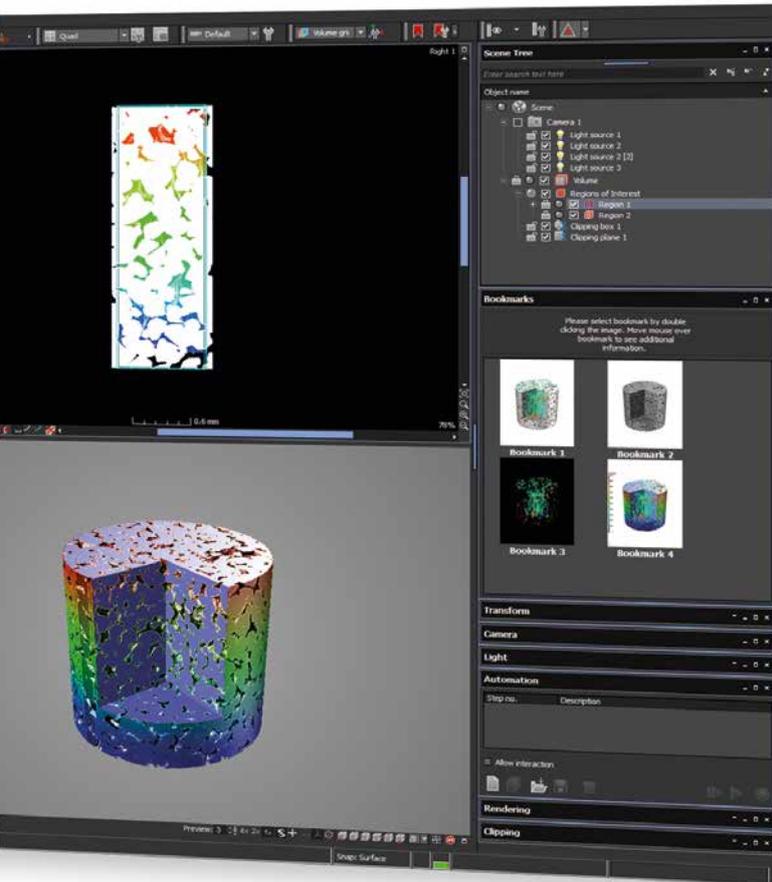
VGStudio MAX 3.0 is the latest version of the high-end software for the analysis and visualization of industrial computed tomography (CT) data. Now more than ever, the software meets your requirements for a future-proof solution for non-destructive testing.



At a Glance

With *VGStudio MAX 3.0*, you:

- determine surfaces with subvoxel precision;
- work natively with voxel, point cloud, mesh, and CAD data;
- segment a volume data set into individual parts;
- use the full performance of your modern hardware;
- reduce memory consumption by working only with solution-relevant data;
- reuse macros like building blocks in different contexts for automation;
- examine bent surfaces as easily as flat surfaces;
- combine analyses, e. g., a wall thickness analysis and a porosity/inclusion analysis;
- measure even on difficult-to-access surfaces of a component (Coordinate Measurement Module);
- compare your manufactured part with CAD data, mesh data (.stl), or other voxel data (Nominal/Actual Comparison Module);
- locate defects within castings and moldings without having to use the saw and the microscope (Enhanced Porosity/Inclusion Analysis Module);
- see if and how pores would be cut during machining – before actually machining the part (Porosity/Inclusion Analysis Module);
- perform virtual experiments on real data, e. g., CT scans of soil and rock samples, other porous materials, or composite materials (Transport Phenomena Module);
- determine cell structures in porous foams and filter materials (Foam Structure Analysis Module);
- calculate fiber orientations in composite materials (Fiber Composite Material Analysis Module);
- find areas with an insufficient or excessive wall thickness or gap width (Wall Thickness Analysis Module);
- reconstruct three-dimensional volume data sets from the images taken by your CT scanner (CT Reconstruction Module);
- import native CAD files and use them for analyses and segmentation tasks (CAD Import Module); and
- make use of additional part information that is saved as PMI data (CAD Import with PMI Module).



Choose from two themes for the interface:
the familiar bright theme (left) and a new dark theme (right).

NEW User Interface

The user interface improves on the previous version without straying too far from it; under the hood, it uses state-of-the-art technologies:

- In addition to the familiar bright theme, *VGStudio MAX 3.0* offers a new dark theme that is perfect for working with gray value images.
- Bright or dark: The new user interface increases usability across the application.

IMPROVED Performance

VGStudio MAX 3.0 has been completely redeveloped in order to use the full performance of modern hardware:

- Open large data sets significantly faster by installing *VGStudio MAX 3.0* on a PC with built-in current SSD or even SSD RAID storage.
- To significantly speed up the calculation of complex tasks, the add-on modules CT Reconstruction and Transport Phenomena use one or multiple GPUs.*
- Unload gray values with the new unload/reload volume data function. Work with high-resolution CT data sets on less powerful PCs and easily transfer such projects. Analysis results – even those based on gray values – are preserved.

* depending on installed hardware

NEW Data Integrity and Safety

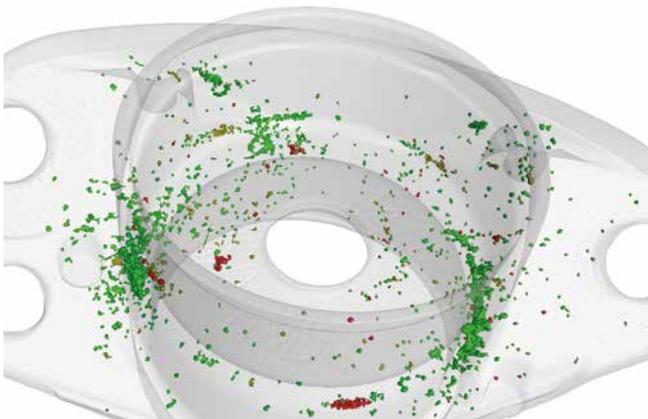
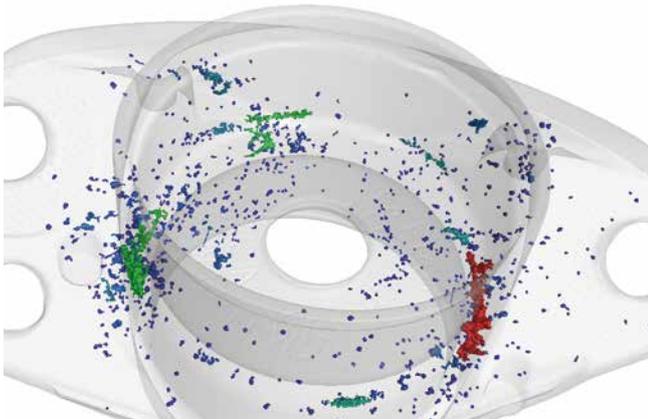
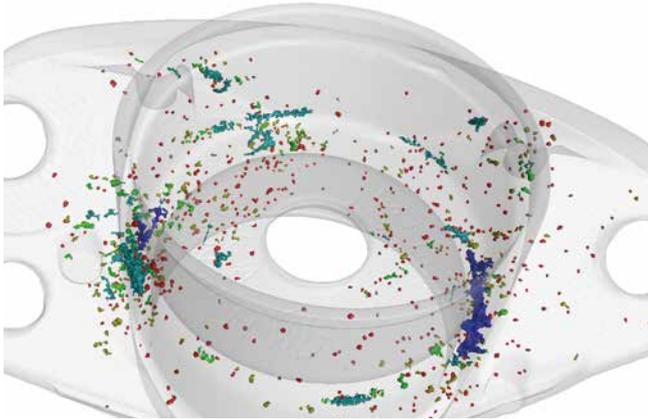
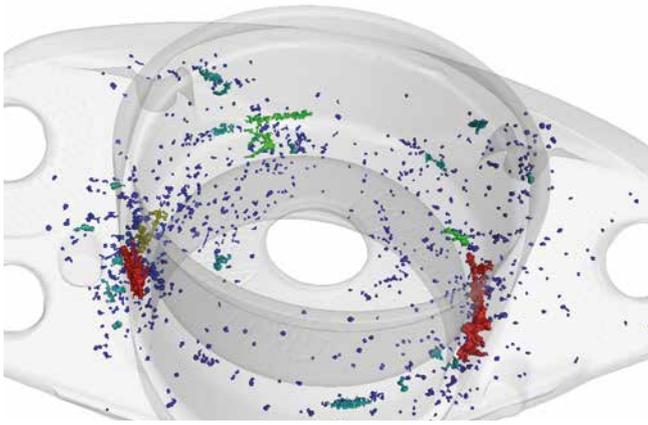
VGStudio MAX 3.0 makes working with files seamless, simple, and extra secure:

- The raw data is now protected against unwanted exchanges and manipulations.
- An improved open function helps those of you who have several users accessing the same project files.
- A single-file option combines all files and folders – including the source data – into one single file.

IMPROVED Instruments

VGStudio MAX 3.0 comes with improved instruments for measuring, e. g., distances, gray values, and angles:

- Instruments now support macros and templates; as well as
- tolerances for evaluation states.



The active columns feature allows you to color code defects according to: volume, sphericity, diameter, distance to surface (from top to bottom).

IMPROVED Bookmarks

In *VGStudio MAX 3.0*, you can now export and import bookmarks (just like templates) and apply them to different data sets. Bookmarks let you easily switch between different project views with multiple objects, analyses, and measurements:

- Save bookmarks including 3D and 2D views, clippings, selected coordinate systems and rendering settings.
- Export and import bookmarks.
- Apply bookmarks to different data sets.
- Also works within macros.

NEW Active Columns

Quickly switch between parameters for color-coding your analysis results – with the new active columns in *VGStudio MAX 3.0*:

- Choose the parameters you want to be the basis for color-coding your findings in visualizations or for your statistics.
- For example, switch between visualizing a defect by its volume and its diameter with the click of a mouse.

IMPROVED Work with Voxel, Point Cloud, CAD, and Mesh Data

VGStudio MAX 3.0 offers plenty of options to import and work natively with CAD, mesh, and point cloud data:

- *VGStudio MAX 3.0* now works with point cloud data in addition to voxel, CAD, and mesh data.
- It reduces measurement uncertainty because geometry object fitting is optimized for each supported data type (voxel, CAD, mesh, and point cloud data).
- Corrupted CAD and mesh data can be repaired and optimized during import.
- CAD and mesh rendering capabilities have been vastly improved.
- You can convert CAD or mesh data to voxel, voxel to mesh, mesh to point cloud, and point cloud to mesh.
- Regions of Interest (ROI) can now also be created on CAD or mesh data and then be used for nominal/actual comparisons and wall thickness analyses.
- Create ROI templates on the CAD model – before the actual CT scan. In combination with evaluation templates, this allows for fast, automated geometry inspection tasks.

NEW Mathematical Operations on Voxel Data

For the first time, you can perform mathematical operations on voxel data with *VGStudio MAX 3.0*:

- Add, subtract, and average voxel data sets.
- Calculate a local maximum or a local minimum data set.
- Draw conclusions for the voxel data sets involved based on sums, differences, and means.
- Combine data sets that are, e. g., scanned using different techniques into one meaningful data set.

IMPROVED Animation Options

Present your CT data more vividly – with the animation options in *VGStudio MAX 3.0*:

- When saving slice images or movies, the new Picture-in-Picture option shows you the exact position of the respective slice within the 3D model.
- A new Anti-Aliasing option leads to smoother-looking renderings.
- The new object exploder animates exploded views of segmented objects.
- As before, you can choose between two tools to create 3D animations: The full-featured classic keyframer and the easy-to-use simple keyframer.

IMPROVED Segmentation Tools

Use the segmentation tools in *VGStudio MAX 3.0* to separate a data set into individual parts.

- Segmentation tools include manual marquee and drawing-style tools as well as semi-automated tools (e. g., the so-called ‘region growing’). These tools will feel familiar to you if used pixel-based picture manipulation tools before.
- With segmentation tools, you separate a data set into individual parts (Regions of Interest, short ROIs). An ROI may consist of different components, materials, etc.
- All analyses and visualizations can be restricted to these ROIs.
- By using CAD models as a starting contour for a (local) adaptive surface determination, you generate precise surfaces more easily, especially in multi-material scenarios.*
- ROIs can now also be created from clipping objects.
- *VGStudio MAX 3.0* comes with sub-voxel precise segmentation capabilities thus further increasing the precision of all data analysis tasks.*

* Requires the Coordinate Measurement Module.



The new object exploder animates explosion diagrams of segmented objects.



The cylindrical surface of a bottleneck has been unrolled to view it in a 'flattened' slice image.

IMPROVED Working with Bent Structures

VGStudio MAX 3.0 simplifies working with bent structures:

- The non-planar viewing mode enables you to 'unroll' cylindrical objects or to flatten/level a dented surface and then scroll into the object slice by slice. What hitherto only has worked with cylindrical objects now also works with freeform surfaces.
- With non-planar resampling, you can level a bent surface (freeform surface), segment this leveled surface, and then transfer the segmentation back onto the bent surface.
- The thick slab option combines consecutive slices into one 2D view. This way the information in these slices becomes visible at a glance.

IMPROVED Documentation and Export

We completely revamped the comprehensive features for data presentation and the documentation of results for *VGStudio MAX 3.0* and added flexible reporting options. The fact that you can now create .pdf files without detours is the smallest of many valuable improvements:

- See analysis results color-coded in 3D and 2D.
- Export images, histograms, and tabular data in common file formats to work with them in other applications.
- Use your data the way you want to by exporting it in the new VG report format (.vgrf). *VGStudio MAX 3.0* then saves all analysis results in a standardized folder and file structure.
- Create hand-in-hand with Microsoft Excel comprehensive and completely customizable test reports. Once customized, you can export your results including tables and pictures in an .xlsx or .pdf file with the click of a button. (Function requires Microsoft Excel.)
- Publish .pdf files without third party tools because *VGStudio MAX 3.0* support this format now natively.
- See the exact position of the respective slice within the 3D model when saving slice images – with the new Picture-in-Picture option.
- Generate reports on all the analyses linked to an object – with the new top-level reporting.
- Define rules which *VGStudio MAX 3.0* follows to generate images or annotations – with the new rule-based image and annotation generation. For example, you can tell *VGStudio MAX 3.0* to generate pictures of all defects exceeding a certain size.

IMPROVED Macros and Templates

Macros are a convenient way to automate processes. *VGStudio MAX 3.0* comes with a completely new flexible macro concept:

- The new macro concept lets you combine and rearrange macros like building blocks. This way, you can flexibly reuse macros in different contexts.
- As usual, you save complex analysis procedures as macros to run them on a single data set or – using the batch processing tool – on several data sets.
- Use macros and templates that you've created in *VGStudio MAX 3.0* for automation with *VG InLine 3.0*.

IMPROVED Evaluations

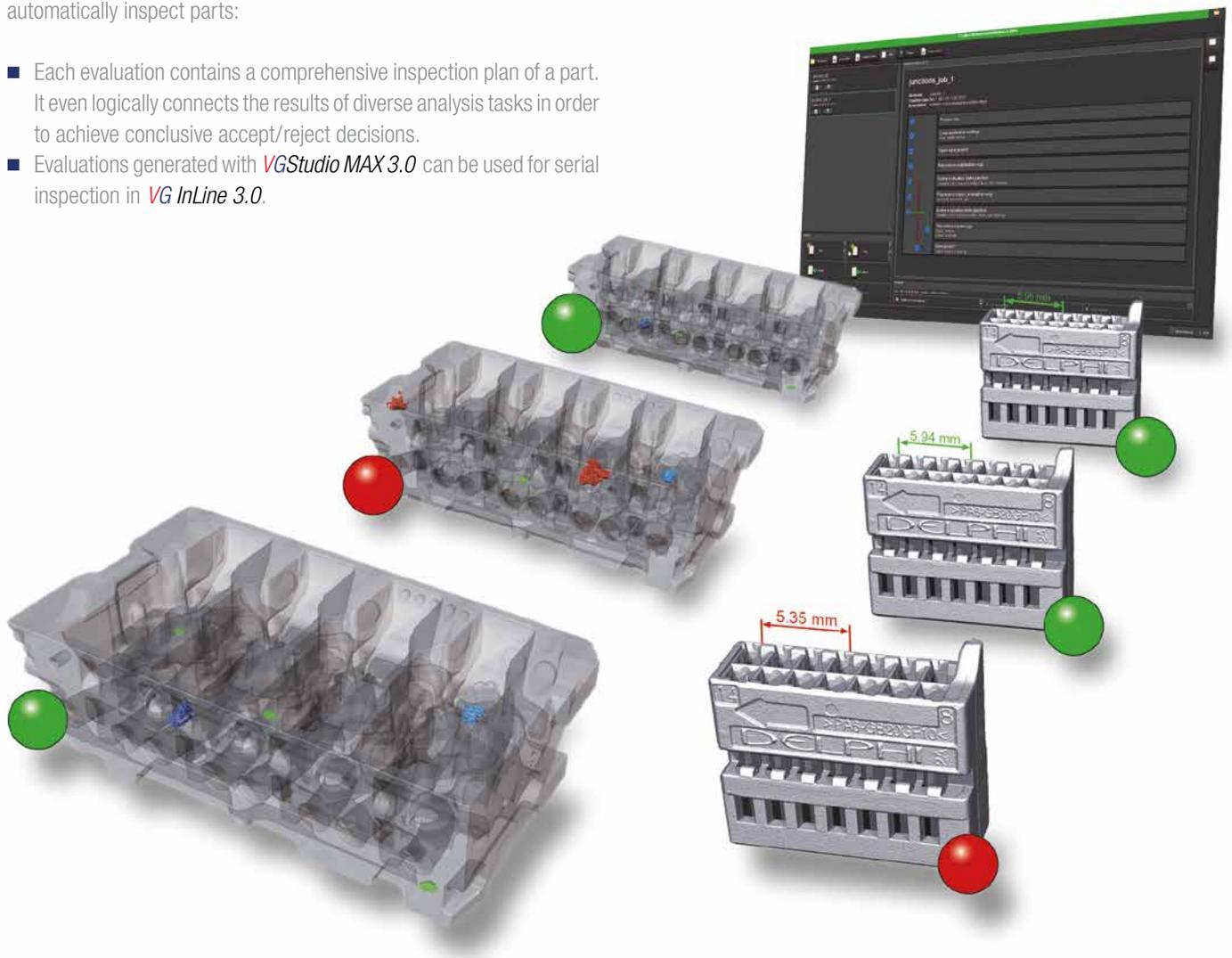
Save comprehensive inspection plans as evaluations to semi or fully automatically inspect parts:

- Each evaluation contains a comprehensive inspection plan of a part. It even logically connects the results of diverse analysis tasks in order to achieve conclusive accept/reject decisions.
- Evaluations generated with *VGStudio MAX 3.0* can be used for serial inspection in *VG InLine 3.0*.

NEW Combined Analyses

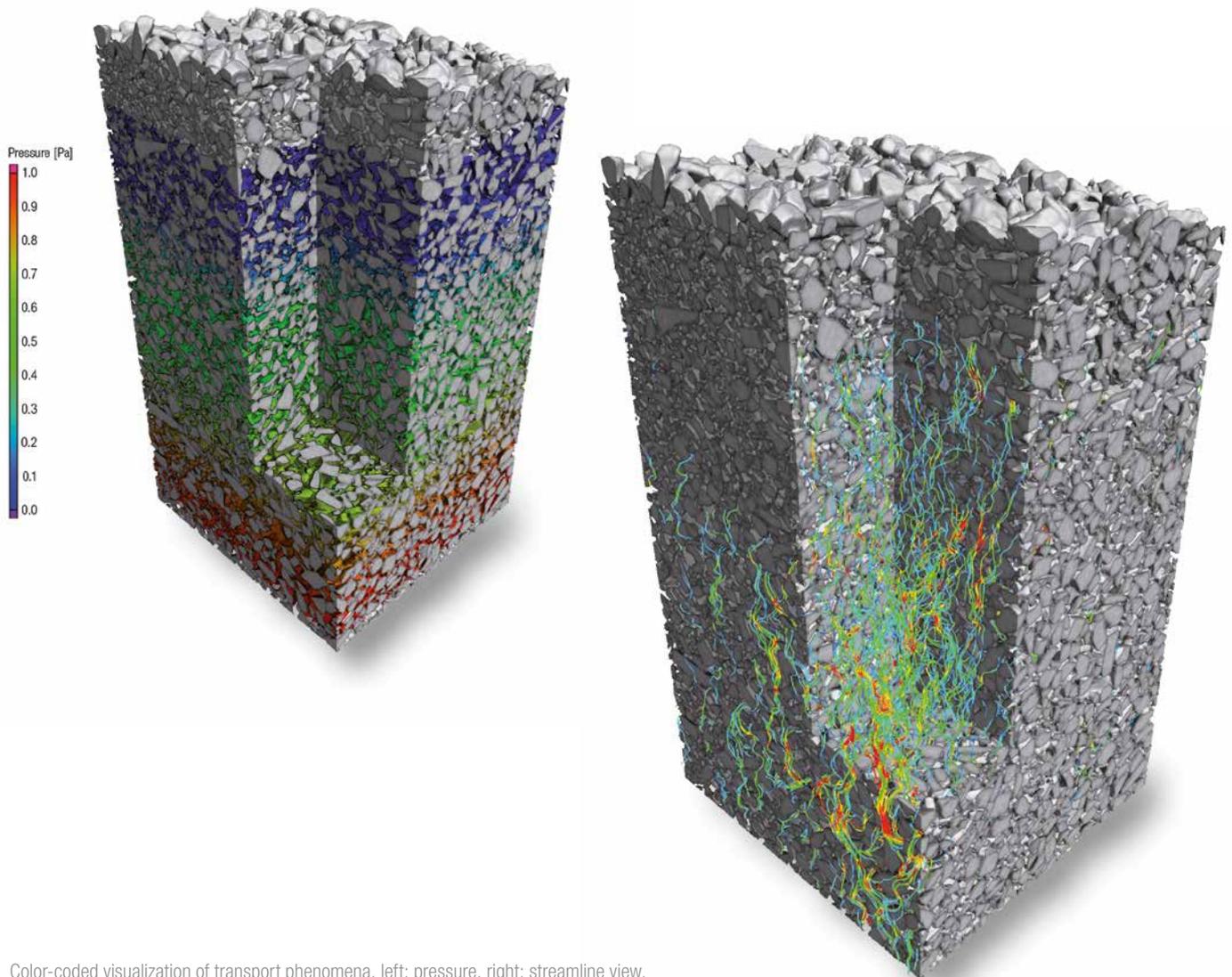
With the new combined analyses feature in *VGStudio MAX 3.0*, you combine the results of successive analyses:

- Combined analyses take the result of one analysis into consideration when performing a follow-up analysis with another module.
- For example, you perform a wall thickness analysis and then combine it with a porosity/inclusion analysis. A defect will then not only be classified according to size, but also reclassified according to its size in relation to the local wall thickness.



Create macros and templates in *VGStudio MAX 3.0* and use them for automation with *VG InLine 3.0*.

VGStudio MAX 3.0 offers an add-on module for nearly every application you can think of.



Color-coded visualization of transport phenomena, left: pressure, right: streamline view.



NEW Transport Phenomena Module

With the new Transport Phenomena Module for *VGStudio MAX 3.0*, you calculate material properties by performing virtual experiments on CT scans of, e.g., soil and rock samples, other porous materials, or composite materials. The module performs all experiments directly on voxel data – no meshing required.

You can:

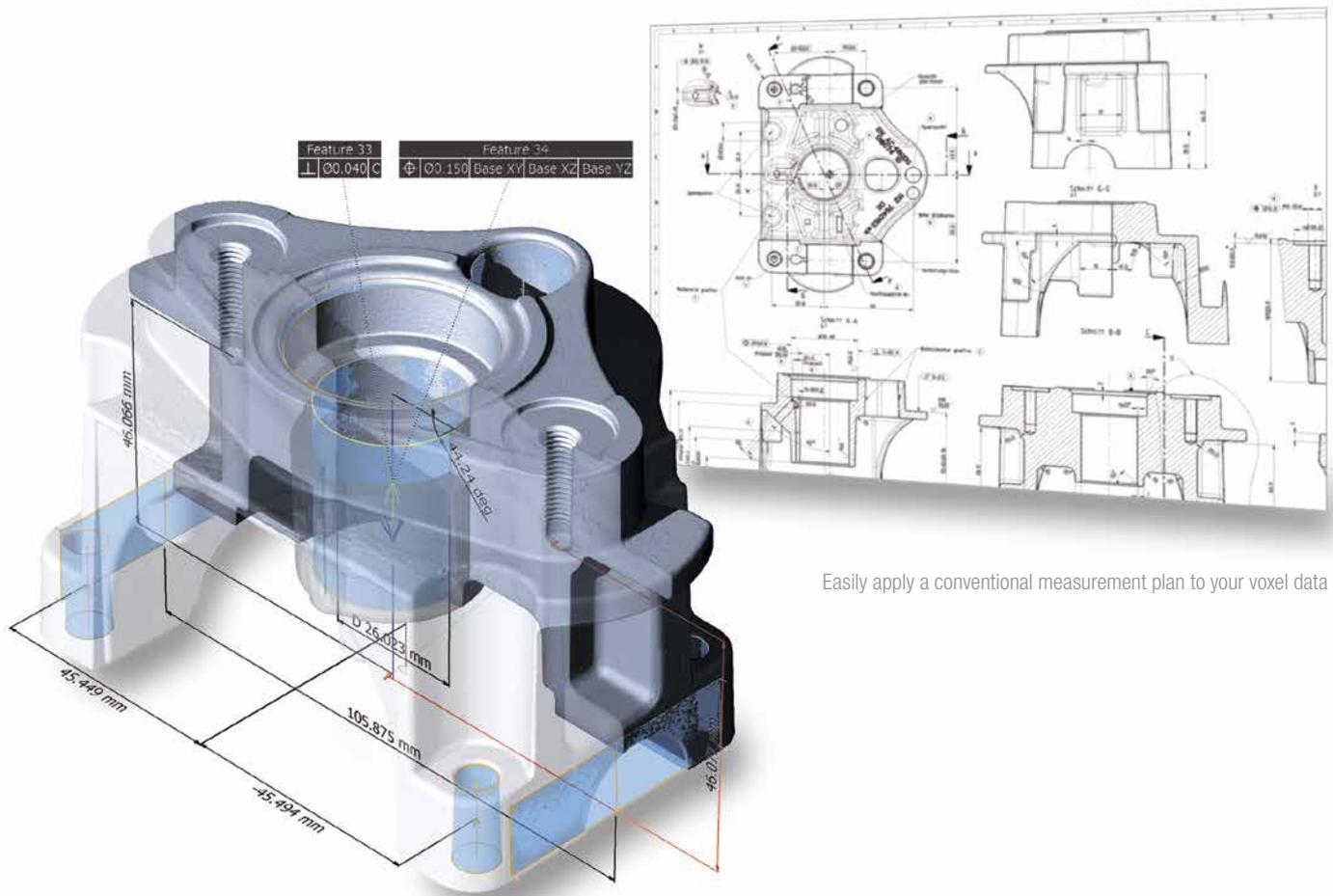
- perform pore-scale simulations directly on CT scans of porous and multi-component materials;
- use virtual flow and diffusion experiments to calculate homogenized material properties such as absolute permeability, tortuosity, formation factor, molecular diffusivity, electrical resistivity, thermal conductivity, or porosity;
- calculate tensor-valued material properties for anisotropic samples;
- stop and re-start the calculation for inspecting intermediate solutions;

- use pore-scale simulation results in upscaled simulations by enriching imported mesh cells in various formats (e.g., NASTRAN, PATRAN) by adding homogenized material properties determined with *VGStudio MAX 3.0*; and
- use these enriched mesh cells in third-party simulation software.

By incorporating OpenCL, the module can use one or multiple GPUs to speed up calculations.

Capillary Pressure Module (part of the Transport Phenomena Module):

- The Capillary Pressure Module provides quantities that are used, e.g., in Geosciences to characterize soil and rock samples.
- It computes the pore size distribution and the capillary pressure drainage curve for a scanned porous material.
- It also performs virtual MICP (mercury injection capillary pressure) experiments.



Easily apply a conventional measurement plan to your voxel data



IMPROVED Coordinate Measurement Module

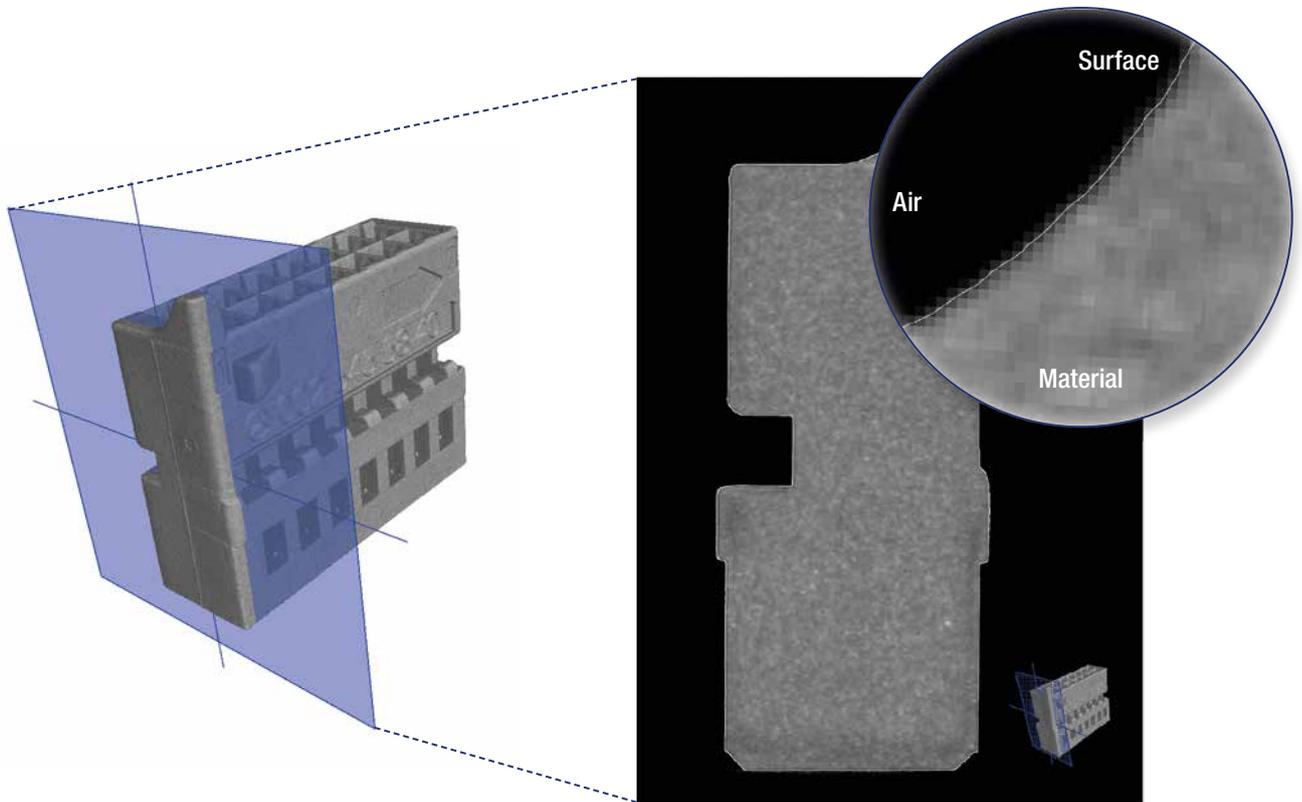
Measure even the most difficult-to-access surfaces of a component. We've added helpful object registration options to the Coordinate Measurement Module (CMM) and significantly improved the best-fit registration.

The module now offers:

- metrology on point clouds in addition to voxel, CAD, and mesh data;
- a complete range of measuring functionality including geometric dimensioning and tolerancing (GD&T according to DIN EN ISO 1101);
- object registration optimized for each supported data type (voxel, CAD, mesh, and point cloud data);
- registration with optional constraints, e. g., rotate an object around one axis only while locking the others;
- enhanced alignment techniques, e. g., 3-2-1 registration that allows for offsets and subsequent rotations to solve highly complex alignment tasks;
- feature-based registration mode that aligns a scan covering only a section of a sample, e. g., to the CAD model of the entire part;
- tolerancing of registration results to determine their quality;
- line and surface profile tolerances;
- more construction possibilities with geometry elements;
- the extraction of min./max. fit points of a contour;
- reduction of measurement uncertainty by using thousands of automatically generated fit points;
- the ability to create preparatory inspection plans on CAD data, mesh data (.stl), or even on another CT scan; and
- saving of .mvgl files for *VG Metrology 3.0*.



The Volume Graphics Metrology Kernel in *VGStudio MAX 3.0* is verified by the Physikalisch-Technische Bundesanstalt (PTB), Germany's national metrology institute.



Between material and air is the surface. Often the surface is defined by a single gray value. When using Advanced Surface Determination, however, the gray values are processed depending on the gray values of the surrounding voxels. The result is a much more precise surface.



IMPROVED Advanced Surface Determination

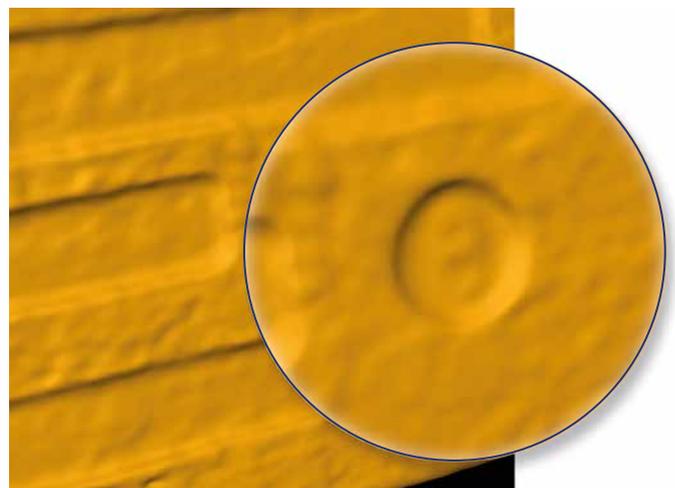
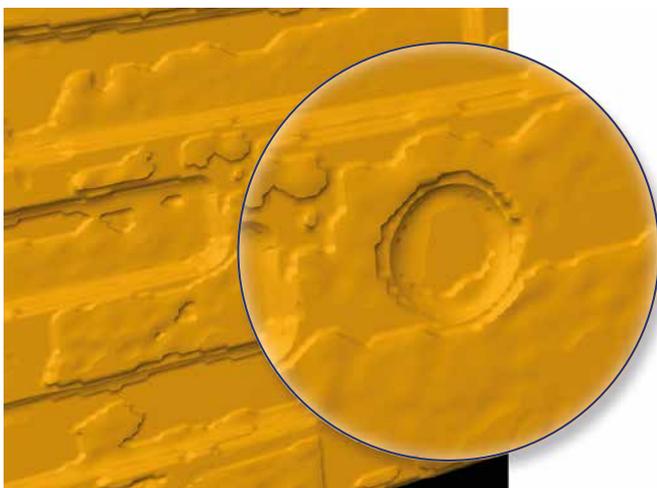
Comes with Coordinate Measurement Module

The high-precision, locally adaptive surface determination now offers subvoxel accuracy, even within an automated environment and in changing gray value conditions. This is made possible by a new interval-based mode – in addition to the automatic and manual modes.

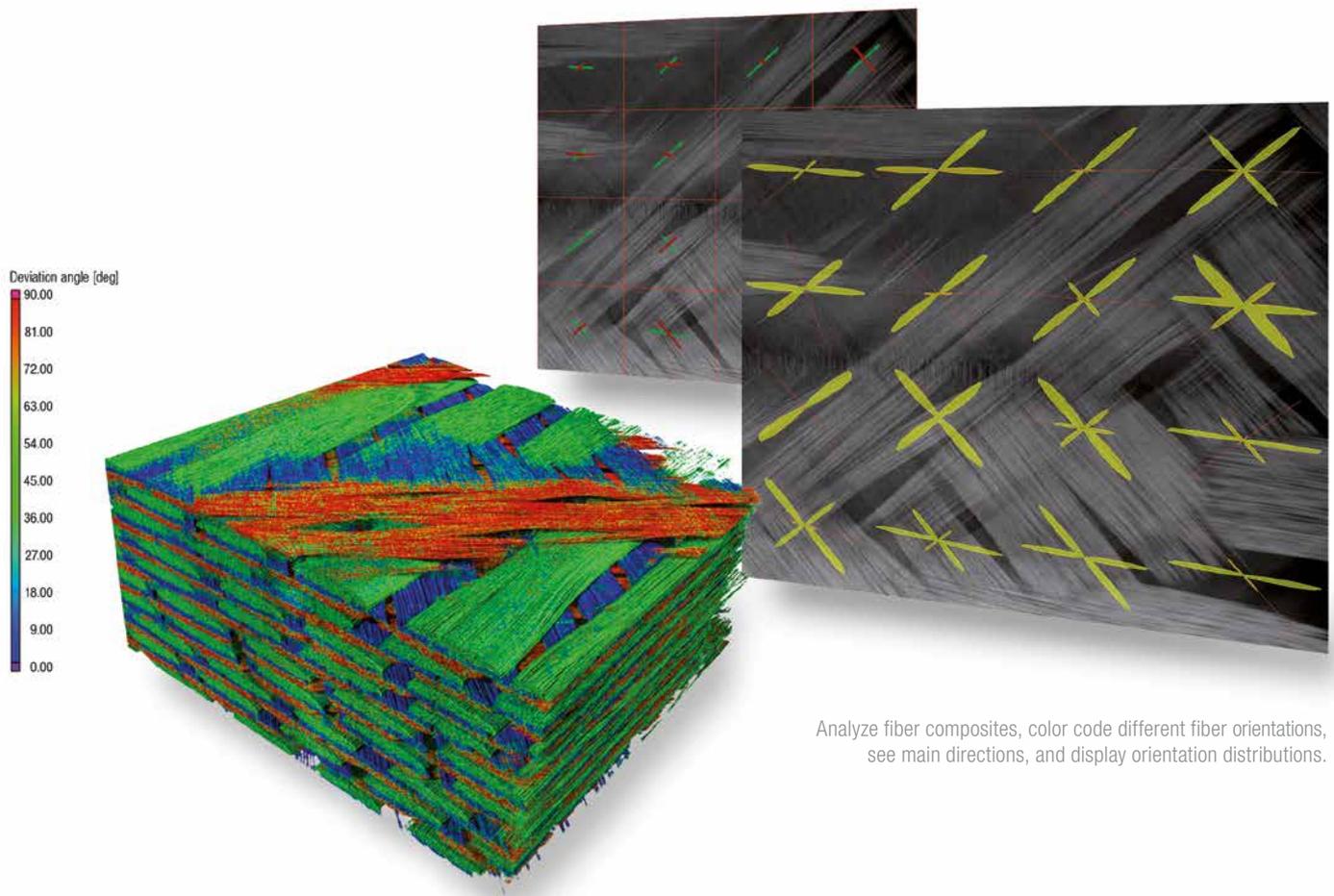
To achieve subvoxel accuracy, *VGStudio MAX 3.0* processes the gray values of individual voxels in a way which makes even those details visible that are smaller than a voxel.

With the new interval-based surface determination, you can:

- define intervals for background and material gray values and, as a result, reliably determine surfaces in changing gray value conditions;
- perform certain new inspection tasks that were not possible before; and
- speed up your automated inspection tasks.



Not only smoother but also more detailed: Using the sub-voxel-precise surface determination (right) reduces your measurement uncertainty by giving you details the voxel-based surface determination (left) is not able to show.



Analyze fiber composites, color code different fiber orientations, see main directions, and display orientation distributions.

IMPROVED Fiber Composite Material Analysis Module

The significantly improved Fiber Composite Material Analysis Module gives you deep insights into fiber composite materials such as carbon-fiber-reinforced plastic (CFRP) or glass-reinforced plastic (GRP). And it allows you to export these insights, e. g., to your simulation software.

In *VGStudio MAX 3.0*, we especially added more functionality for the handling of layered and woven materials.

The module calculates, e. g.:

- local fiber orientations;
- local fiber volume fractions;
- global fiber orientation distributions;
- global volume fractions; and
- other statistical parameters.

With the improved module you can:

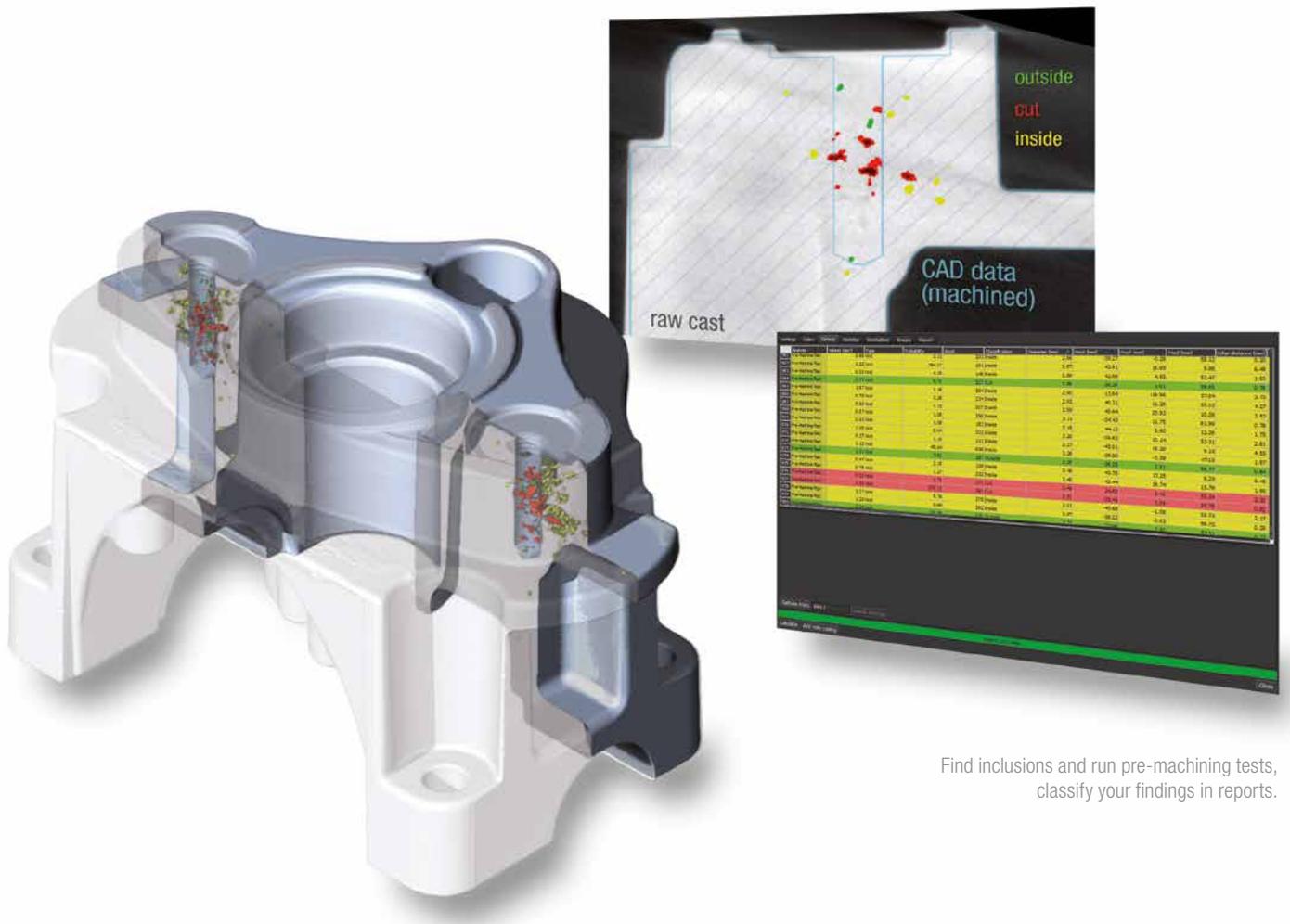
- display local fiber orientation color-coded or as vectors, tensors, and streamlines;
- display global orientation distribution, e. g., as a histogram; and
- produce line plots of the individual components of the orientation tensor in order to easily compare nominal and actual values.
- import your simulation mesh with the enhanced support of PATRAN and NASTRAN files;
- view the detailed angular distribution of any number of directions in a 2D histogram;
- determine the main orientations for rovings; and
- export these material properties for use in your simulation software.



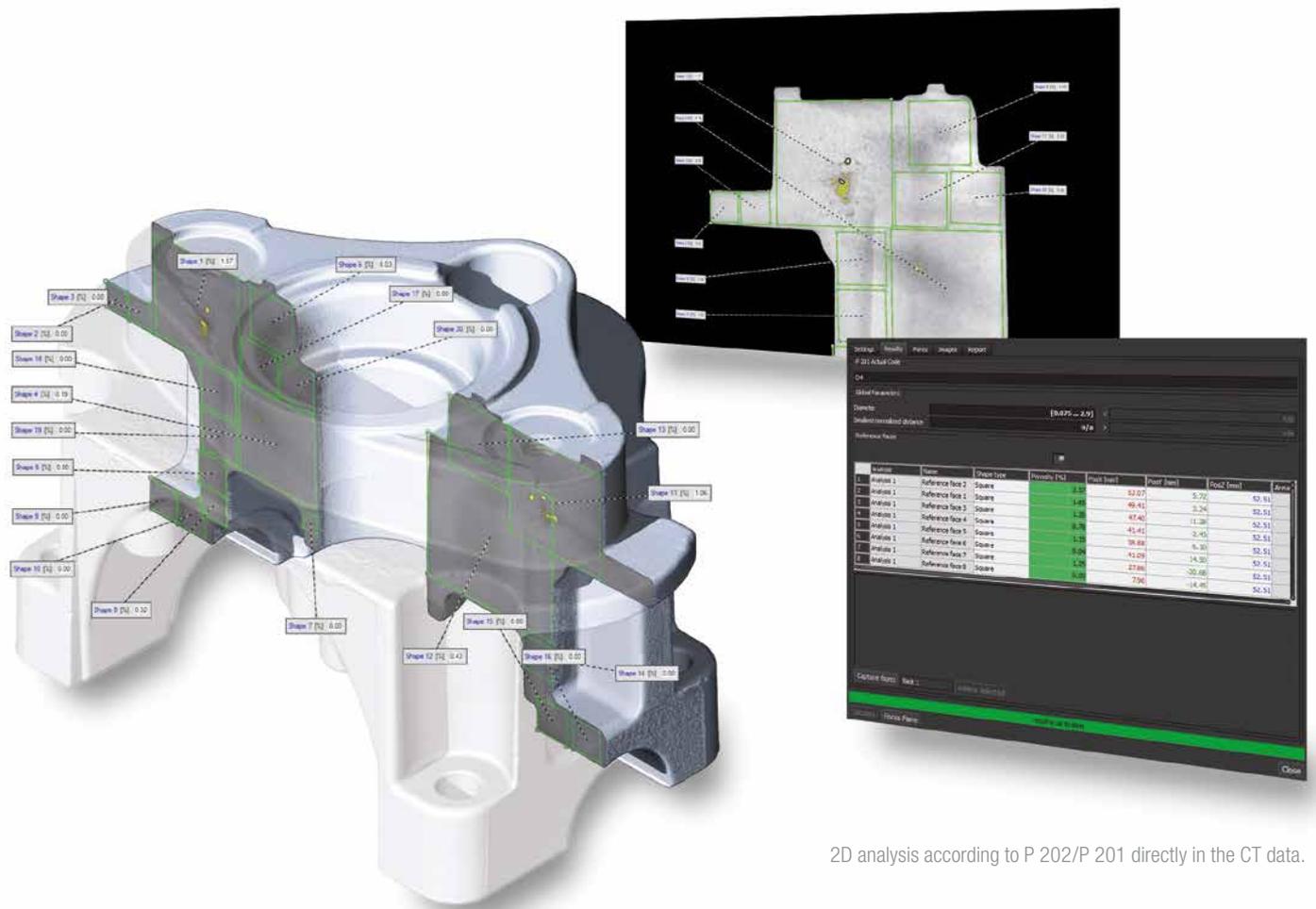
IMPROVED Porosity/Inclusion Analysis Module

Locate pores, holes, and inclusions within castings and moldings and get detailed information about these defects with the improved Porosity/Inclusion Analysis Module.

- Use the module to automatically detect, analyze, and visualize pores, holes, and inclusions.
- Calculate various parameters for each defect (defect position, defect compactness, defect size and geometry, gap to closest other defect, distance of each defect to a reference surface).
- Calculate the overall percentage of porosity and see it in a defect volume histogram.
- Export analysis results and import simulation results from, e. g., MAGMASOFT®.
- Use the VGDefX defect detection algorithm for an optimized calculation of defects based on different criteria.
- Find and calculate cut faces and apply tolerances to them in pre-machining tests (CAD file of the part required). See which pores will be inside or outside the machined part and how they would be cut during machining.
- Combined analyses: E. g., perform a wall thickness analysis before a porosity/inclusion analysis. A defect will then not only be classified according to size, but also reclassified according to its size in relation to the local wall thickness.
- Find defects of different shapes with the filter function.
- Visualize your results in scatterplots.



Find inclusions and run pre-machining tests, classify your findings in reports.



2D analysis according to P 202/P 201 directly in the CT data.



IMPROVED Enhanced Porosity/Inclusion Analysis Module

The improved Enhanced Porosity/Inclusion Analysis Module allows you to find defects in castings without having to use a saw and a microscope. The module meets the rules P 202 and P 201 for examining the porosity of castings made of non-ferrous metals set by the VDG (German Association of Foundry Specialists).

The module:

- supports defect analysis in line with the VDG rule P 202 (VW 50093), in addition to P 201 (VW 50097);
- eliminates the need for the time-consuming production of micrograph sections and the preparation of samples in many cases;
- quantifies the surface size of defects in CT slice images automatically; and
- supports templates to rapidly and repeatedly analyze all parts without manual intervention.



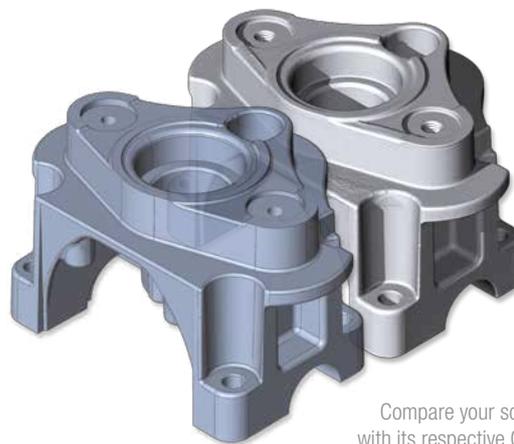
IMPROVED Nominal/Actual Comparison Module

The improved Nominal/Actual Comparison Module allows for a direct comparison of voxel data with CAD or other voxel data. Being able to directly compare the dimensions of a part within one software environment is much more efficient than any conventional method.

The module:

- allows the geometric comparison on CAD data, mesh data (.stl), and, of course, on voxel data (e. g., a defined 'good part');
- allows the application of tolerances to the nominal/actual comparison with various parameters, e. g., deviation (minimum, maximum, cumulated); and
- processes faulty CAD or mesh data.

Note: The Nominal/Actual Comparison Module requires the Coordinate Measurement Module.



Compare your scanned object with its respective CAD data set.



Get color-coded results of deviations and local annotations.



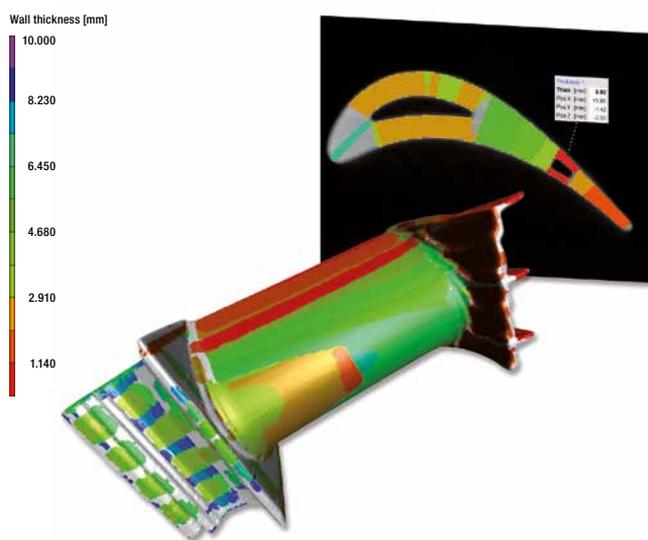
IMPROVED Wall Thickness Analysis Module

With the Wall Thickness Analysis Module, areas with an insufficient or excessive wall thickness or gap width can be automatically localized directly within the voxel, point cloud, mesh, or CAD data set.

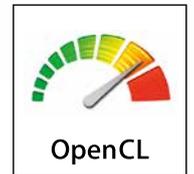
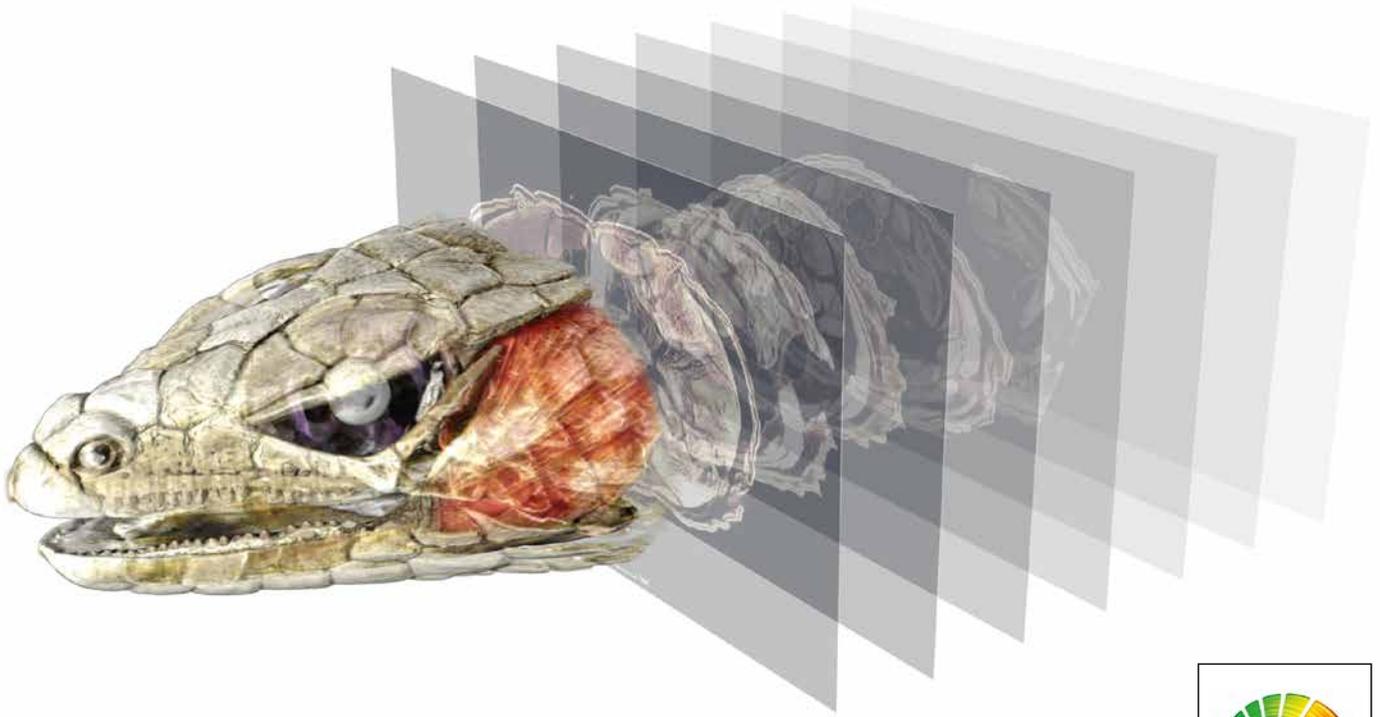
The module:

- automatically and quickly analyzes wall thicknesses;
- allows the application of tolerances to the wall thickness analysis with various parameters, e. g., thickness (minimum, maximum, mean, deviation); and
- reduces the number of false detections with a new noise filter. This is especially helpful for automated inspections.

Note: If wall thickness analyses are to be evaluated with the highest possible precision and within a precisely defined coordinate system, the optional Coordinate Measurement Module is required.



Color-coded results of a wall thickness analysis.



For highest performance needs, VG's CT Reconstruction Module now comes with OpenCL multi GPU support.



IMPROVED CT Reconstruction Module

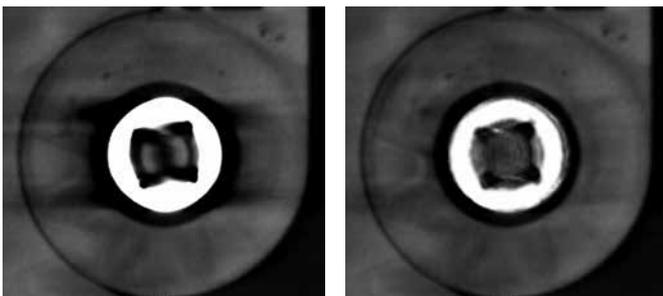
The improved CT Reconstruction Module quickly and precisely calculates three-dimensional volume data sets from the images taken by your CT scanner. You can then analyze and visualize these volume data set in *VGStudio MAX 3.0*.

The module:

- uses, by incorporating OpenCL, one or multiple GPUs to speed up calculations;
- offers interactive reconstruction previews;
- supports cone beam, fan beam, parallel beam, planar, and helical (spiral) CT;
- offers better support of planar CT including CT geometry misalignment correction;

- uses the algorithms Feldkamp, Davis, and Kress (FDK) and Algebraic Reconstruction Technique (ART) for the image reconstruction of, e. g., planar or helical (spiral) scans;
- reduces metal and ring artifacts;
- uses more robust automatic scan geometry corrections (e. g., horizontal detector offset correction and axis tilt correction); and
- improves the image quality using the standard Volume Graphics beam hardening correction or the optional Iterative Artifact Reduction (IAR)*.

* Technology licensed by Fraunhofer EZRT



Left: without metal artifact reduction
Right: with metal artifact reduction

Licensing Options

VGStudio MAX 3.0 is available as node-locked, floating or dongle license and comes in six language localizations (English, German, French, Japanese, Chinese, and Korean). The software can be purchased with an optional Update/Service Agreement that gives you access to regular product updates and priority support.

To try *VGStudio MAX 3.0* before you buy, request a free evaluation license with full functionality on our website (www.volumegraphics.com/trial).

System Requirements

Please visit our website to read about the latest system requirements of *VGStudio MAX 3.0* (www.volumegraphics.com/requirements)

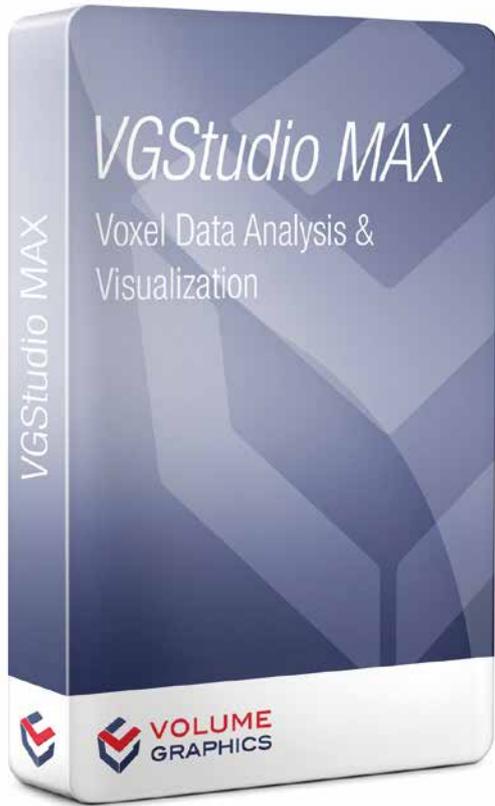
Software Bundles

With its add-on modules, *VGStudio MAX 3.0* can be tailored to the needs of virtually any industry. In order to save you time, we've put together packages for the most common tasks in your field of application. See the table for a detailed description of the *VGStudio MAX 3.0* software bundles.

The pre-packaged software bundles offer considerable savings in comparison to buying modules separately. All analysis add-on modules available for *VGStudio MAX 3.0* can, of course, also be configured individually if your demands are not covered by our bundles. Our sales team will be more than happy to advise you on the option that is just right for you.

Moreover, all software bundles already come with an Update/Service Agreement that will keep the software up-to-date up to one year after the date of purchase.

Bundles	 <i>VGStudio MAX 3.0</i> Geometry	 IMPROVED <i>VGStudio MAX 3.0</i> Material	 <i>VGStudio MAX 3.0</i> Cast & Mold
It's made for	<ul style="list-style-type: none"> – metrology and quality control in a variety of industries; – users who need to measure and analyze the geometrical properties of parts; and – e. g., first article inspection, tool compensation, for assembly inspection, for damage analysis, and all kinds of nominal/actual comparisons. 	<ul style="list-style-type: none"> – lightweight construction in a variety of industries, e. g., aerospace; – users who need a detailed insight into the material properties of parts; and – e. g., finding specific material structures like pores, holes and inclusions as well as the orientation of fibers in composite materials. 	<ul style="list-style-type: none"> – automotive industry, aerospace industry, medical engineering; – users who want to examine cast parts; and – answering geometrical as well as material-related questions.
Consists of			
Coordinate Measurement Module	✓	✓	✓
Nominal/Actual Comparison Module	✓		✓
Wall Thickness Analysis Module	✓		✓
Porosity/Inclusion Analysis Module		✓	✓
Enhanced Porosity/Inclusion Analysis Module			
Fiber Composite Material Analysis Module		✓	
Transport Phenomena Module			
Foam Structure Analysis Module		✓	



 VGStudio MAX 3.0 Cast & Mold Enhanced	 NEW VGStudio MAX 3.0 Composites & Plastic	 NEW VGStudio MAX 3.0 Oil & Gas	 IMPROVED VGStudio MAX 3.0 Complete
<ul style="list-style-type: none"> – aluminum casting, mainly for the automotive industry; and – users who need non-destructive 2D defect analysis of castings directly on CT slice images according to specifications P 202/VW 50093 and P 201/VW 50097. 	<ul style="list-style-type: none"> – industries working with plastic injection molding and fiber composite materials; – users who need geometrical as well as material-related insight into parts, even when dealing with fiber composite materials; and – e.g., finding pores, holes and inclusions, orientation of fibers in composite materials as well as nominal/actual comparisons or wall thickness analyses. 	<ul style="list-style-type: none"> – oil and gas industry, geologists, construction industry, filter manufacturers; – users who need to quantify and analyze properties of different phases in porous and multi-component materials; and – e.g., determine cell structures in porous foams and filter materials or calculate complex phenomena such as permeability, diffusivity, electrical resistivity, thermal conductivity. 	<ul style="list-style-type: none"> – advanced users in quality assurance labs that face different analysis and measurement tasks as part of their daily work routine.
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Volume Graphics

Volume Graphics GmbH, founded in 1997, develops software for the analysis and visualization of industrial computed tomography data. Today, thousands of companies across diverse industries use our software. They analyze, inspect, and measure objects in research, production, and quality assurance. Our customers value our software's ability to display and analyze voxel, point cloud, mesh, and CAD data within one application.

VGStudio MAX is our extendable high-end software; *VGStudio* offers a budget entry into the world of CT data analysis and visualization; *VG InLine* brings industrial CT in or close to the production process; *VG Metrology* turns a computed tomography scanner into a comprehensive and precise metrology device; and *myVGL* is the free, universal CT data viewer.

Our customers get more than support: We offer training courses and partner certification in our VG Academy, consulting services in all aspects of industrial computed tomography, and custom development projects in the fields of analysis, visualization, and processing of volumetric data.



Visit our website to learn more about our software, support and training opportunities, custom software development and consulting services.

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