Wyrowski VirtualLab
Release Notes

March 2019

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VirtualLab Fusion 7.5.0
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Contents

1   VirtualLab Fusion 2nd Generation Technology Update (Build 7.5.0.158)

Release Date	March 2019
Update Service	1st quarter 2019 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.5.0.158) replaces VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

1.1 User Interface

- VirtualLab now comes with many new and updated **Focus Topics**. The corresponding section of the *Start* ribbon has been completely reworked.

- Optional **indicator for hidden digits** in text boxes which show a physical value (= *physical unit text boxes*). This indicator provides a tooltip showing all digits.

- You can now *Copy Value* of a physical unit text box to the clipboard. This allows you to paste it into other text boxes with full precision.

- For the **Detectors Result** tab of the main window you can now switch off physical units. This eases up copying the values to other programs.

- For the Stored Function, the Stored Lateral Field and the Customized Planar Source, the **Set button** now allows you to reset the data to a default value and to load it from files.

- For the **Combined Output** of Chromatic Fields Sets into Animations, "Scale to Common Value Range" is now also available for the real color mode.

- Optional **transparency** for document windows copied to the clipboard.

- The preview for **interface media sequences** now allows you to change the preview wavelength.

1.2 Performance

- Improved performance for loading and processing of certain **optical setups**.

- The fitting of (linear, quadratic, spherical, polynomial, …) **functions** now runs faster and in parallel.

- You can now configure which regions of a **surface layout** expose their parameters to Parameter Extraction. This can increase performance significantly and makes e. g. the Parameter Overview less crowded.

1.3 Programming

Modules can now be processed via batch files using the command "`virtuallab.exe -performModule {module path and file name}`".

1.4 Optical Setup & Simulation Engines

- For the Field Tracing 2nd Generation the new **Homeomorphic Fourier Transformation** has been added.

- You can now define which Fourier Transformations are to be used for Field Tracing 2nd Generation.

- New *Oversampling Factor Gridded Data* for Field Tracing 2nd Generation.

- Better handling of **very small translations and rotations** of Optical Setup Elements.

1.5 Light Sources

- Now negative values for the angular order of a **Laguerre Gaussian** can be entered. This allows for example the generation of petal modes.

- The **Stored Lateral Field** light source now handles an analytical spherical phase factor of the stored field.

1.6 Ideal Components

- **Jones Matrix Components** can now have an aperture.

- Ideal Components which represent a transmission can now be **illuminated from behind**.

1.7 Real Components

- New **Rudimentary Waveguide** component for the Starter Toolbox.

- Now all types of components can be saved to the **Components Catalog**.

1.8 Detectors

The **Uniformity Detector** can now determine the pupil positions automatically (from the chief rays).

1.9 Parameter Run

New Combined Output which converts multiple two-dimensional data arrays or sets of data arrays into an **animation** and also works for gridless data.

1.10 Calculators

- New **Coherence Time & Length Calculator**. This calculator can be used from various detectors which allow setting the coherence time.

- New **Debye-Wolf Integral Calculator** to calculate the field in or near the focal plane.

1.11 Data Arrays and Related Documents

- One or more subsets can now be **extracted** from a Data Array without the detour of using *Delete Subsets*.

- A **Set of Data Arrays** can now be converted into a single data array.

- **Selection markers** can now be copied from any type of data array based document to another. For example you can copy a marker from a Ray Distribution to a Set of Data Arrays.

- New tool to synchronize colors and / or symbols in **Multigraph mode** of 1D Data Arrays.

- **Font size** for diagram titles can be set separately now.

- Clearer indication of the **zero value** in color scales.

- You can now specify a separate number of displayed digits for color scales.

- For ray distributions, the format of the **color scale** can now be changed.

- New **color lookup tables** have been added.

1.12 Optical Components

The Zernike Standard Interface has been extended to the **"Zernike & Seidel Interface"**, which means that now also Zernike Fringe and Seidel coefficients can be entered.

1.13 Import

The **Zernike Fringe Sag** from Zemax can now be imported.

1.14 Changes

- Changed (default) extension of Optical Setups to **.os**.

- Changed (default) extension of Optical Setup Elements to **.ose**.

- If the **Spot Size** detector is used for Field Tracing 2nd Generation, now always the more accurate second momentum theory is used.

- If the period of the reference interface or medium is infinity, the resulting **stack period** is now 1 pm. This avoids an infinite number of resulting orders.

- To increase clarity, the **Field Inside Component Analyzer: Split Step** now returns Sets of Data Arrays if more than one harmonic field component is calculated.

- The view settings of **3D ray distributions** saved in prior versions cannot be loaded and are thus reset.

- The settings of a **Coating Analyzer** saved in prior versions cannot be loaded and are thus reset.

- Data Array based documents resulting from an Optical Setup now mostly use the **extrapolation method** *Constant Value [of zero]* instead of *Border Value Continuation*.

- The maximum **spherical phase radius** has been decreased to 10^7 meters to avoid numerical problems.

- *Sampling Accuracy* for Field Tracing 2nd Generation has been renamed to *Oversampling Factor (Grid-less Data)*.

2   VirtualLab Fusion 2nd Generation Technology Update (Build 7.4.0.49)

Release Date	August 2018
Update Service	3rd quarter 2018 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.4.0.49) replaces VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

2.1 Handling

- The Optical Setup Tool **Insert Element** now asks for the optical channel to which the element shall be added.

2.2 Import & Export

- Harmonic Fields can now be exported to **16 bit gray scale images**. This increases the number of possible gray scale values to 65 536 instead of only 256.

- **16 bit gray scale images** can now be imported into Harmonic Fields and Data Arrays.

- You can now export **single members** of a Harmonic Fields Set into an image.

- 1D HFS are now exported as **1D bitmaps** to ease import into other programs.

2.3 Optimization

Levenberg-Marquardt Algorithm available for Parametric Optimization.

2.4 Parameter Run

- New Combined Output to generate a **two-dimensional data array** out of 1D data arrays.

- New Combined Output to generate a **two-dimensional Chromatic Fields Set** out of 1D Chromatic Fields Sets.

2.5 Performance

- **Optimized automatic sampling** for 2nd Generation Field Tracing.

- Certain **IFTA optimizations** now run 20 % faster than in VirtualLab 7.3.

- The generation of **Parameter Runs and Parametric Optimizations** with many parameters is now substantially faster.
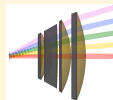
2.6 Programming

- Added stacks as Global Parameters for the **Programmable Function**.

- Added data array as Global Parameter for the **Programmable (Pulse) Spectrum**.

2.7 Sources

- New **Laser Scanning Source**
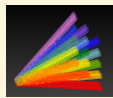
How to Set Up a Scanning Source

Evaluation of an F-Theta Scanning Lens

- New **Panel Type Source**
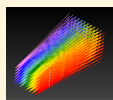
How to Set Up a Panel Type Source

2.8 Views & Data Arrays

- Added conversion from **Order Collections to equidistant data arrays**.

- The user defines the **start coordinate for line data** extracted from gridless 2D data now.

- New **Scale to Given Value Range** manipulation for all numerical data arrays.

- In the 3D and the 2D ray tracing view (when positions or directions are shown), the **color look up table** is used for coloring all incoherent and wavelength modes.

- The Animations view now allows **fractional frames per second**.

- The first column in the table of an Order Collection now shows **order numbers** instead of 1D indices.

2.9 Waveguide Component

- **Programmable Efficiencies** for Grating Regions

- Within the Waveguide Component now also **3D gratings** (which are not invariant in y-direction) can be used.

- **Split Component** Tool now also works for Waveguide Components.

2.10 Changes

- For consistency, the manipulation **Extract Numerical Data Array** has been renamed to "Create Numerical Data Array" (to "Extract Current Data Array" for Set of Objects with the new shortcut `Shift` + `F3`).

- **Custom FMMs** now must have another interface.

- In **Global Options** dialog, moved *Initial Window Size of Result Documents* from *Views > General > Main Window* to *Views > Document Windows > General*.

- **Pattern Generating Diffuser** now uses Nearest Neighbor interpolation.

- The **CPU usage gauge** is now related to the number of physical cores, not logical cores.

3   VirtualLab Fusion 2nd Generation Technology Update (Build 7.3.1.5)

Release Date	April 2018
Update Service	1st quarter 2018 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.3.1.5) replaces VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

This is a service release without additional features.

4   VirtualLab Fusion 2nd Generation Technology Update (Build 7.3.0.50)

| Release Date	March 2018
Update Service	1st quarter 2018 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.3.0.50) replaces VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

New Non-Sequential Extension

Our new Non-Sequential Extension allows non-sequential simulations where the simulation does not follow the sequence of components and interfaces defined in the Optical Setup. Instead it is examined which way the light actually takes. This allows you to examine among others multiple reflections, back scattering, interferometers, and ghost images.
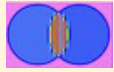
System Analysis with Sequential and Non-Sequential Tracing
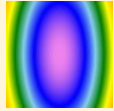
Ghost Image in Collimation System

4.1 Analyzers

The **Coating Analyzer** can now be used for the Parametric Optimization. Thus coatings can be optimized.

4.2 Components

- If a **spherical lens** is invalid, it is now indicated better why this is the case. The parametric optimization no longer designs invalid lenses.

- Correct geometry for **Ideal Beam Splitter** and **Polarization Beam Splitter**.

- Several additional Ideal Components can now be configured to have a **finite aperture**.

- The definition areas of the interfaces in the **Waveguide** component can now be synchronized.

4.3 Detectors

- **Programmable Detectors** now allow interfaces and stacks as Global Parameters.

4.4 Handling

- Document windows can now be renamed, minimized, shown in front, and closed via context menu in the **VirtualLab Explorer**.

- For modules and snippets now **compiler warnings** are always shown. These warnings for example inform you about obsolete methods which may be removed in a future version of VirtualLab.

- **Updated Source Code Editor** (improved code completion, searching highlights all occurrences, improved tooltips for constructors)

- In the **status bar** of the main window now an information about the current parallelization settings is shown.

- Added sample **Slanted Grating Optical Setup** to the ribbon.

- Now nice values for the **scale bar** length in the 3D view are used.

- Warning when a **time-limited license** comes to its end.

4.5 Import & Export

- **Chromatic Fields Sets** can now be exported to text files.

- **Bitmaps** can now be imported also into Chromatic Fields Sets.
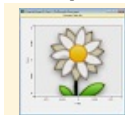
Import and Export of Chromatic Fields Sets

- The various text exports have a more **unified header**.

4.6 Optical Setup

- The *Light Path Diagram* has been renamed to **Optical Setup**.

- Added simple **Optical Setup Tool** for deleting of all lookup tables in a Waveguide Toolbox Optical Setup.

- The **type** (~ originating toolbox) of the Optical Setup is now shown in the Property Browser.

4.7 Performance

- Several performance improvements for **Waveguide Toolbox**.

- New caching mechanism to improve the performance of **media**.

- The **Far Field Propagation** now runs in parallel and is thus more performant.

4.8 Propagation

- The propagation to detectors in **Field Tracing 2nd Generation** now uses all available analytical parameters (quadratic phase, linear phase, and lateral offset). In addition it now also includes the far field propagation.

- For the **Cells Array Propagation**, more settings can now be configured by the user.

4.9 System Building Blocks

- New medium to simulate **slanted gratings** whereas the slant angle for left and right flank do not need to be the same. Furthermore a coating can be applied.

Advanced Configuration of Slanted Gratings

- For the **Volume Grating Medium** the refractive index modulation can now be shifted relatively to the refractive index of the base material.

- For **Programmable Media** interfaces can now be used as Global Parameters.

- If you program both profile height and gradient of a **Programmable Interface**, now the same snippet body, additional usings, and external DLLs are used for both snippets. No need to maintain them twice.

- If you program both (real) refractive index and absorption coefficient of a **material**, now the same snippet body, additional usings, and external DLLs are used for both snippets. No need to maintain them twice.

- Boundary operators using a **cells array** now provide information about the minimum and maximum values of their parameters in their edit dialog.

- More **Parameters of Grating Regions** are available for Parameter Extraction.

- You can now delete rows in the **coating** table using the `Del` key.

4.10 Views & Data Arrays

- **Unwrap phase** for harmonic fields now generates a data array with more clear labels and physical units.

- **Marker coupling** implemented for 1D profile and 2D view.

- **Update of 1D section** when line marker is moving.

- **Line width and color** for the 1D profile in 2D data array views (and related views) can now be set by the user.

- **Elliptical markers** can now be shown for gridless data too.

- **Marker indices** are not read-only anymore.

- **Normalization of real color** single wavelength view for Chromatic Fields Sets can be chosen now: Referring to maximum of all wavelengths versus single maximum value.

- **Data point symbols** now available in 1D CFS-view.

- **Zoom Factors** can now be used in all Data Array related views.

4.11 Changes

- **Direction angles** renamed to rho, sigma, tau.

- Relaxed value range restrictions for some of the **orientation definitions**.

- Changed default **interpolation for detectors** from *Accelerated Sinc* to *Cubic 6 Point*.

- For **1f-Setup** and **2f-Setup** Ideal Components the field might now be resampled to avoid an undersampled phase.

5 VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.3.4)

Release Date	January 2018
Update Service	3rd quarter 2017 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.3.4) is an update of VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

This is a service release without additional features.

6 VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.2.18)

Release Date	November 2017
Update Service	3rd quarter 2017 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.2.18) is an update of VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

This is a service release without additional features.

7   VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.1.12)

Release Date	October 2017
Update Service	3rd quarter 2017 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.1.12) is an update of VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35). It is not necessary to uninstall previous versions of VirtualLab.

This is a service release without additional features.

8   VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35)

Release Date	August 2017
Update Service	3rd quarter 2017 is required.
Installation	VirtualLab Fusion 2nd Generation Technology Update (Build 7.0.0.35) replaces VirtualLab Fusion User Experience Edition (Build 6.0.0.57). It is not necessary to uninstall previous versions of VirtualLab.

Paradigm shift in optical modeling and design

With VirtualLab Fusion 2nd Generation Technology Update the new propagation engine *Field Tracing 2nd Generation* becomes available. It replaces the Geometric Field Tracing Plus engine included in the VirtualLab Fusion User Experience Edition.

It brings about an implementation that makes the experience of modeling with physical optics as easy for the user, and often as fast, as with ray tracing. For detectors, when employing Field Tracing 2nd Generation, VirtualLab automatically decides which propagation technique shall be used to calculate the light information in the detector plane.

New Waveguide Toolbox

Our new Waveguide Toolbox allows the non-sequential analysis of optical systems including waveguides. For in- and outcoupling into a waveguide usually gratings are used. For it rigorous analyses are necessary which are fully supported by VirtualLab.

You can apply for the User Experience Hands-On Program of this toolbox. For further details please contact sales@lighttrans.com.

8.1 Analyzers

- The new **Distortion Analyzer** allows the plotting of distortion versus angles. This can be very helpful for designing lenses and take the field distortion during a parametric optimization into account.

- The new **Field Curvature Analyzer** can be used to calculate and plot the field curvature of a component. Several evaluation options are available and can be used within the parametric optimization.

- New **Focal Length Analyzer** is available to get the effective and the back focal length of a real component. The analyzer supports the selection of any Optical Interface Sequence, Double Interface Component, Single Optical Interface or Spherical Lens component.

- The **Polarization Analyzer** is now able to evaluate only a certain order range.

8.2 Catalogs

- It is now possible to **export entries** from a user-defined catalog to a separate catalog and also import entries from a separate catalog to the user-defined catalog.

- Revised constraints for **inter-toolbox operability** and removed some obsolete limitations. Examples:
    - Elements from all toolboxes can be saved to the catalogs. If you load elements from a catalog, only elements valid for the current light path type are shown.
    - In particular you can now save Light Shapers into the catalog and add saved Light Shapers from the catalog.
    - You can now paste elements into the Laser Resonator Toolbox.
    - You can now copy elements from the Lighting Toolbox and paste them for example into the Starter Toolbox.

8.3 Components

- For 3D gratings, the *Remove Redundant Data* feature for the layer decomposition is now available.

- Improved tolerance for **setting new cells data** via a Data Array (non-matching strings are now allowed).

- The **Double Interface Component** has been split into several sub-types: Diffractive Optical Element, Fiber Element, GRIN Component, and Inhomogeneous Medium Component, which contain a reasonable pre-configuration for the corresponding components.

- The **Zernike & Seidel Aberrations** function has been re-implemented so that among others
    - Zernike standard aberrations are included.
    - The coefficients refer to wavelengths instead of radians.
    - You can switch between achromatic and chromatic mode.

8.4 Detectors

- Each detector in VirtualLab was reconsidered to work with **all available engines** within VirtualLab. This allows a consistent usage of detectors for ray and field tracing.

- If detectors are applied on a Harmonic Fields Set in the **main window**, the user can now decide whether to evaluate all modes or only the currently visible one.

- You can now apply any **detector from the catalog** on Harmonic Fields or Harmonic Fields Sets within the main window.

- It is now possible to specify the **resolution** of detectors by setting the number of sampling points. Several pre-defined resolutions are offered. In addition the user can also define his own customized resolution for detector evaluation.

- On the detector size and resolution page it is now possible to specify the **center position** of the detector window. This can be used to evaluate a subset of the information within the field to be evaluated. In addition we added a shortcut in the context menu of each detector to copy size and position of a rectangular selection in an open VirtualLab document as size and center position of the detector.

- The new **Electromagnetic Field Detector** can be used to to calculate E_x, E_y, E_z, H_x, H_y, and / or H_z of a field. The user can select whether he likes to evaluate only the amplitude, the residual phase or the complete phase information.

- There is a new **Field Deviation Detector** for Harmonic Fields and Harmonic Fields Sets which computes the deviation of two fields by subtracting their amplitudes and phases separately.

- A new detector to calculate the **Modulation Transfer Function (MTF)** and **Point Spread Function (PSF)** is introduced.

- The **Beam Parameters Detector** now calculates diameters instead of radii to comply with standards (and consequently also full-angles of divergence instead of half-angles).

- The Beam Size Detector was renamed to **Spot Size Detector** with improved functionality:
    - It now always calculates diameters.
    - You can now choose whether you want evaluate all modes separately or all modes together.
    - The *Use Centroid as Reference* flag now also works for Classic Field Tracing.

- The Virtual Screen has been renamed to **Raw Data Detector** to better reflect its functionality. It should be used to get the full field information which can be used for further propagation. In most cases we recommend to use the camera detector (for the evaluation of the real color information) or the electromagnetic field detector to get subsequent field information.

- The user can now set real color / false color as well as the color lookup table already in the edit dialog of the **Camera Detector**.

- The **wavefront detectors** (Polynomial Aberrations Fit, RMS Detector, Wavefront Error, and Zernike & Seidel Aberrations) now all support an off-axis spherical phase as reference phase and that dark pixels are ignored.

- For clarity, the **Two Point Contrast** is now given as percentage.

- The edit dialog for the **Pulse Evaluation** detector was reconsidered. The selection of 1D, 2D or 3D pulse evaluation can now be done on subsequent tab pages.

8.5 Handling

- We replaced the old **help system** using a chm file by a properly layout pdf file.

- To enable faster access to the tool for **3D ray tracing system analysis** we added a button for processing this engine to the *Go!* ribbon of the light path diagram. In addition the user can pre-define the 3D system analysis (or any other available engine) as default engine within the global options of VirtualLab.

- **New parameters** have been added for Parameter Extraction (the base for e. g. Parameter Overview, Parameter Run, and Parametric Optimization):
    - absolute positions of Light Path Elements
    - medium at a linkage

- the parameters for light sources like the number of rays and the wavelengths and weights of a triplet of wavelengths
- the parameters of free space propagations and rotation operators
- the coefficients of the Zernike Standard interface

- The **parameter table** (used in the parameter run and the parametric optimization for example) can now be filtered to show only varied / used parameters. The filter string set for this table now also applies on object and category column.

- In former versions of VirtualLab **signal regions** were always on equidistant data. We improved the implementation of signal regions. They can now defined by sampled data, formulas or even as combination of both. Thus they have a new view and allow a more flexible usage.

- Many basic functions for complex fields now run parallel to use **multiple cores**. This leads to faster simulations.

- The new docking tab **Parameter Overview Tree** is available where you can easily change parameters of light path diagrams without the need to open any dialog.

- Parameter Run, Iteration Document, and Parametric Optimization have an **extended ribbon** allowing among others to delete results, show the initial Light Path Diagram or the Light Path Diagram of a certain simulation step and to create combined outputs.

- The **Property Browser** now shows name and type of the edited document.

- The setting whether multiple cores shall be used for the **Parameter Run loop** can now be set also per Parameter Run, not only as Global Option.

- The settings of the **Data Array Import Wizard** can now be saved and loaded again later.

- VirtualLab now uses **Windows™ notifications** to inform you about the end of long lasting simulations (whether successful or not) or if the available RAM is insufficient to continue the simulation – even if VirtualLab is in the background.

8.6 Import & Export

- The **Zemax import** of VirtualLab was reimplemented. This allows to handle much more complicated systems. Also the complete 3D position information is imported from the given zmx file and reinterpreted into VirtualLab system description.

- Several **additional glass definitions** used in Zemax are now supported for the import of zmx files into VirtualLab.

- The new Zemax import allows using **Zemax Table Glass** files (ZTG files) when used in Zemax lens file.

- VirtualLab provides import of **Zemax Beam Files** in binary format.

- **Headers** of exported text files now show consequently values without units for easier import into other programs.

- **Larger bitmaps** (> 22'000 $\times$ 22'000 pixels) can now also be handled during import and export.

- The **STL export** of prism and mirror cells arrays now generates completely closed meshes. Closing the meshes is necessary to realize a fabrication by 3D printing.

- The **system description** of light path diagrams can now be exported into a XML file containing all parameters in easily readable form. It includes also read-only parameters like the reference points used for positioning. The generated XML file can be used for visualization, documentation, and further processing of the parameters.

8.7 Light Path Diagram

- For the **visualization of the position and orientation information** inside the Light Path View several additional options are available. The user can select which coordinates shall be displayed (relative or absolute). In addition we introduced markers which indicate whether an element is shifted or tilted.

- A new **Light Path Tool** is now available to combine some components (Optical Interface Sequence, Single Interface, Spherical Lens) to one Optical Interface Sequence Component.

8.8 Optimization

- **Laser Resonator systems** can now be optimized by the parametric optimization of VirtualLab.

- Now the Parametric Optimization also allows the optimization of Light Path Diagrams which contain a **polychromatic or partially coherent light source**. This enables among others the optimization of pulses.

- Via Property Browser you can now define whether the **contributions** of the distinct merit functions to the target function are logged during optimization.

- For Parametric Optimizations you can now see the **initial target function value** on the constraint settings page.

- In the new version of VirtualLab it is allowed to disable the **logging of results** while an parametric optimization is in progress to gain performance.

- Within the Parametric Optimization, **analyzers** can now be used together with any simulation engine.

8.9 Parameter Run

- The Parameter Run now has a new combined output to convert **Chromatic Fields Sets** into an animation.

- New combined output for the Parameter Run to convert **Data Arrays or Sets of Data Arrays** to a single Data Array or a single Set of Data Arrays. In previous VirtualLab versions, Sets of Data Arrays and gridless Data Arrays did not have such a combined output at all. For gridded Data Arrays, this combined output has been improved so that

  - you can select only one subset which is extracted from all Data Arrays
  - you can select a Set of Data Arrays as combined output. In this way, no resampling of the subsets is done.

- The combined output to create an animation out of two-dimensional **Harmonic Fields** now switches to a linear intensity mode if invisible fields are to be shown.

- For the usage of random parameter distributions within the Parameter Run the new *Cutoff Normal Distribution* is available.

8.10 Programming

- **Help information** for snippets is now shown directly in the edit dialog of the Programmable Item.

- **New methods** to generate 3D transition points, to use the 3D FMM and for General Incidence FMM are included in the VirtualLab.Programming.dll.

8.11 Propagation

For processing of the **ray tracing engine** (2D or 3D) coordinate breaks and other ideal components that have no effect are now skipped.

8.12 Sources

The *Medium at Source Plane* of light sources can now be changed also in the main window.

8.13 System Building Blocks

- A new **tool for optical stacks** is available to synchronize the definition areas of the interfaces with the stack period.

- VirtualLab now allows the specification of **Volume Grating Media** with decreasing refractive index.

8.14 Views & Data Arrays

- The 3D view as well as the 3D ray tracing view shows **coordinate systems** of the displayed light path elements or surfaces.

- Gridless data arrays and sets of two-dimensional data arrays can now be converted into an **animation**. The conversion of 2D gridded data arrays has been improved to this end.

- Views of 1D data arrays can be **transposed**. This is used by default in the output of the distortion analyzer.

- For 1D Data Arrays we now allow **logarithmic scaling**. This option can be selected for x- and y-axis independently.

- The **description of the axes** is now shown in the Property Browser to avoid confusion if e.g. the x-axis is labeled "Y".

- You can now extract the **cross profile** (profile along both x- and y-direction) from the current position of the point marker.

- The user can now select the **color to visualize envelopes** within the property browser of the 3D ray tracing view.

- The **color of the envelopes** can now be preset within the edit dialog of the Ray Tracing System Analyzer.

9   VirtualLab Fusion User Experience Edition (Build 6.2.1.15)

Release Date	July 2016
Update Service	2nd quarter 2016 is required.
Installation	VirtualLab Fusion User Experience Edition (Build 6.2.1.15) is an update of VirtualLab Fusion User Experience Edition (Build 6.0.0.57). It is not necessary to uninstall previous versions of VirtualLab.

This is a service release without additional features.

10   VirtualLab Fusion User Experience Edition (Build 6.2.0.27)

Release Date	May 2016
Update Service	2nd quarter 2016 is required.
Installation	VirtualLab Fusion User Experience Edition (Build 6.2.0.27) is an update of VirtualLab Fusion User Experience Edition (Build 6.0.0.57). It is not necessary to uninstall previous versions of VirtualLab.

10.1 Analyzers

- The **Field Inside Component Analyzer: Split Step** now supports multiple physical values as output of the custom merit function evaluation.

- In the **Grating Order Analyzer** you can now switch off the output of Order Collections to boost performance if you are only interested in single value output.

10.2 Components

- **Single Phase Dislocations** now allows a negative charge.

- Within the edit dialog of the **Grating Cells Array** boundary operator the total number of calculated results in rigorous lookup tables is shown.

- The minimum and maximum height of the cells array are now shown in the export dialog of a **Prism / Mirror Cells Array**.

10.3 Detectors

- **Complex values** are now allowed **as detector results** and thus also in the result table of the Parameter Run. Thus for example the Rayleigh coefficients of the Grating Order Analyzer are no longer shown separately as "Amplitude" and "Phase".

- New **Wavefront Error detector** which shows the wavefront error as data array and calculates the RMS and peak-to-valley value thereof. This detector works for Ray Tracing and Geometric Field Tracing.

10.4 Handling

- **Automatic update check** when VirtualLab starts.

- New ribbon entry added to *Close All Result Windows*.

- A **new edit dialog for the Global Options** is available. The new dialog uses a tree view to provide a better overview.

- The **maximum number of digits** that the user can set has been increased to 17. In this way you can export data with the maximum precision.

10.5 Import & Export

- For import and export of harmonic fields and harmonic fields sets a **new text format** has been defined which stores the complete complex field information. The format is called "Field Information" and has the file extension "*.fin".

- Interfaces, real components, complete systems, and Ray Tracing Results (3D) can be exported to the **IGES** format. For the latter, also the rays are exported.

- Animations can now be exported as an **animated GIF**.

10.6 Light Path Diagram

- The light path diagram now has a **Property Browser** which allows you to quickly set some settings.

- New **Coupled Parameters** mechanism: You can define that certain parameters change their value according to other values. The parameter dependencies are defined in a snippet that also allow the specification of global parameters.

- New option in the light path diagram was introduced to define the **system temperature and pressure** that shall be used for simulation. The temperature and the pressure are taken into account for calculation of refractive indices within optical media. The user can also vary these parameters within the parameter run.

- A new Light Path Tool is available to **turn** an Optical Interface Sequence, Spherical Lens or Single Optical Interface by 180° about its y-axis.

- The LPD tool to split an Optical Interface Sequence can now optionally **split after each surface**.

- The user can define which **propagation engine** shall be used as default **in the global options dialog**. This option is used for the systems of the starter toolbox.

- The **light path view** now allows you to define new linkages between light path elements. In addition the user can also change the start or end element of a linkage via drag and drop within the light path view.

- Several improvements for **pasting light path elements** into a light path were done. If elements are pasted from the clipboard, they are inserted at the current cursor position if possible. If multiple elements are pasted, their relative position to each other is maintained.

10.7 Media, Materials and Interfaces

- The **performance of catalogs** within VirtualLab was improved significantly.

- The **edit dialog of materials** now uses the validity control to support the user even better in solving misconfigurations.

- The user can choose whether to show the relative or the absolute refractive index inside the **material's preview**.

- "Standard Air" was renamed to **"Air"**.

10.8 Optimization

- The **optiSlang interface** of VirtualLab has been significantly improved:
  - The user can specify a short name for the exported parameters
  - To make the resulting files easier transferable between different computers, an environment variable storing the VirtualLab path has been introduced.
  - The pop up of error and warning messages can now be completely suppressed during the processing of the batch file. The corresponding settings from the Global Options dialog are used to this end.

- In the **Parametric Optimization** you now have the possibility to show a Light Path Diagram with **parameters** of a certain simulation step.

- New possibility to set the **start values** of a **Parametric Optimization** from any optimization step.

- It is now possible to disable individual **Parameter Constraints** in the constraint specification table of the **Parametric Optimization**.

10.9 Parameter Run

- New **combined output for Order Collections** to convert them into an animation.

- If a Parameter Run contains exactly two varied parameters, you can now generate **more understandable combined outputs** of physical values: two-dimensional (gridded or gridless) data arrays and multiple one-dimensional data arrays.

- In the Parameter Run you can now decide whether the combined outputs are always **plotted versus Iteration Step** or versus the varied parameter if there is only one.

- The rotations of a **Sequence of Axis Rotations** are now available in the Parameter Run.

10.10 Programming

- New methods for the **VirtualLab.Programming** for selecting a currently open data array or ray distribution.

- **Code completion in modules** now includes all other classes defined in the same module. The classes have to be in one namespace.

- **Code completion of the "Main Function"** of a snippet now includes the variables and methods defined in the "Snippet Body".

10.11 Views & Data Arrays

- **New detectors for Numerical Data Arrays** implemented: Average per Data Point, Complex Histogram, and Standard Deviation.

- **"Replicate Periodically"** of Data Arrays now works for **non-integer replication factors**. In this manner, non-integer periods are allowed in the Field Inside Grating Analyzer.

- Now it is possible to **transpose** two-dimensional gridless data arrays.

- **Editing of single data points** in Numerical Data Arrays is now possible.

- The **value scaling** of data arrays with more than one subset can be easily equalized now.

- VirtualLab offers more possibilities for editing **coordinate ranges or marker coordinates** now.

- If data from any data array table is **copied to the clipboard**, the corresponding row and column headers are now also copied thereto.

- New global option introduced to define the **default symbol** for 1D data arrays in **multigraph mode**.

- The **multigraph legend** can be positioned via alignment within the property browser now.

- The user can specify its **own y-axis label(s)** for 1D diagrams.

- The **1D profile** for a 2D data array can be switched off. Furthermore, the height of the profile can be set via property browser.

- The **axis format** and the minimum number of axis ticks can now be set also **for Gridless Data Arrays**.

- Option to define **axis of ray distribution** via property browser.

- The 3D view provides a new option to enable or disable **transparency**.

- New option within edit dialog of ray tracing system analyzer to **(pre-)configure the display mode** and whether to **draw envelopes** in the ray tracing 3D view.

- **Animations can be stitched**. In this way you can compare for example Ray Tracing and Field Tracing results.

- The **animation view** has been improved so that animations can be resized with kept aspect ratio.

11 VirtualLab Fusion User Experience Edition (Build 6.1.0.20)

Release Date	December 2015
Update Service	4th quarter 2015 is required.
Installation	VirtualLab Fusion User Experience Edition (Build 6.1.0.20) is an update of VirtualLab Fusion User Experience Edition (Build 6.0.0.57). It is not necessary to uninstall previous versions of VirtualLab.

11.1 Calculators

- The **Spherical Lens Calculator** is introduced within VirtualLab. It allows the evaluation of both, lens definition data and imaging formulas.

11.2 Design

- The **variablity of spots** within the cell design document can be set to larger values than 100%.

11.3 Gratings

- The new **Grating Order Analyzer** which replaces the Grating Efficiency Analyzers is introduced. It allows to plot efficiencies and Rayleigh coefficients versus spherical angles, Cartesian angles, positions, wave vector components or order numbers. This allows among others, a better visualization of the results for **conical incidence**. To this end a new **Order Collection** document has been introduced storing the complete order data in one single document.

- The grating **sign convention** in the Grating Toolbox has changed. This means that the reflected orders now bear the opposite sign.

- The **programmable grating analyzer** can be used for the evaluation of 1D and 2D gratings.

11.4 Handling

- In the ribbon of the Light Path Diagram, you can now **select the simulation engine** to be used for simulation.

- Via global options the user can select the **default definition type** for entering an **orientation** in the dialog of a Light Path element.

- The user can now change the **path for user settings** in the Global Options dialog.

11.5 Light Path Diagram

- A new option to **enable/disable process logging** during simulation is introduced to the Light Path simulation settings.

- Within the simulation report the **display title** of each Light Path element is displayed in addition.

11.6 Parameter Run

- For the **subsystem component**, all parameters of the subsystem are now available in the Parameter Run.

- The **document windows** resulting from detectors and analyzers now always indicate from which detecting device they originated.

- The combined output of the Parameter Run which merges data arrays into a single data array now also works for **non-equidistant data**.

- The **heights of a Transition Point List interface** can be varied in a Parameter Run (and Parametric Optimization and alike).

- The parameters of **double arrays** which are a global parameter of a programmable item can now be varied in the Parameter Run.

11.7 Positioning/Tolerancing

- Now we provide an additional mode for entering orientations via a **rotation matrix**.

11.8 Programming

- The source code editor has been completely rewritten so that you can write code much faster.

  New Features:

  – Code completion
  – Syntax Tooltips showing e.g. the input and output parameters of a method
  – Code snippets
  – Line modificators
  – Split view
  – XML comments for methods, properties and variables which can be invoked using /// above the field declaration
  – "Go To" feature which allows you to jump directly to a certain line
  – Modern font which supports ClearType

  Improved Features:

  – Syntax highlighting
  – Smart indentation
  – Find & Replace
  – Printing
  – Collapse all

- For the source code editor of snippets there are the following new features and improvements to **allow faster coding**:

  – You can change the order of the Global Parameters.
  – You can invoke the consistency check with the shortcut F6 (Shift + F6 if you want to see the errors).
  – The next time you open this dialog it has the same size, position, and settings as before.

   – The question whether you really want to discard your changes appears only if you have changed something.

11.9 Propagation

- The rotation operators have been renamed to **Geometric Rotation operator** and **Diffractive Rotation operator**, respectively.

- **Idealized polarizer components** are now handled correctly within the Geometric Field Tracing Plus engine.

11.10 Sources

- For **hexapolar ray selection** also density of 0 is supported. Then only the chief ray is generated.

- For random ray generation the user can now select whether the **mesh information** should be generated in addition.

11.11 System Building Blocks

- The diagrams in the Fresnel Effects Calculator can use **energy dependence** now.

- **Energy dependence** can be shown for optical materials data.

11.12 Views & Data Arrays

- For numerical 1D Data Arrays we provide the special view mode **Multi Graph mode**. This mode allows to see more than one graph (subset) at the same time. It is possible to specify special view options for the mode like color and symbols for the different graphs. Within the global options dialog the user can specify the default colors which shall be used.

- In Data Arrays, the Parameter Run and related documents very **wide table columns** are now shown smaller by default so that more columns can be seen at once.

- For the visualization of 1D Data Arrays (and related documents) the user can select the interpolation mode "None", which allows to see a **"spike like" diagram**.

- 1D Data Arrays may now have **data point specific labels** which are shown in the view.

- 1D data can now be **extracted from gridless 2D data**. This is especially very helpfull for the output of the grating order analyzer within the grating toolbox.

- Five different **default color lookup tables** (one for each field quantity) can be defined in the Global options.

- Line and point marker coordinates will be copied by **"Retrieve Marker Coordinates..."** as well.

- Rectangular markers for the view of data array based objects can be **moved via arrow key**.

- Within the ray distribution view it is now possible to select **user defined value scaling** for the displayed information.

- A new possibility to **select the element to view** is introduced to the 3D view as well as the result view of the ray tracing system analyzer.

- In the preview of the interface media sequence of an optical interface sequence or an optical stack, **drawing of media** can now be switched off.

- The stack preview is improved. It now visualizes the **coordinate system of its orientation** in the parent component.

12   VirtualLab Fusion User Experience Edition (Build 6.0.0.57)

Release Date	September 2015
Update Service	3rd quarter 2015 is required.
Installation	VirtualLab Fusion User Experience Edition (Build 6.0.0.57) is a complete installation. It is not necessary to uninstall previous versions of VirtualLab.

12.1 Analyzers

- The new **Ray Tracing System Analyzer** can be used to visualize the propagating rays in a 3D optical system. The user can define several view options for an optimal visualization.

- In case that the **Polarization Analyzer** varies more than two parameters, the varied parameters are now shown in the resulting data array.

12.2 Calculators

- **Calculators** can now be saved and they are shown in the VirtualLab Explorer.

- The materials within the **Diffraction Angle Calculator** can now be swapped easily.

12.3 Catalogs

Stored Lateral Field and **Stored Complete Field** light sources have been added as templates to the light source catalog.

12.4 Components

- VirtualLab offers the new **Off-Axis Parabolic Mirror** in the category real components. It has a specific edit dialog where the user can enter the parameters of the mirror according to the specification within standard optical catalogs. The off-axis parabolic mirror has also special reference points which makes the positioning of the component more user-friendly.

- The **Evanescent Field Filter** now optimizes the sampling of the resulting field.

12.5 Detectors

- **Uniformity Error** detector for data arrays

- Detectors for Data Arrays analyze the currently visible subset (formerly: all subsets).

- Detectors for Chromatic Fields Sets analyze the Summed Data in Summation Mode (formerly: all wavelengths independently) and they work also in the Real Color Mode (in the same manner as in the False Color Mode).

- Detectors for Harmonic Fields Sets always analyze all subsets if the light view is shown (previously you could choose that only the first subset is analyzed.)

12.6 Handling

- VirtualLab now uses **ribbons** instead of a menu with toolbars. This enables a user-friendly access to light sources, functions, catalogs and also to document specific options (like Light Path Diagram tools or propagations of harmonic fields).

- The **Quick Access Toolbar** enables the user to specify menu items that are often used for a more direct access. The entries of the toolbar are available in dependency of the active document. For users which worked already with the LightTrans VirtualLab toolbar this feature can be very helpful to get fast into the new ribbon technology.

- The items in the Quick Access Toolbar can be saved and loaded.

- **Docking Tabs** allow you to move the *Property Browser*, *VirtualLab Explorer*, *Messages*, and *Detector Results* tab of the main window at any position you like. It is also possible to re-arrange them in any user-defined order. The tool Reset Docking Tabs on the Windows ribbon resets the positions to their default.

- VirtualLab Fusion comes with new and fresh layout including **new icons** for the ribbons as well as for each document type. The icons are used very consequently, e. g. in the upper left corner of the document windows, the VirtualLab Explorer as well as the list of recently used files in the file menu.

- The user can select the visual style he likes to apply to VirtualLab. **Different visual styles** are available. Some styles can be even personalized. The visual style is configured within the Global Options dialog.

- The global options of VirtualLab can now be saved as a file for backup or to transfer them to another computer. The generated file can be loaded again to restore a given set of global settings. The global options are no longer stored within the registry.

- The default Global Options have been adapted to the improved computer hardware: By default parallel computing with 2 cores is used.

- The user can now define a length unit which is taken as default (i. e. if no unit is specified).

- The 32-bit edition of VirtualLab (previously VirtualLab Standard) now shares most of the features of the **64-bit edition** (previously VirtualLab Advanced). Only the memory handling is limited to 3 GB for the 32-bit version.

- The base technology of VirtualLab is now the .Net framework version 4.5. Thus **larger arrays** are supported; for example the Fourier Modal Method now allows more evanescent orders.

- All types of document windows can be duplicated.

- VirtualLab can be used within a **batch mode**. For an active Light Path Diagram the user can export the system (including its parameters) and a batch file which allows the automatized usage of VirtualLab via console. By performing a simulation via batch mode the result data of the system is stored within an XML file that can be used for further processing.

- Data Field Diagram, Plane Waves Field, and Spread Sheet documents cannot be opened anymore. They can only be imported as data arrays (Data Field Diagrams and Plane Waves Fields) or appended to an OIS.

- The new **Parameter Overview** tool allows to view and edit all numerical parameters of a Light Path Diagram at once. This enables a more intuitive and easy-to-use access to the parameters of your optical setup.

- The parameters table in the Parameter Run as well as the Parameter Overview allows **filtering** by parameter name.

- **New manipulations** for Harmonic Fields Sets: *Resample According to Spherical Phase Radius & Remove Sampled Spherical Phase*.

- If a spatial field is converted to spectral coordinates, the analytical spherical phase factor is sampled correctly.

- The consistency checks and validity indicators for the Session Editors of the Diffractive Optics Toolbox are available consistently.

12.7 Light Path Diagram

- The user can specify an **arbitrary comment for a Light Path Diagram**. The comment can be edited by a new button in the Light Path View.

- New **(compact) mode to visualize the positions** within the light path diagram. The user can specify whether only the z-coordinate shall be displayed.

- The Light Path View visualizes whether collapsed comment controls contain a non-trivial comment.

- In the Light Path View, linkages can now be enabled / disabled by double-clicking on them. Furthermore a selected linkage can be deleted with the `Del` key.

12.8 Media, Materials, and Interfaces

- **New view for materials** within the material preview. In addition the view contains a small calculator which allows some fast evaluation on the dispersion behavior of the selected material.

- **New view for coatings**. The user can specify the display options in more detail. In addition the user can use a small calculation tool for a fast investigation on the selected coating.

- Coatings can now be inserted on an empty stack. No "base interface" is needed.

12.9 Optimization

- A new file export for a Light Path Document into the **optiSLang format** is available. The user can select the engine as well as the parameters which shall be preselected within optiSLang. The generated files can be used to set up an optiSLang project and perform several advanced optimization tasks.

- The new **Optimize Detector Positions** tool for an active Light Path Diagram uses a ray tracing algorithm to place all detectors within your optical system centered to the incident light.

- The new **Find Focus Position** tool is a one-click optimization to find the distance of a detector where the size of the detector signal reaches its minimum. The user can specify several size measurement parameters. The tool is available within the Light Path ribbon.

- The parametric optimization now allows the usage of **different propagation engines**. The user can select the propagation engine to use for the optimization. For the different engines each detector may have a different functionality.

- The "Gaussian -> Top Hat" Transmission Design allows arbitrary sampling in *Circular* mode.

12.10 Parameter Run

- The Parameter Run now supports the usage of the two **new simulation engines** *Geometrical Field Tracing Plus* and *Ray Tracing*.

- The parameter run allows combined output for ray distributions (result of Geometric Field Tracing Plus and Ray Tracing):

  - Animation: The user can configure all view settings which are also available within the 2D view, e. g. triangles, transparency, different quantities (E_x, OPL, …)

  – Ray Distribution: Combination of given ray distributions in one combined ray distribution including correct handling of index concept

- **New combined output** combines a set of chromatic fields sets to one chromatic fields set. Only if the sampling for all members is configured completely the same the combined output is supported.

- Random variation in the Parameter Run now also supports **normally distributed values**. The user can define a standard variation and a seed for the random distribution.

- Tables in the Parameter Run and the Parametric Optimization now allow you to set the **number of shown digits**.

- The Parameter Run and the Parametric Optimization now show also the **Original Value** in the Parameter Specification table.

- The Parameter Specification table of the Parameter Run now allows you to check multiple rows at once.

12.11 Programming

- **Improved handling of the Global Parameters** of snippets. A nice graphical user interface is generated within the snippet control. So the user has no longer the need to open the source code editor to set up complex parameters. In addition also standard edit features (like double-clicking on text boxes) works now automatically for global parameters. Each global parameter may have a comment which can also be accessed very user-friendly.

- **More data types** are allowed for the general global parameters of snippets. The developer can define strings, Boolean values, integers, vectors, and complex values have been added. Also more physical properties (like percentage, energy, …) are supported.

- Within the source code editor a list of input and global parameters is given. A color indicates the according type of the parameter, which makes the snippet development much more easy.

- For **importing a snippet** the user can now choose what parts of a snippet (Snippet Body, Global Parameters, and so on) are imported.

- The LightTrans.Programming.dll has been renamed to **VirtualLab.Programming.dll**, but older modules and snippets still work.

- New methods added to the VirtualLab.Programming DLL which provide detectors and functionality to extract the underlying ComplexField from various document types.

- Within the VirtualLab.Programming.dll a method for rigorous FMM calculations for general incidence fields is available.

- The operator ^ in C# stands for a binary XOR operation. But in VirtualLab it was also used for the power function of complex numbers or vectors (classes Complex, ComplexField, Vector3C, VectorC, VectorD). The problem is that a binary operator is executed *after* a summation or multiplication. Thus the line "`new Complex(3)^2 + 1`" would yield the result 27 instead of the expected result 10. To avoid such errors which are hard to find, the ^ operator of the Complex class has been replaced by the new Complex.Pow(double basis, double exponent) method and the PowerEqual method of the ComplexField class. For the same reason, the & operator of VectorC and Vector3C standing for a complex conjugate scalar product has been removed.

12.12 Propagation

- The **new Ray Tracing engine** of VirtualLab delivers 2D ray information on the detector surface including:

  – Position
  – Direction (multiple view modes)
  – Optical Path Length
  – Absorption

  The Ray Tracing engine runs in parallel which allows a very fast analysis of the performance of your optical system.

- The **new Geometric Field Tracing Plus engine** in VirtualLab is based on the Ray Tracing engine. It delivers 2D ray information on the detector surface including:

  – all Ray Tracing quantities
  – Electric Field (E_x, E_y, E_z)
  – Magnetic Field (H_x, H_y, H_z)

- The *Power Portion for Field Size Estimation* can now be set individually for each **Automatic Propagation Operator**.

- The **Rayleigh Expansion Propagation** now allows to filter out evanescent orders.

- Performance improvement: locally polarized light becomes globally polarized by a **linear polarizer**.

12.13 Sources

- **Ray Tracing** (2D and 3D) and **Geometric Field Tracing Plus** are supported for polychromatic and also partially coherent light sources as well as for the combined light source.

- The ray selection strategy for light sources is extended by **hexapolar and random mode**. For each mode individual parameters can be specified.

- The **Combined Light Source** now allows adding light sources from the catalog. Furthermore the parameters of the two light sources in the Combined Light Source can now be varied in the parameter run.

- Within the light source dialog the user can specify **elliptical polarization** in addition. In this case the polarization is defined by angle and eccentricity of the polarization ellipse.

12.14 Views & Data Arrays

- New *Ray Distribution* documents are available for the results of the **Geometric Field Tracing Plus** and **Ray Tracing** engines. The view includes handling for

  – Visualization of ray and field quantities
  – Triangles (and linear gradient filling)
  – Transparency
  – Handling of Light Object consequently in light cube (different handling for wavelengths, incoherent as well as coherent modes and rays)

  Via the context menu of the visualization control the chief ray can be selected.

- Within the dot diagram results of the Ray Tracing engine an algorithm is available to **snap onto points** for the point and line marker tools. This enables an accurate measurement via property browser.

- **Intermediate rays** for which the propagation is defined within a Programmable Component can be displayed within a Ray Distribution 3D. The user can select whether the coloring of such rays shall differ from the standard coloring.

- **Gridless data arrays** can now be shown as data arrays instead of only as tables. The table for gridless data arrays now offers a one-dimensional mode. Also the layout of the table has been adapted to resemble the tables for one- and two-dimensional data arrays, respectively. And the performance has been improved.

- The performance of the tables of gridded data arrays has been improved.

- For the tables of gridded data arrays you can set that no units are shown and define the number of shown digits (as for the gridless data array).

- Most of the **manipulations** which exist for harmonic field documents are implemented for **Numerical Data Arrays** too (if they make sense for such documents).

- New manipulation tool to **sum all subsets** within one numerical Data Array.

- **View settings for documents** are handled more consistently. On the one hand they are saved to disk by saving the document. On the other hand the copy view settings tool can be used to copy the view settings from one document to another document of the same type.

- Within the view of 2D data arrays also a **1D section** is displayed if a profile line is drawn. The user can define the 1D section by defining the position and orientation of the line marker.

- All document windows of same dimensionality share the selection mode (Point Marker, Line Marker, Rectangle Marker).

- The position of the color legend can be adapted by the user for 2D data array (related) objects. It is also possible to hide the legend completely.

- NaNs (e. g. resulting from a division 0/0) inside data arrays (1D and 2D) are indicated by a special color. The color can be set as a global option.

- You can **zoom in and out via keyboard** now: Zoom In: `Ctrl` + `+`(NumPad), Zoom Out: `Ctrl` + `-`(NumPad). Show all: `Ctrl` + `0`(NumPad).

- The *Bitmap Sequence* document has been renamed to **Animation**.