GeoDict

Creating videos from GeoDict simulation results

User Guide

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Creating Videos from GeoDict simulation results

Videos are an excellent medium to visualize time-dependent processes, 3D scans and structure models from all sides. Moreover, scrolling through the slices in 2D in a video is a great possibility to visualize a complete structure in detail.

GeoDict provides many visualization options, offering great animations for videos from all kinds of GeoDict results.

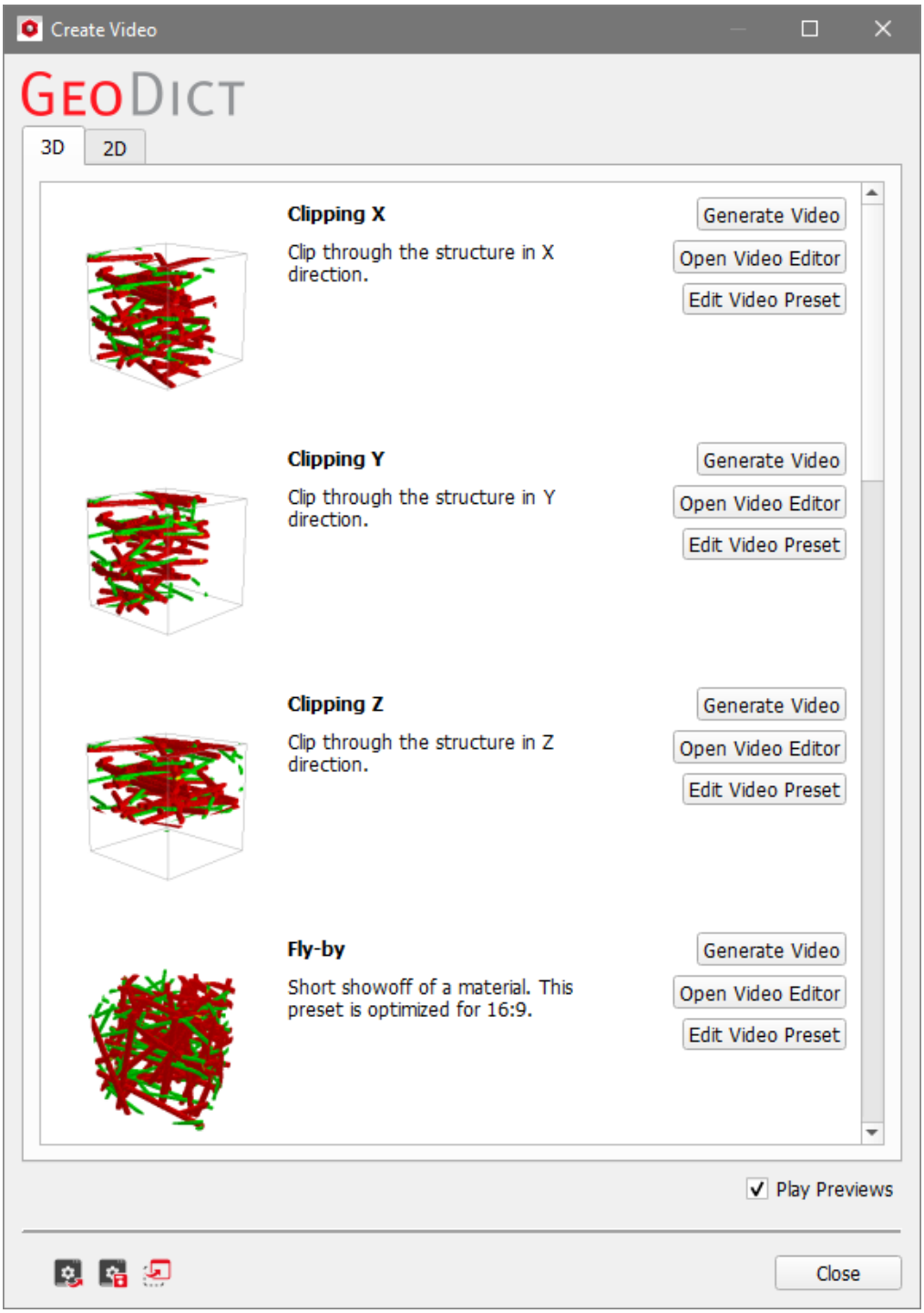
The **Create Video** dialog offers a variety of presets that are either ready-to-use with a click or can be tailored for the user needs by defining own presets and combining the animations fitting best to the results.

Different video formats and quality options are available to save movies with the perfect settings for individual purposes.

CREATE VIDEO

If a structure or a volume field are loaded in the Visualization area of the GeoDict GUI, the **Create Video** dialog opens after selecting **File → Save Video as ...** from the menu bar or by clicking the icon  in the GeoDict toolbar.

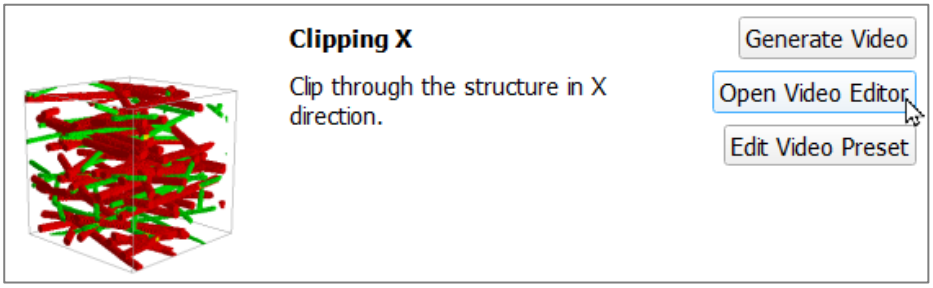
In the **Create Video** dialog, the options are organized into the **3D** and **2D** tabs. The **Create Video** dialog opens automatically to the **2D** tab or the **3D** tab depending on the current view (2D or 3D) in the Visualization area. That is, the **3D** tab is active if a structure is visualized in 3D while opening the **Create Video** dialog. When switching to the **2D** tab, the visualization of the structure changes to 2D view automatically in the GeoDict GUI.



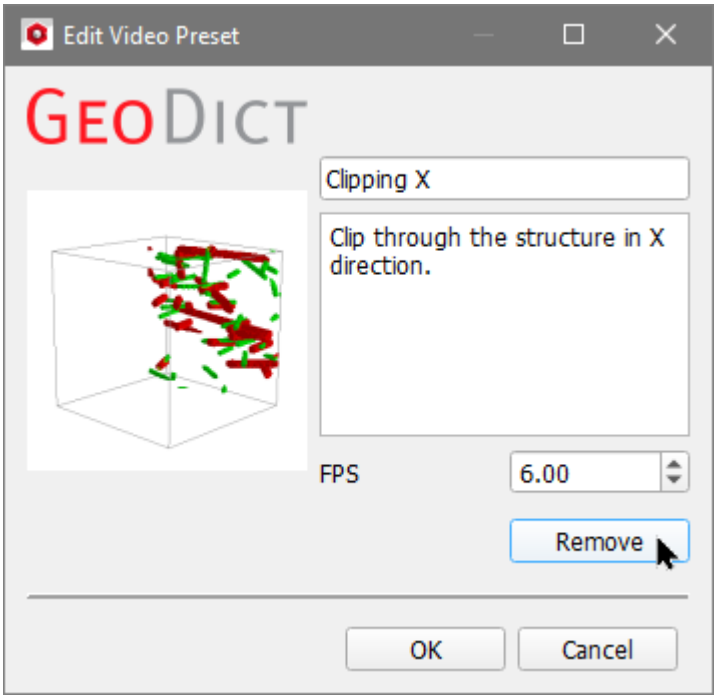
For 3D and 2D visualization, the **Create Video** dialog contains a selection of several preset animations that are used to create a video immediately after clicking the corresponding **Generate Video** button:

- **Clipping X**, **Clipping Y**, and **Clipping Z**
- **Fly-by**
- **Follow Particle**
- **Particle Animation**
- **Rotate X**, **Rotate Y**, and **Rotate Z**
- **Streamlets**
- **Back To Front**, and **Back To Front (all slices)**
- **Front To Back**, and **Front To Back (all slices)**

The preset file for each animation may be opened and edited in the **Video Editor** dialog (see page 19) by clicking the **Open Video Editor** button. The preview on the left shows (approximately) how the finished video should look like.

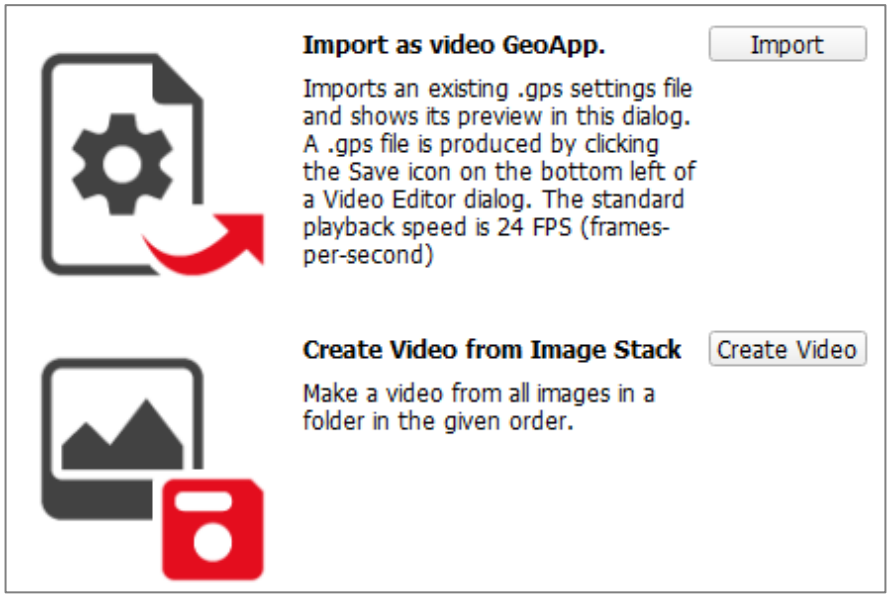


By clicking on **Edit Video Preset**, the name, the description, and the playback speed of the preview (through **f**rames-**p**er-**s**econd or **FPS**) of the preset may be modified. Also, a preset can be removed from the list by clicking **Remove**.

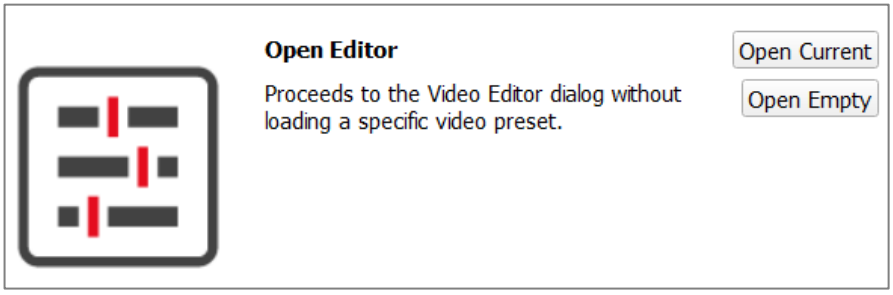


The following options appear when scrolling down under the 2D and the 3D tabs in the **Create Video** dialog:

- **Import as video GeoApp**. The video presets created and saved by the user are added to the **Create Video** dialog and are displayed with their own preview.
- **Create Video from Image Stack** converts a stack of single frames into a video.



Finally, the **Video Editor** dialog can be opened containing the last edited animation by clicking **Open Current** or as a fresh, empty dialog by clicking **Open Empty**.



Uncheck **Play Previews** on the bottom right of the **Create Video** dialog to stop the animation of the previews that display the Video Presets.

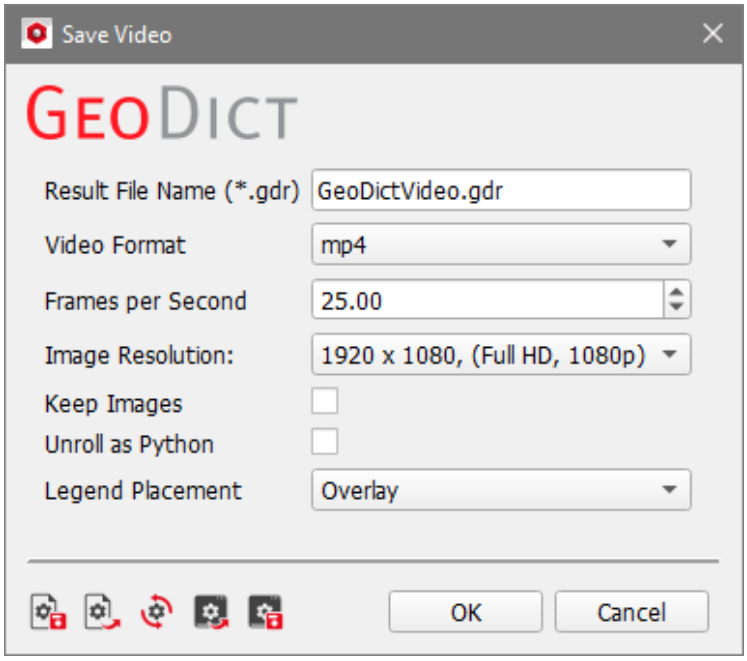
Load the saved **Start-up Settings**, save the current **Create Video** dialog settings as **Start-up Settings** or raise the **GeoDict Main Window** (GUI) by clicking the corresponding icons on the bottom left.

Resting the mouse pointer over an icon prompts a ToolTip showing the icon's function to appear.

Clicking **Close** closes the **Create Video** dialog.

GENERATE VIDEO

Clicking **Generate Video** for any of the presets or in the **Video Editor** opens the **Save Video** dialog.

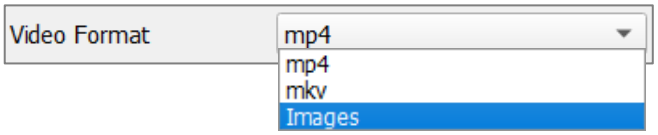


Enter a customized **Result File Name (*.gdr)** to differentiate the generated videos. The resulting GDR file will be placed inside the chosen project folder next to the generated video with the same name. Additionally, a result folder also with the same name is generated, containing the structure file (*.gdt) and the saved images.

Select the **Video Format**, **Frames per Second**, and **Image Resolution** and decide whether to **Keep Images** and **Unroll as Python** or not.

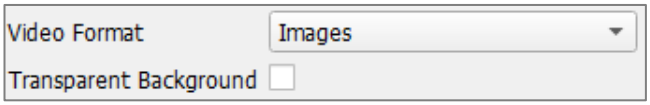
For the 2D animations, additionally the **Legend Placement** may be changed.

For **Video Format**, choose between three different video formats:



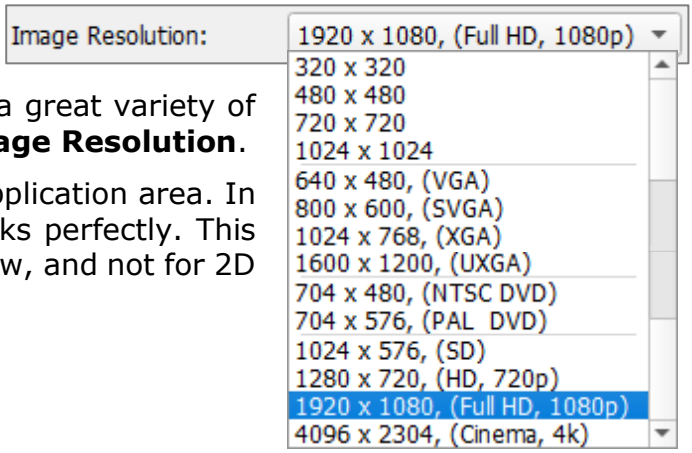
- **MP4:** Best format for any application, with the resulting video being of good image quality at a reasonable size.
- **MKV:** MKV files are multimedia container formats, which can include different and mixed audio and video formats. Since this is not an industry standard not all media players support it.
- **Images**: If this format is checked, no video is generated. Instead, only the images are created and stored in the result folder.

If **Images** in 3D view are generated, the option **Transparent Background** allows to save the images with transparent background if selected.



The option **Frames Per Second** is available for the MP4 and MKV video formats. Increasing the number of frames per seconds increases the number of images shown within a second of the video and the video appears smoother.

If the number of frames per second is increased from 25 to 50, the video plays twice as fast. To counteract this and maintain the same duration of the video, the total number of frames must be doubled in the **Video Editor** as described on page 25.

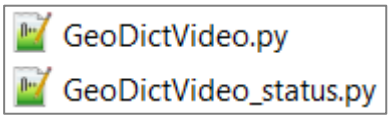


The **Save Video** dialog comes with a great variety of choices for formats and sizes for **Image Resolution**.

Choose the one that best fits your application area. In most cases, the **Full HD** preset works perfectly. This option is only available for the 3D view, and not for 2D view animations.

By default, the single images temporarily rendered to create the video are deleted to save disc space after the video generation has finished. For further video editing and to use them instead of the compressed video, the images may be kept by checking **Keep Images**. For the **Images** video format, the checkbox is grayed out and checked automatically.

Select **Unroll as Python** to save two GeoPy macros with the same name entered for **Result File Name**:



- ***.py**: generates the video using the *_status.py.

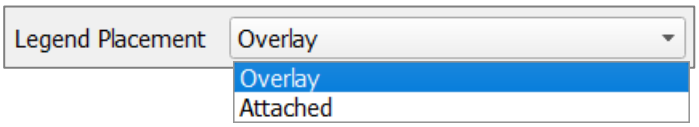
  Execute this file to generate the video, by selecting **Macro Execute Macro / Script** from the menu bar. In the **Macro Execution Control** browse for the macro and click **Run**, as described in the Automation by scripting user guide.

- ***_status.py**.

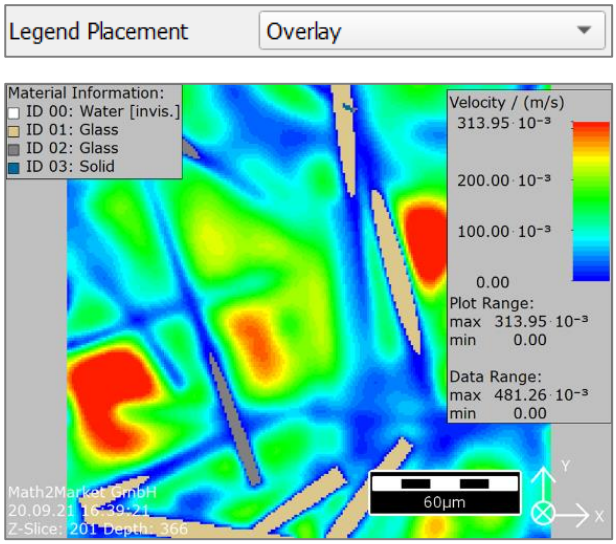
  Includes the video generation parameters as a large Python macro containing the complete states of GeoDict for every rendered frame.

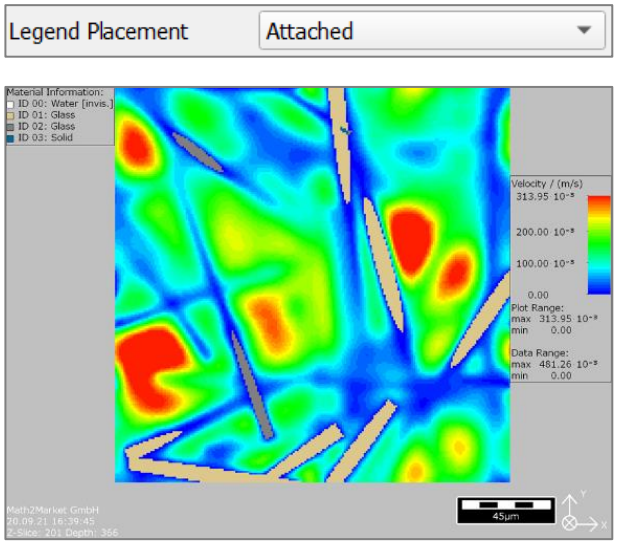
Note, that this creates and saves two Python files but does not render the video. However, this is useful if the video should be tweaked at a specific point or if animations should be added via script. To learn more about how to edit and play back GeoPy macros, see the Automation by scripting handbook of this User Guide.

For 2D animations, additionally, the **Legend Placement** may be selected as **Overlay** or **Attached** from the pull-down menu.



If **Overlay** is selected, the legend elements are shown above the 2D slices, while for **Attached** the full slice is visible, as the legends are placed around the image.





This option is not available for the **(all slices)** presets. For these presets, the legends are placed as overlay by default.

After clicking **OK** in the **Save Video** dialog, the video is generated and saved to the current GeoDict project folder. Additionally, a result file (*.gdr) containing information about the video generation is created and placed next to the video file. The structure (*.gdt) is saved in the result folder.

The parameters entered in the **Save Video** dialog may be saved into GPS (GeoDict Project Settings) files and/or loaded from them.

Remember to restore and reset your (or GeoDict's) default values through the icons at the bottom of the dialog when needed and/or before every video generation.

Resting the mouse pointer over an icon prompts a ToolTip showing the icon's function to appear.

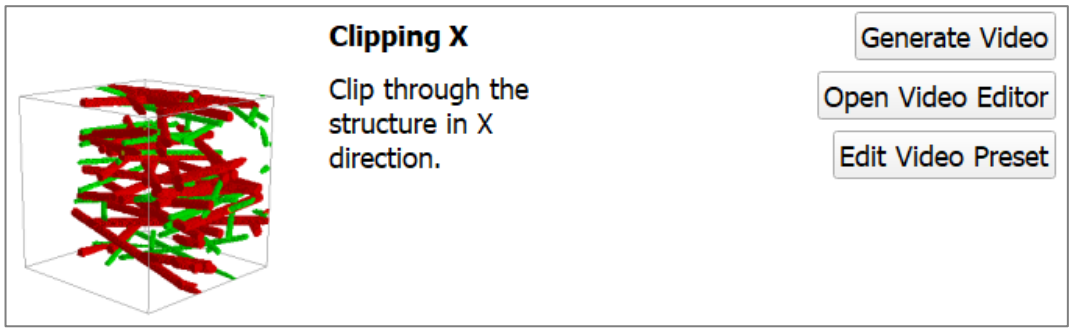
VIDEO PRESETS

For 2D view and 3D view, several video presets are provided that let the user generate great videos from the loaded microstructure by simply clicking **Generate Video**.

For each of these video presets, a **preview** is shown on the left-side of the panel. Checking or unchecking **Play Previews** at the bottom right of the **Create Video** dialog controls whether the previews should play or stop.

In the middle of the panel, the name and a short description of the video preset are displayed.

The options **Generate Video**, **Open Video Editor**, and **Edit Video Preset** are given for each preset (as mentioned above in page 3) on the right side of the panel.



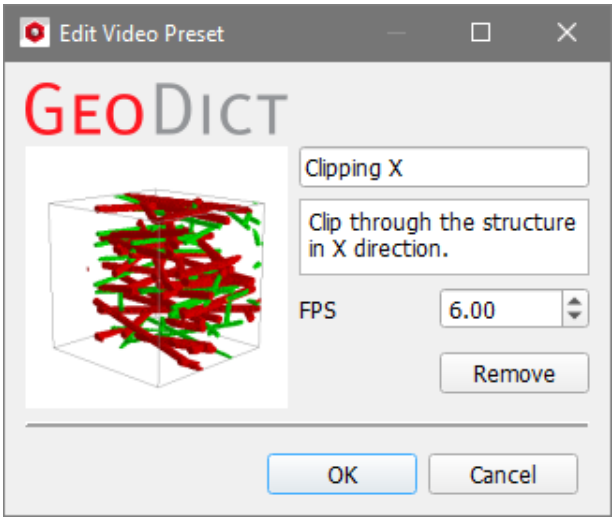
Clicking **Generate Video** opens the **Save Video** dialog. The dialog has a good initial default setup for most videos. Select a **Result File Name** and click **OK** to generate the video. For a more detailed description of this dialog, see page 5. The animations shown in the preview are applied to the current structure displayed in the Visualization area of GeoDict.

Click **Open Video Editor** to open and edit each video preset in the **Video Editor** dialog. A description of how to edit a video with the **Video Editor** is found starting on page 19.

The **Edit Video Preset** dialog opens by clicking the **Edit Video Preset** button. Modify the name, the description, and the **FPS** (frames-per-second) that define the preview playback speed of the selected video preset.

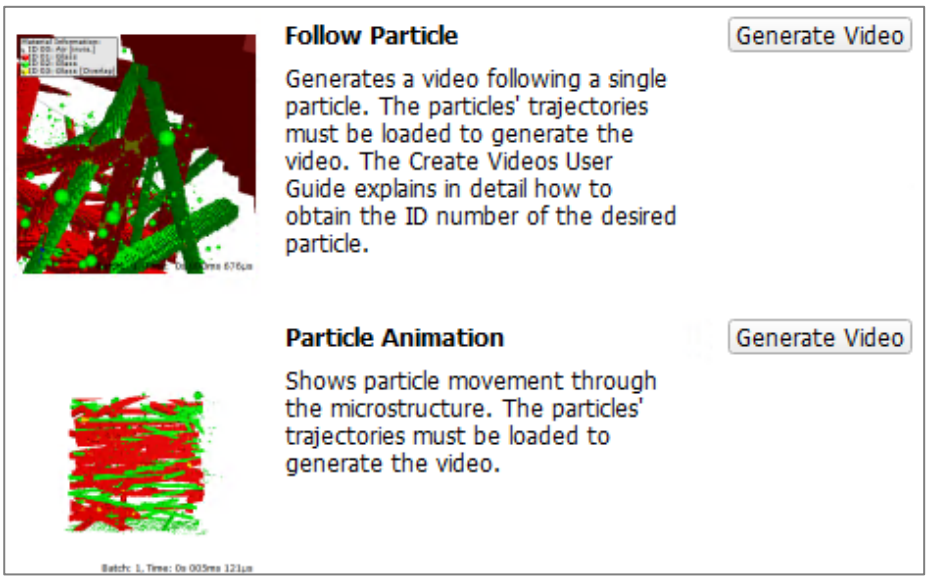
The preset can be removed from the list by clicking **Remove**.

Click **OK** to save the new settings for the preset or click **Cancel** to reject the changes and close the dialog.

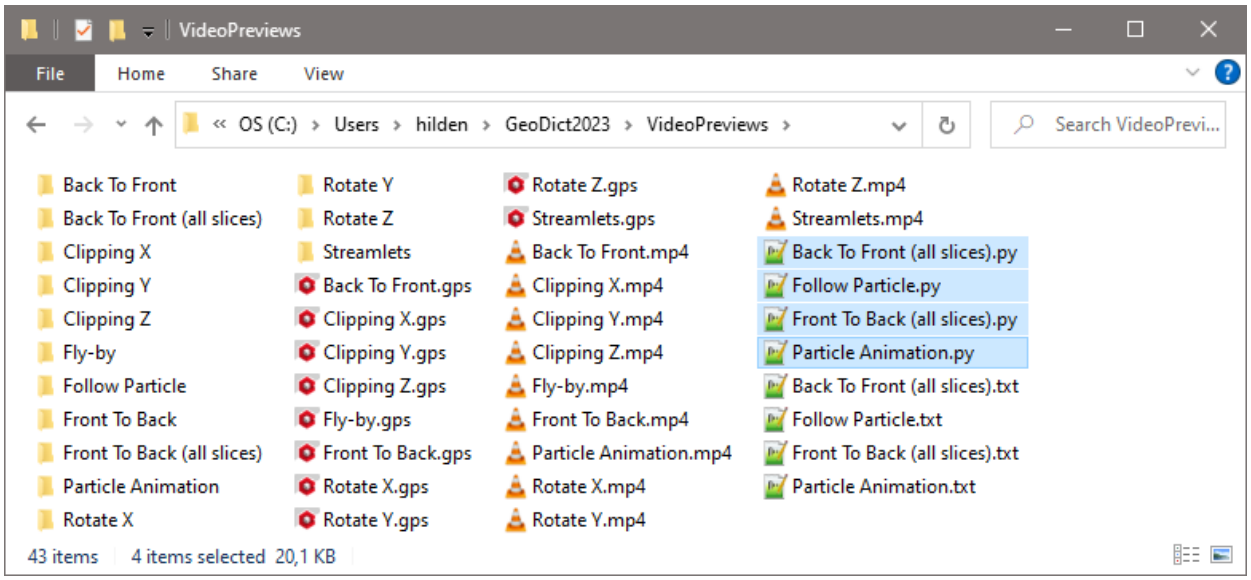


The video presets **Follow Particle**, **Particle Animation**, **Front To Back (all slices)**, and **Back To Front (all slices)** cannot be edited directly in the **Video Editor** dialog or in the **Edit Video Preset** dialog.

However, the Python scripts corresponding to these video presets can be found in the GeoDict settings folder and can be edited with a text editor. Learn how to edit GeoPy macros in the Automation by scripting handbook of this User Guide.



The files corresponding to the other **Video Presets** can be found in the GeoDict settings folder, together with the folders containing the images for the preview videos, the GPS (GeoDict Project Settings) files, which can be opened in the **Video Editor**, and the files for the previews.

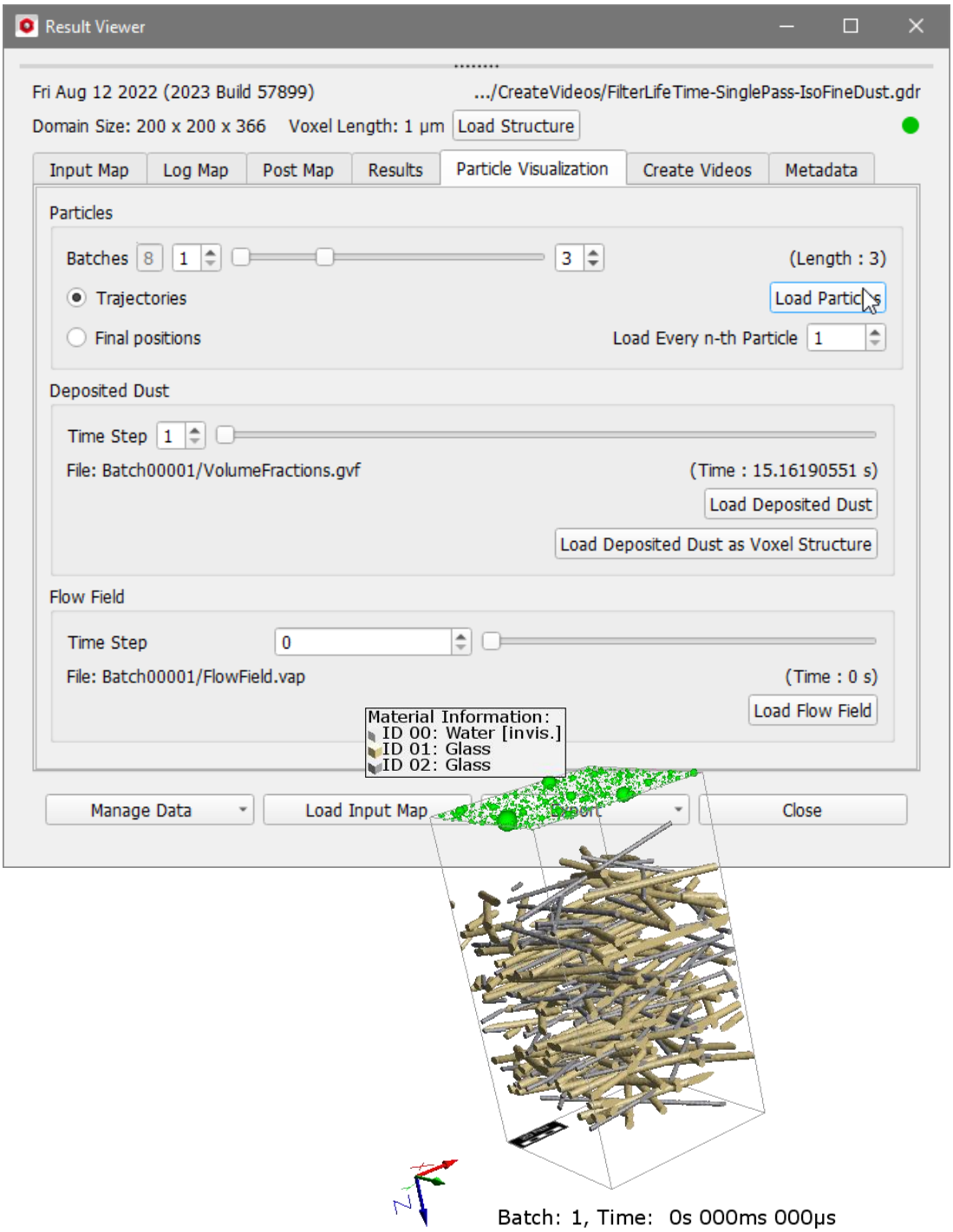


For the **Follow Particle** and the **Particle Animation** video presets, the videos of animated particles are generated only if the microstructure AND the files containing the particles trajectories are loaded in the Visualization area in the GeoDict GUI.

In these two cases, the workflow for the video generation starts with the opening of the **Result Viewer** of the result file (*.gdr) obtained from a FilterDict or AddiDict simulation.

Then, click the  icon in the toolbar or select **File → Open Results (*.gdr)...**.

In the **Result Viewer**, first click **Load Structure** to load the microstructure into the Visualization area of GeoDict. Then, under the **Particle Visualization** tab, make sure that **Trajectories** is checked and click **Load Particles** in the **Particles** panel. It is possible to limit the number of batches and particles to be loaded (**Batches**, **Load Every n-th Particle**).



FOLLOW PARTICLE PRESET

Now, click the  icon in the toolbar or select **File → Save Video as**…. to use the **Follow Particle** video preset.

In the **Create Video** dialog, click the **Generate Video** button for the **Follow Particle** preset video. Adjust the parameters in the **Save Video** dialog as explained above, give the video a name, and click **OK**.

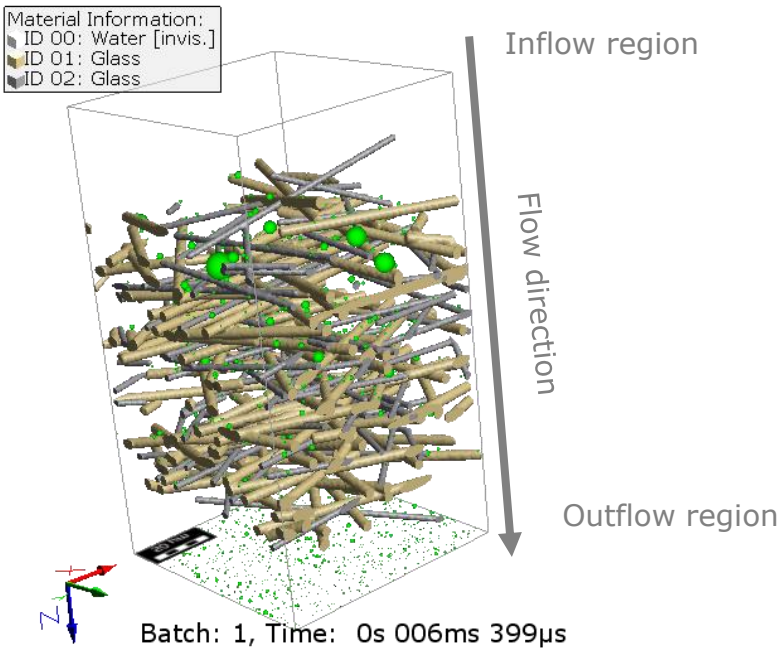
The **Follow Particle** dialog opens, and the following parameters can be specified:

- Enter the number of the desired **Particle Batch**. In our example above, the result file contains results from 8 batches.
- For **Particle to follow**, enter the ID of the particle the camera should follow. How to obtain this ID number is explained directly below.
- **Video Duration** controls the length of the video in seconds. The smaller the number, the faster the particle flies through the structure.
- **Distance to Particle** defines the distance from the camera to the particle. The default distance is fine for most cases if the **Visualization → Diameter Factor** in the **Custom Particle Selection** dialog was not changed (see next page). When the particle is large, the user should increase the **Distance to Particle** to avoid having the camera "enter" the particle. The effect in this case is that the particle would appear as a ring instead of a sphere.

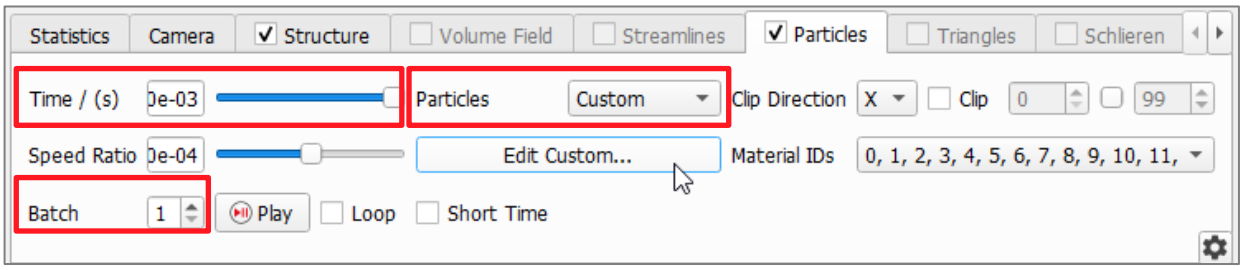
The user may want to create a great video of a single particle moving through the microstructure. This could be a particle that is not filtered but runs from inflow region to the outflow region through a fibrous media. After having loaded the microstructure and the particles, it is possible to locate this individual particle to follow and obtain its ID.

Look at the **Visualization panel** above the **Visualization area** and do the following:

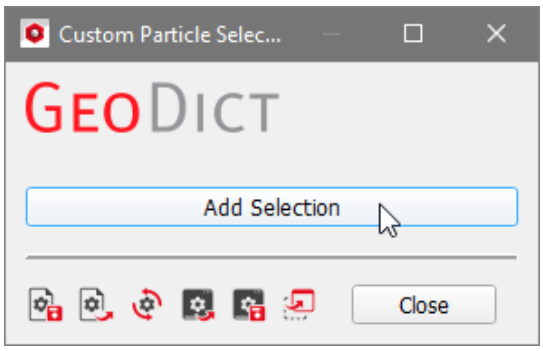
1. In the **Particles** tab, select the number of the **Batch**. This number will be later entered in the **Follow Particle** dialog (see above) as **Particle Batch**.
2. Move the **Time** slider all the way to the right to observe the position of the particles in the outflow region at the end of the batch.



3. From the **Particles** pull-down menu, select **Custom** and click **Edit Custom...**.

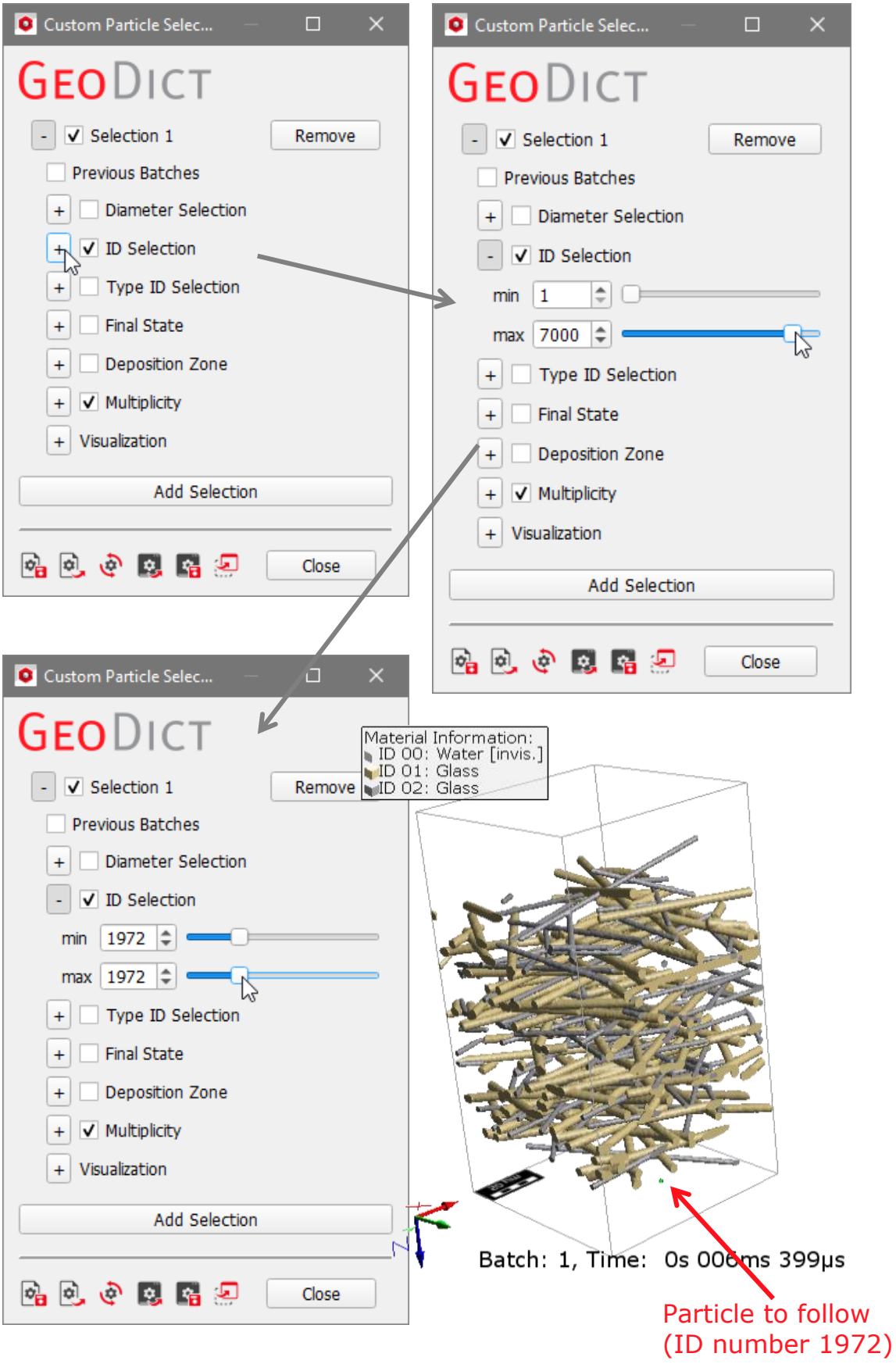


4. In the opening dialog, click **Add Selection**. Click the + icon to unfold **Selection 1**.



5. Check and unfold **ID Selection** and move the slider for **max** to the right until you can see some (good looking) particles in the outflow region, i.e. particles easily visible and around the center on the final position for the batch. Slowly move the slider for **min** (also, directly insert numbers or click the up-arrow) and see how the particles start to disappear.

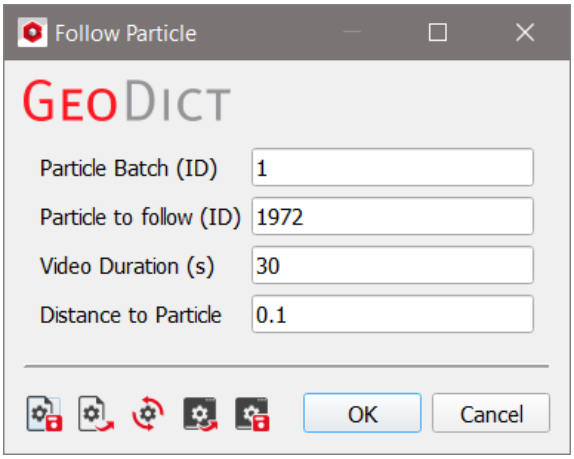
   Visually locate a single particle and adjust both sliders in this way until they show the same ID number and only this single particle can be seen above the microstructure in the Visualization area.

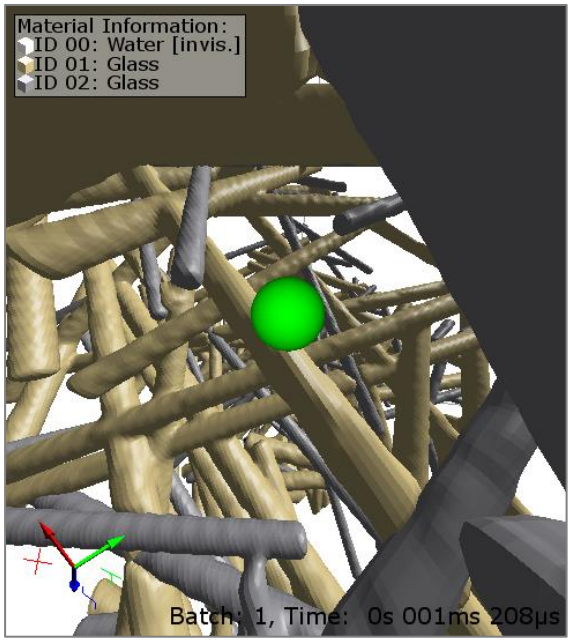


If also the other particles, and not only this individual particle, should be visualized in the final video uncheck **ID Selection** before going to the next step (in the Follow Particle dialog).

It is also possible to change the color of the single particle to make it stand out from the others (for more information on how to do this, ask support@math2market.de).

Back in the **Follow Particle** dialog, enter the **Particle Batch** as 1, the ID number of the selected **Particle to Follow** as 1972, increase the **Video Duration** to 30 s, and increase the **Distance to Particle** to 0.1. After clicking **OK**, the Python script is executed, and the video generated.

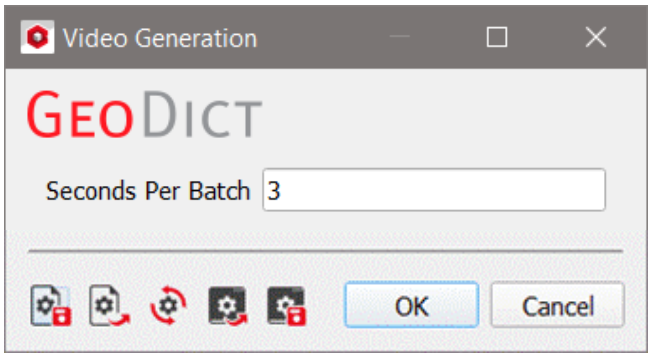




PARTICLE ANIMATION PRESET

Also for the **Particle Animation** video preset, an additional dialog opens after clicking **Run** in the **Save Video** dialog.

In the **Video Generation** dialog, enter the **Seconds Per Batch** defining the time spent on each batch in the video.

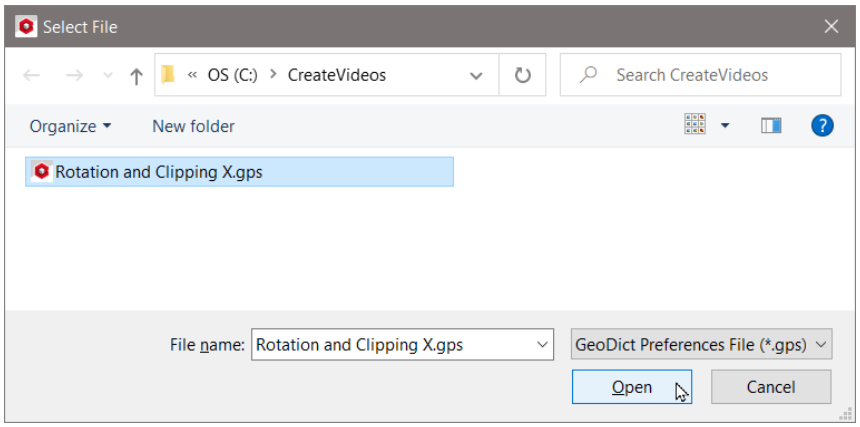


IMPORT AS VIDEO GEOAPP

Via **Import as video GeoApp**, the video presets created and saved by the user are added to the **Create Video** dialog and are displayed with their own preview.

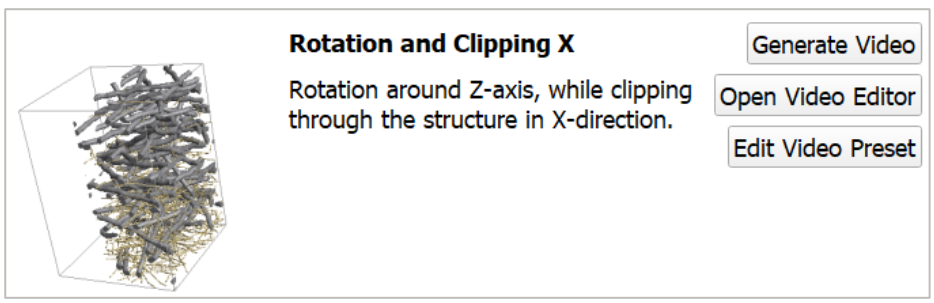
A *.gps (GeoDict Project Settings) file saved from the **Video Editor** (as described in page 20) is imported by clicking the **Import** button for the **Import as video GeoApp** entry in the **Create Video** Dialog.

Select the saved *.gps file and click **Open**.



Afterwards, the selected animation is applied to the structure currently loaded to the Visualization area and a folder containing the images, the GPS file, and a *.mp4 file for the preview are saved in the GeoDict settings folder.

After the video is created, the new video preset is available in the **Create Video** dialog list with its own preview. It can be modified or removed through the **Edit Video Preset** button and its dialog (see page 8). Here, a GPS file with the name **Rotation and Clipping X** was imported and a description was added via the **Edit Video Preset** dialog.



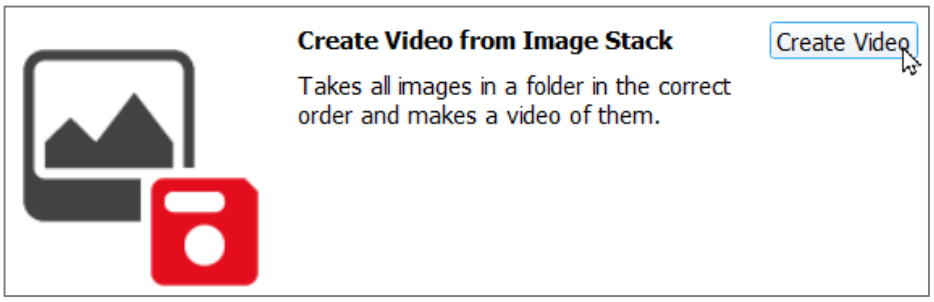
Additionally, the result file and result folder corresponding to the preview video are placed in the GeoDict settings folder.

CREATE VIDEO FROM IMAGE STACK

A created stack of single frames is converted into a video using **Create Video from Image Stack**

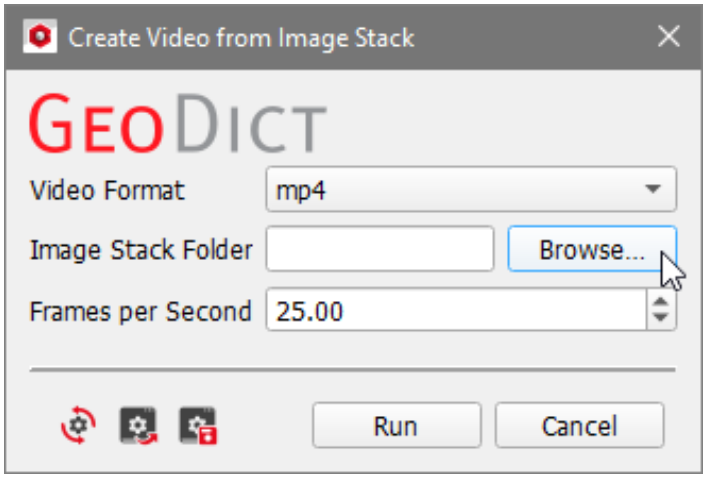
For example, if a video was generated with the **Keep Images** option checked in the **Create Video** dialog (as described on page 5), creating a video from this image stack is done quickly with the possibility of changing other settings, such as the **Video Format** or the **Frames per Second**. These options are described in detail on page 5.

Scroll to the **Create Video from Image Stack** entry in the **Create Video** dialog and click **Create Video**.



In the opening dialog, choose the **Format** of the video, and click **Browse ...** to search for the folder with the saved individual frames (**Image Stack Folder**). All images found in this folder are used for the video generation.

To control the order in which the images are combined to make the video, make sure that all images have the same name and a running number.



Clicking **Run** opens a dialog to choose filename and destination of the movie. After clicking **Save**, the video is generated and saved to the specified file path.

RESULTS

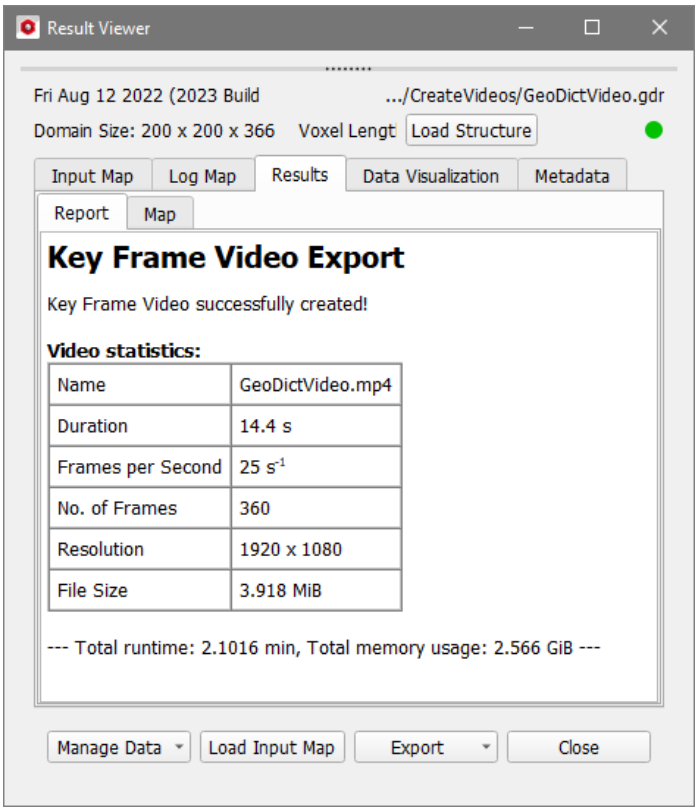
At the end of the video generation, the following files and folder are automatically saved in the selected project folder:

- A result file. For example GeoDictVideo.gdr, which is the default name.
- A result folder with the same name as the result file (e.g. GeoDictVideo). It contains the structure file (Structure.gdt) and, if **Keep Images** was checked in the **Save Video** dialog, the folder **images** with all video frames as *.png files.
- A video with the same name as the result file and in the selected video format (e.g. GeoDictVideo.mp4)

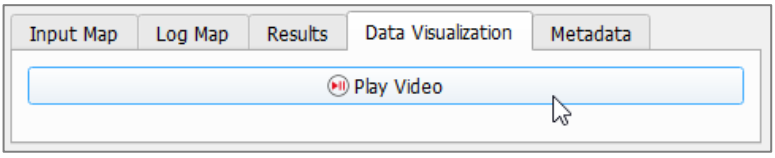
For detailed information about the **Result Viewer** options, see the Result Viewer handbook of this User Guide.

After the video is finished, the result file (.gdr) is saved in the project folder and the **Result Viewer** automatically opens.

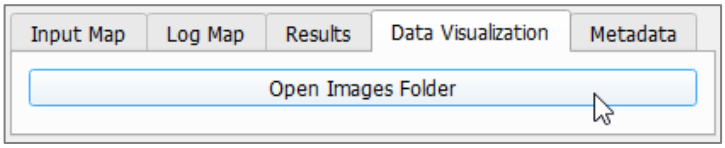
The **Results - Report** subtab shows the information about the generated video: the name of the video, the video duration, the FPS, the total number of frames, the resolution, and the video file size.



Under the **Data Visualization** tab click **Play Video** and the video is played in the default video player.



If **Images** was selected for **Video Format** in the **Save Video** dialog, clicking **Open Images Folder** opens the result folder containing the saved images, as no video is generated.



The animation settings used for the video can be loaded in the **Video Editor** by clicking **Load Input Map** in the Result Viewer and opening the Video Editor with **Open Current**, or by dragging the result file to the opened Video Editor and dropping it there.

VIDEO EDITOR

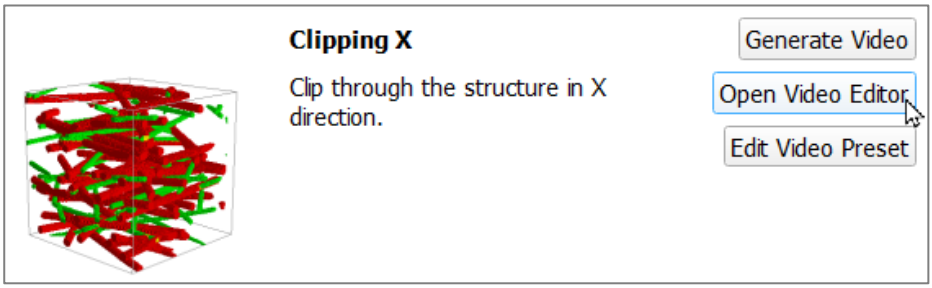
A large variety of possibilities to generate animations for videos is provided by the **Video Editor**. It can be opened in three different ways:

- Clicking **Open Video Editor** to edit any of the video presets (via the Video Editor)
- Clicking **Open Current** to open the animation last edited or used for video generation in the current GeoDict session by.
- Clicking **Open Empty** to start with an empty dialog.

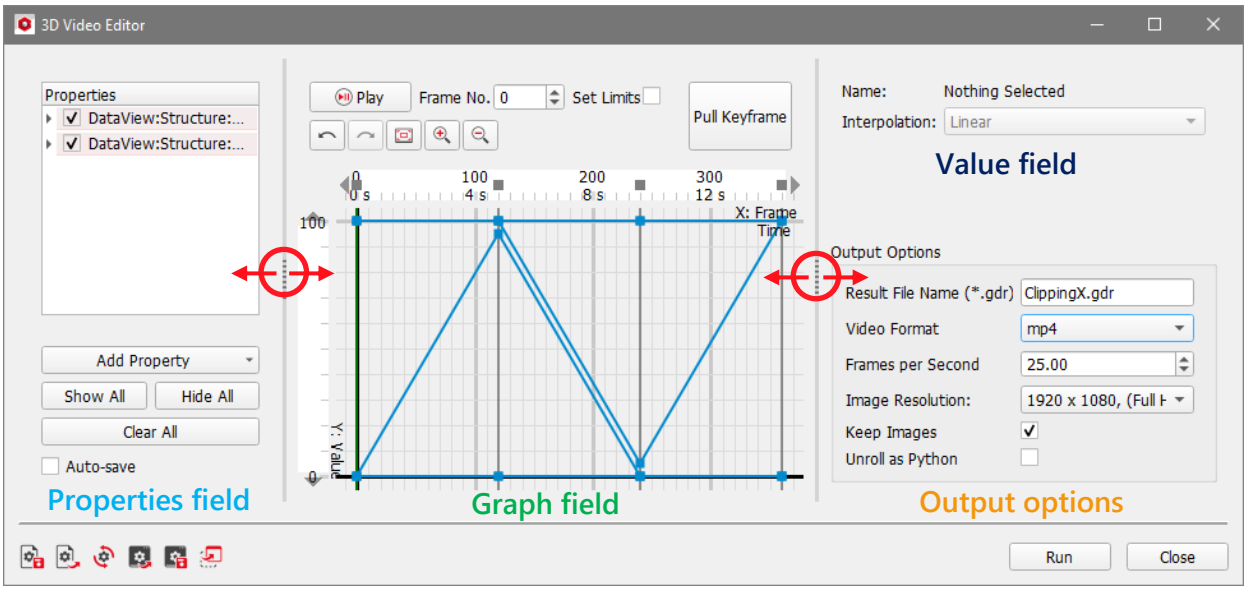
The **2D Video Editor** opens from the **2D** tab, and the **3D Video Editor** from the **3D** tabm but only the **3D Video Editor** is described here, since the options are the same.

The **Video Editor** uses keyframes to animate a structure or object in a user-defined manner. In the animation, the objects can be made to change position, orientation, size, etc. Most parameters of the visualization in GeoDict can be animated in the **Video Editor**, allowing to present structures as desired by the user.

Here, as an example, we modify the video preset Clipping X to describe the Video Editor's options. Click **Open Video Editor** in the **Clipping X** video preset.



As seen below, the **3D Video Editor** dialog contains the **Properties field**, **Graph field**, **Value field**, and the **Output options**. The **3D Video Editor** dialog opens as a graph-editor that in the middle displays the flow and changes of the video on a 2D-graph (Graph field). The **X-axis** shows the time in frames and seconds and the **Y-axis** shows the values of the chosen parameters.



To the left of the Graph field, in the **Properties field**, find the names of the properties corresponding to the plots. These properties are animated over time and displayed in the **Graph field** as curves. The **Properties field** is described in detail in page 21.

In the middle of the **Video Editor**, the **Graph field** contains a plot of the properties chosen in the **Properties field**. The curves are described by keyframes and data points, and display the changes of the properties over time. The **Graph field** is explained in more detail starting in page 24.

The options to be modified for a selected data point in the graph area are in the **Value field** in the upper right side of the **Video Editor**. They are described in detail on page 28.

Right below, find the **Output Options**. These are the same options shown when clicking **Generate Video** in the **Create Video** dialog, which opens the usual **Save Video** dialog that has been explained in detail above (see page 5).

The **Video Editor** fields can be collapsed and expanded by pulling the dotted lines in the left or the right, respectively.

Clicking **Run** starts the video generation. The video, result file, and result folder or Python macros, as defined in the **Output Options**, are placed in the current project folder.

Close the **Video Editor** by clicking **Close**.

The parameters entered in the **Video Editor** dialog can be saved into GPS (GeoDict Project Settings) files and/or loaded from them. Remember to restore and reset your (or GeoDict's) default values through the icons at the bottom of the dialog when needed and/or before every video generation.

Resting the mouse pointer over an icon prompts a ToolTip showing the icon's function to appear.

PROPERTIES FIELD, GRAPH FIELD, AND VALUE FIELD

Under the menu bar, the **Video Editor** dialog contains the **Properties field**, the **Graph field**, the **Value field**, and the **Output Options**.

The **Output Options** are the same options that appear in the **Save Video** dialog and were already described on page 5.

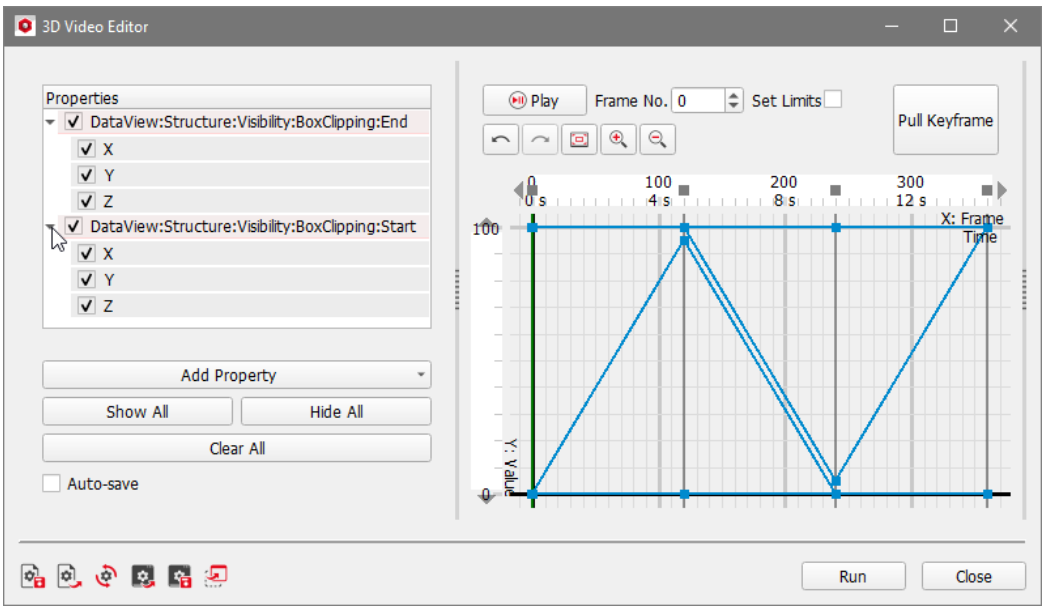
Before getting into the fields, two definitions are important for comprehensibility:

- **Keyframe** is a frame in time used to indicate the beginning or end of a change made to a property.
- **Data Point** is a representation of a property on a keyframe which holds the current state of the property on the keyframe.

Any video consists of frames and the frames represent specific time values. A **keyframe** stores all visualization values at a specific time. For example, if a structure should be clipped in X-direction, it requires a start keyframe for the beginning of the clipping property and an end keyframe for the finish of the clipping property. The clipping property is then interpolated in the interval between those keyframes.

PROPERTIES FIELD

In the **Properties field**, two properties (in regard the Clipping X video preset) are already displayed by default. If the **Video Editor** dialog was opened by clicking **Open Empty** in the **Create Video** dialog, the **Properties field** is empty, and no plot is displayed in the **Graph field**.



The long names of the **Properties** are also the path of the properties in the **Visualization Settings** panel in the GeoDict GUI and in the GeoPy script structure.

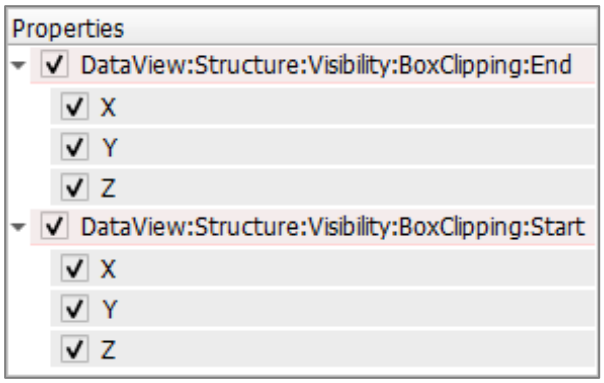
If **Unroll as Python** was checked in the **Save Video** dialog (described on page 5), the corresponding keys of the property are found in the resulting Python macro. Learn more about the visualization settings in the Visualization and the Base Reference handbooks of this User Guide and how to edit and play Python macros back in the Automation by scripting handbook.

If the box on the left side of the **Properties**' name is checked, the corresponding curve is visible in the Graph field.

In the example, the **BoxClipping:Start** property defines the clipping in the corresponding directions (X, Y, Z) and the **BoxClipping:End** defines the clipping from the other sides, respectively.

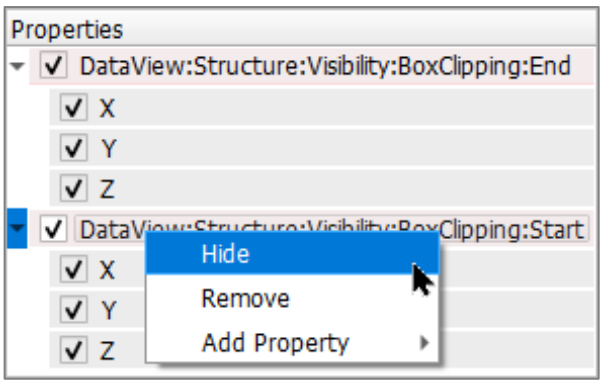
Click the arrow on the left or double click on the property to unfold the **sub-properties**, if they are available. In this example, the different clipping axes are the sub-properties of BoxClipping.

The sub-properties, boxes are also available for checking to show or hide the sub-property in the **Graph field**.



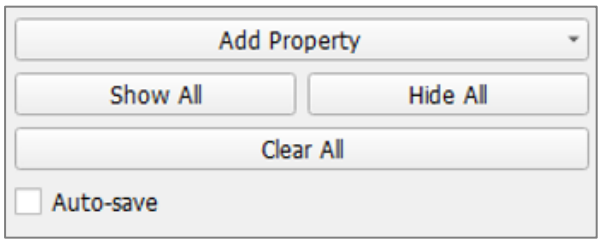
Clicking on a property in the **Properties field** highlights the selected property in the **Graph field** in red, to visualize its change of values over time.

Right-clicking on a property opens a dialog providing the following options:



- **Hide** (or **Show**): Unchecks (checks) the property and thus, hides (shows) the corresponding graph in the Graph field.
- **Remove**: Removes the property from the Properties field, and thus also from the Graph field.
- **Add Property**: Adds a new property to be changed over time. More information about this option is given below.

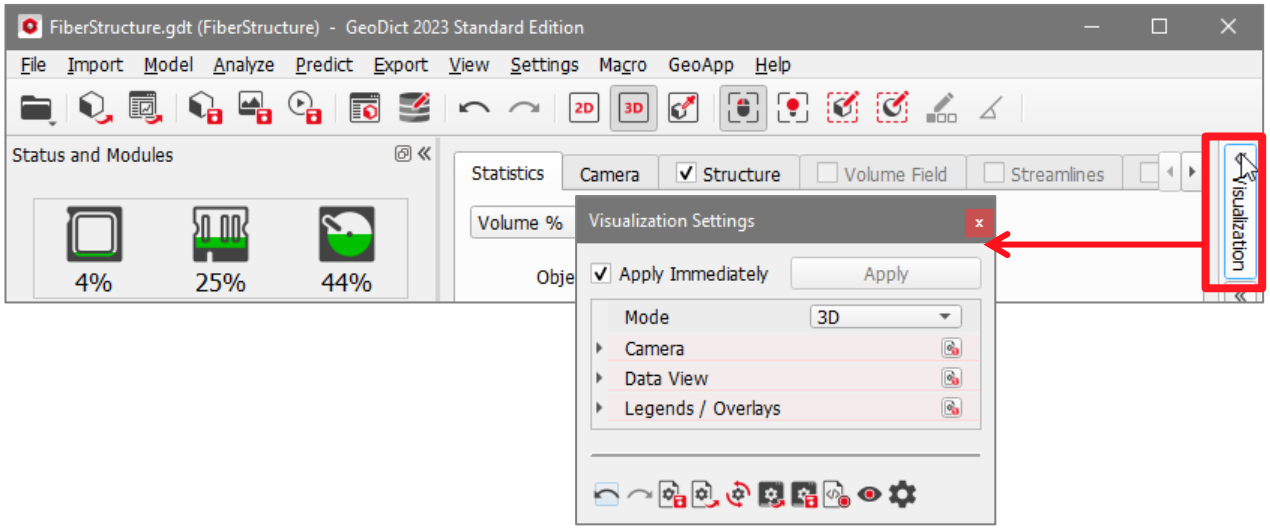
At the bottom of the **Properties field**, find the following options:



- **Add Property**: Add a new property to be changed over time.
- **Show All**: Selects all properties in the Properties field to be shown in the Graph field.
- **Hide All**: Unchecks all properties in the Properties field, resulting in an empty Graph field.

- **Clear All** clears and deletes all properties along with all keyframes and data points.
- **Auto-save**: Check to save the current settings as start-up settings with each change. Thus, the video settings are not lost after closing GeoDict and can be loaded again by opening the Video Editor with the option Open Current in the next GeoDict session or by clicking the Load Start-up Settings icon in the bottom left of the Video Editor.

For **Add Property**, most of the visualization settings of GeoDict can be selected. They are organized corresponding to the **Visualization Settings** panel, that can be expanded and collapsed, on the right side of the Visualization area of the GeoDict GUI, accessible by clicking on the double arrow at the right. Learn more about these settings in the GeoDict Base Reference and Visualization handbooks of this User Guide.



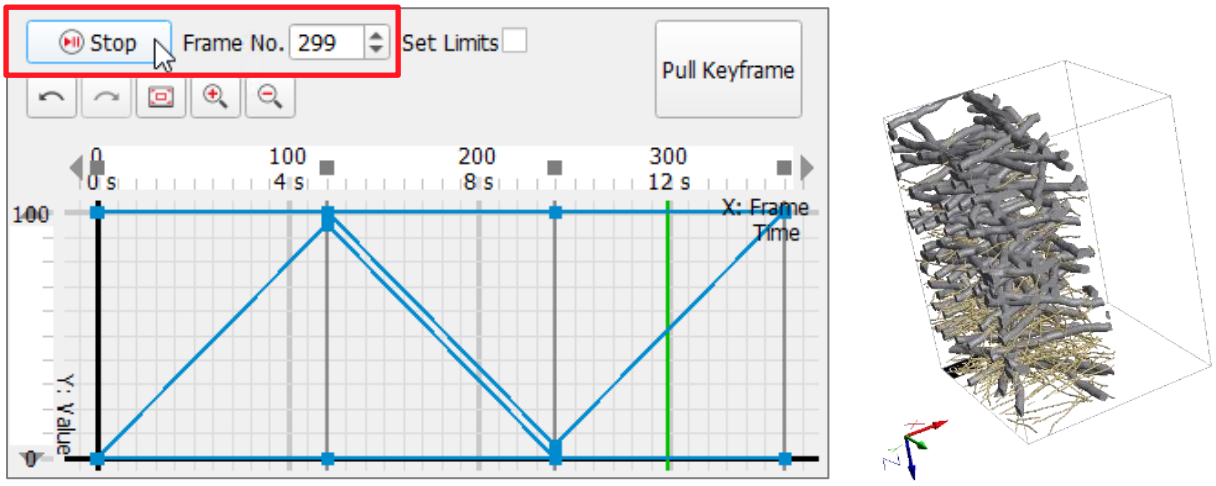
- If working in the **2D Video Editor**, only **Properties** available for **Mode - 2D** can be added to the Video Editor. The other settings are greyed out.
- When using the **3D Video Editor**, only properties available for **Mode - 3D** can be selected.
- Properties available for both visualizations can be chosen for both editors.

The selected property is added to the **Properties field** and can be modified in the **Graph field**. An example for adding and editing a property is given on page 30.

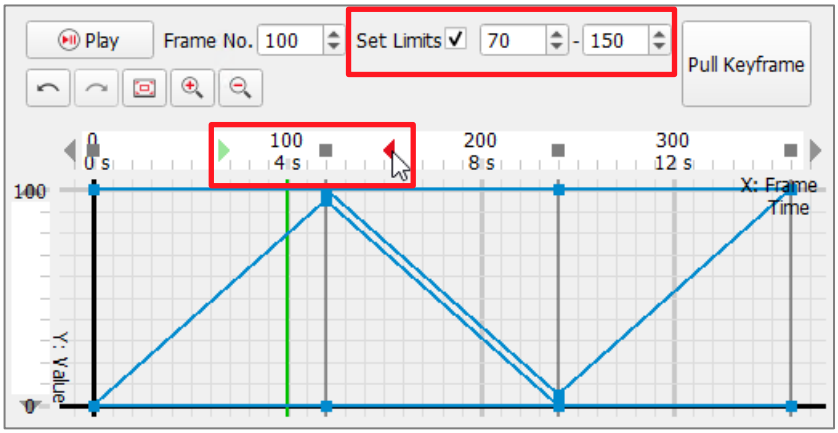
GRAPH FIELD

At the top of the **Graph field**, by clicking the **Play** button, the animation defined in the **Graph field** from the first keyframe to the last keyframe is played in the GeoDict Visualization area.

The frame of the animation is displayed in the plot of the **Graph field** by a vertical green line, the **playhead**, that moves along the X-axis. It can be set manually by left clicking on the X-axis in the **Graph field**, or by entering the desired frame number for **Frame No.** above the plot. This also updates the GeoDict's Visualization area. Click **Stop** to end the playing back.



If only a small part of the animation should be played in a loop, check **Set Limits** and enter the desired limits or move the starting arrow (▶) and the end arrow (◀) on the X-axis to the desired positions. In the example below, clicking **Play** will only play the frames 70-150 back.



Below the play options, several buttons control the view of the graph as described here:

- **Undo**: Undo an action.
- **Redo**: Redo an undone action.
- **Center View**. Zoom in or out of the plot in the Graph field, resulting in all unhidden curves being in view.
- **Zoom in**: Zoom-in in the plot of the Graph field.
- **Zoom out**: Zoom-out of the plot of the Graph field.

In the **Graph field**, keyframes and data points can be modified, created, deleted, and captured.

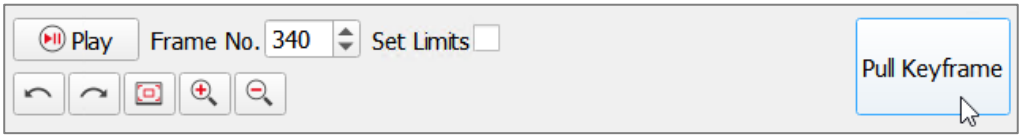
Zoom in and **Zoom out** can also be applied using the mouse wheel while the cursor is inside the plot of the **Graph field**. The zoom takes the cursor as its center and zooms in and out of its position in the plot of the **Graph field**.

Right click and move the cursor inside the plot of the **Graph field** to **move around the view**.

If only one axis should be affected, hover the mouse over the value range of the axis and use the mouse wheel to zoom, or the right click to move, just on this axis.

On the X-axis, which represents the time in frames, (in this example) markers can be found at frames 0, 120, 240 and 360. Those markers are **keyframes** and are shown as a small dark gray box on the X-axis and a dark gray line in the plot of the **Graph field**. If the **Video Editor** was opened by clicking **Open Empty**, there are no keyframes to be found.

The button **Pull Keyframe** is found in the upper right corner of the **Graph field**.

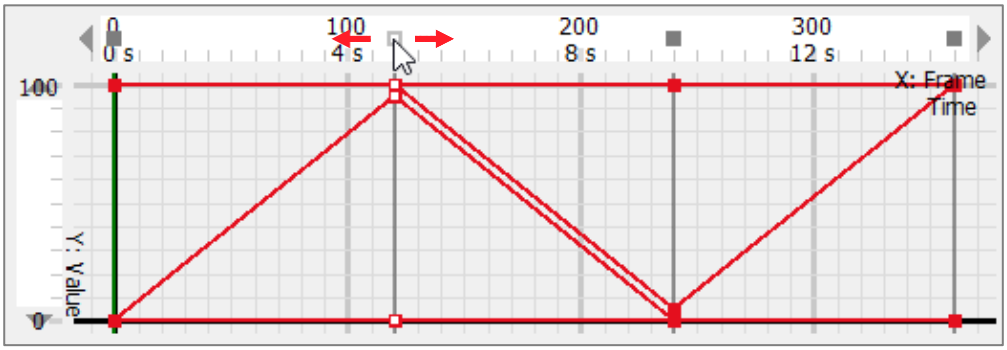


Pull Keyframe reads the current state of the Visualization area in the GeoDict GUI and transfers it into the **Graph field**. If a property has changed but is not recorded in the **Properties field**, GeoDict gives the user the possibility to add it. The new keyframe is then inserted at the playhead's position. An example of pulling a keyframe from GeoDict is given on page 33. If no property was changed, still a new keyframe is added at the playhead's position, containing interpolated data points for all properties in this plot section.

Keyframes are groups that contain the data points, represented by small blue or red boxes on the keyframe lines.

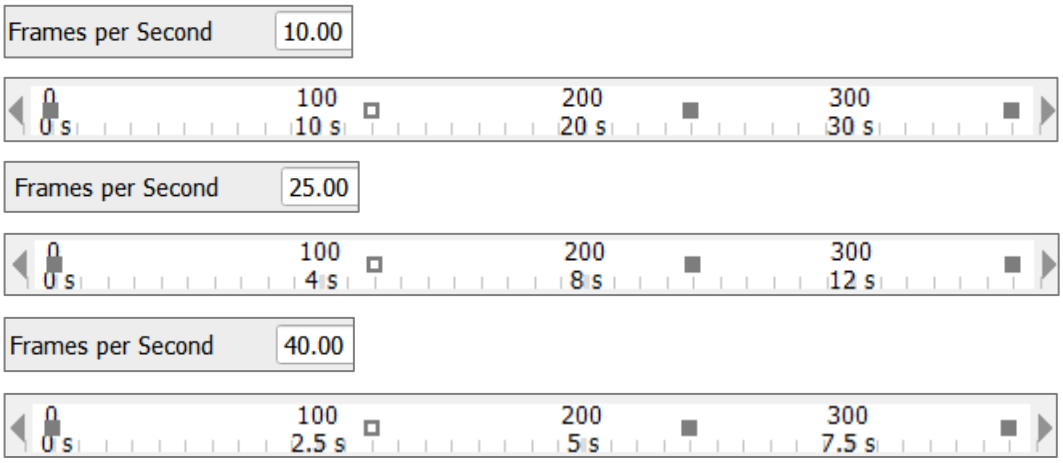
A keyframe can be selected by left clicking on the small dark gray box on the X-axis. If the keyframe is selected, this box is marked white. Also, all data points to be found on the selected keyframe are selected automatically.

By left clicking and holding, the user can **change the position** of the keyframe in time. Move the cursor left or right to decrease or increase the number of keyframes used for the last keyframe field. Moving the last keyframe also changes the total number of frames used for the animation.

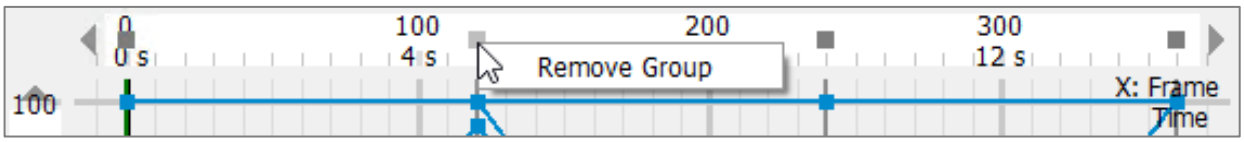


A standard animation runs at a speed of 25 FPS (frames-per-second). Due to this, for example, for an animation that lasts 4 seconds, the properties need to be set over 100 frames.

However, the **Frames per Second** can be changed on the right in the **Output Options** panel. Observe, how the time values change in the X-axis of the plot in the **Graph field** for different FPS values.

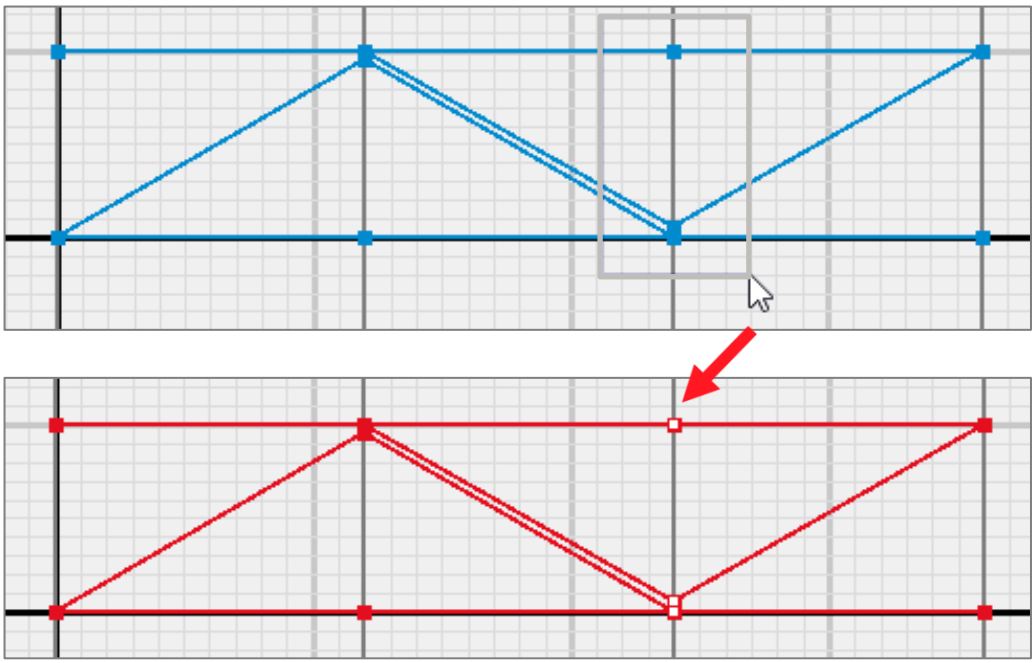


To remove a keyframe, right-click the keyframe marker on the X-axis to call its options menu and select **Remove Group** to delete it.



To select a data point of a property on a keyframe, left click on the blue or red box which represents the data point. The selection status of the data point is indicated by displaying a smaller white box inside its box. Also, the data point shows up in the **Value field** with its name, frame, value, and interpolation type.

Multiple data points can be selected by drawing a multiselect rectangle. To do so, click and hold the left mouse button in the **Graph field** and draw a box around the desired data points. All data points within the box are then selected.

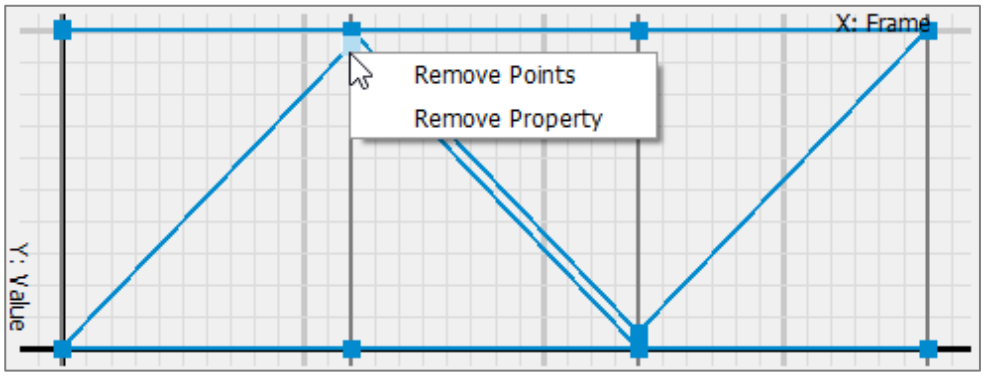


To change the value of a data point, select it and hold down the left mouse button. Then, move the cursor up and down along the keyframe to raise or lower the value or move the mouse left and right to change the timing or frame of a data point. This automatically creates a new keyframe if there is none at the chosen time or attaches it to an existing keyframe.

Alternatively, change **Frame**, **Value**, and **Interpolation** in the **Value field** as described on page 28.

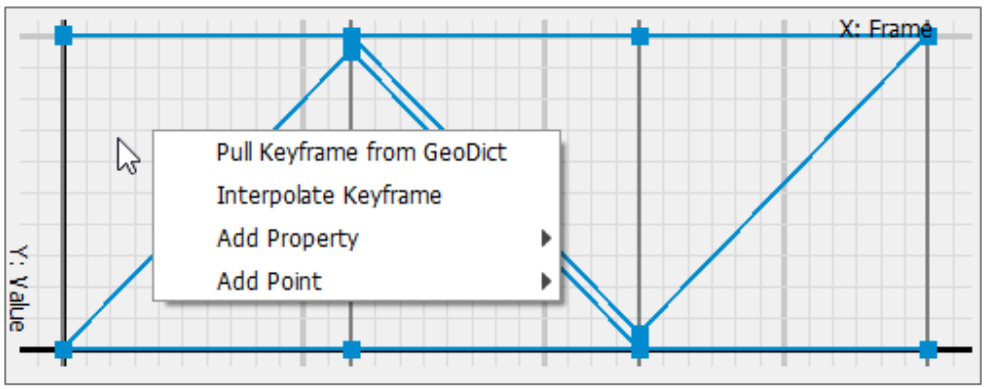
Right clicking on a data point offers the following options:

- **Remove Points:** Removes the data point beneath the right click. If multiple data points are selected, all these selected data points are deleted.
- **Remove Property:** Removes the property and all its data points beneath the right click. Multiple selection does not have an effect here.



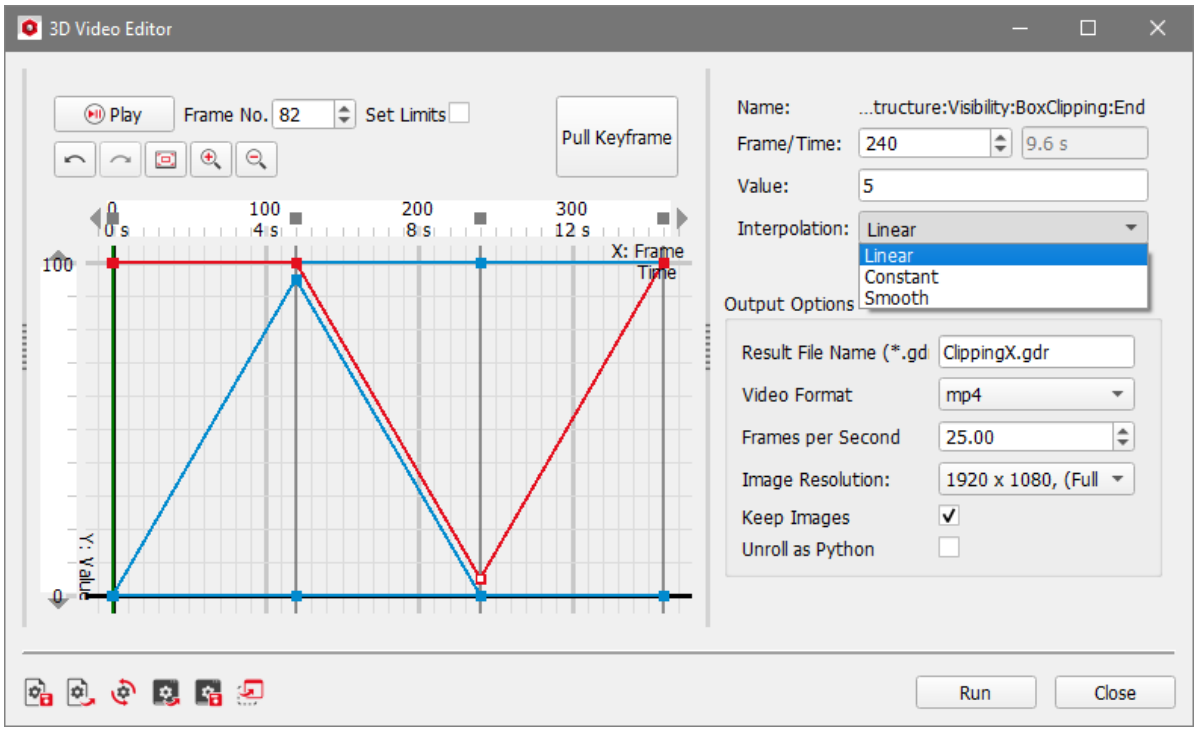
The following options are available by right clicking in the plot of the **Graph field**:

- **Pull Keyframe from GeoDict:** Reads the current state of visualization in the Visualization area of the GeoDict GUI and transfers it into the plot of the **Graph field**. If a property has changed but is not recorded in the **Properties field**, GeoDict gives the user the possibility to add it. The new keyframe is inserted at the position of the right-click.
- **Interpolate Keyframe:** Adds a keyframe at the mouse position. The new data points of the properties on this keyframe are calculated through interpolation between the data points before and after.
- **Add Property:** Adds a property in the **Properties field** .
- **Add Point:** Adds a single data point of a selected property. The value of the data point is interpolated. If no keyframe is present at this X-axis frame, a new one is created.



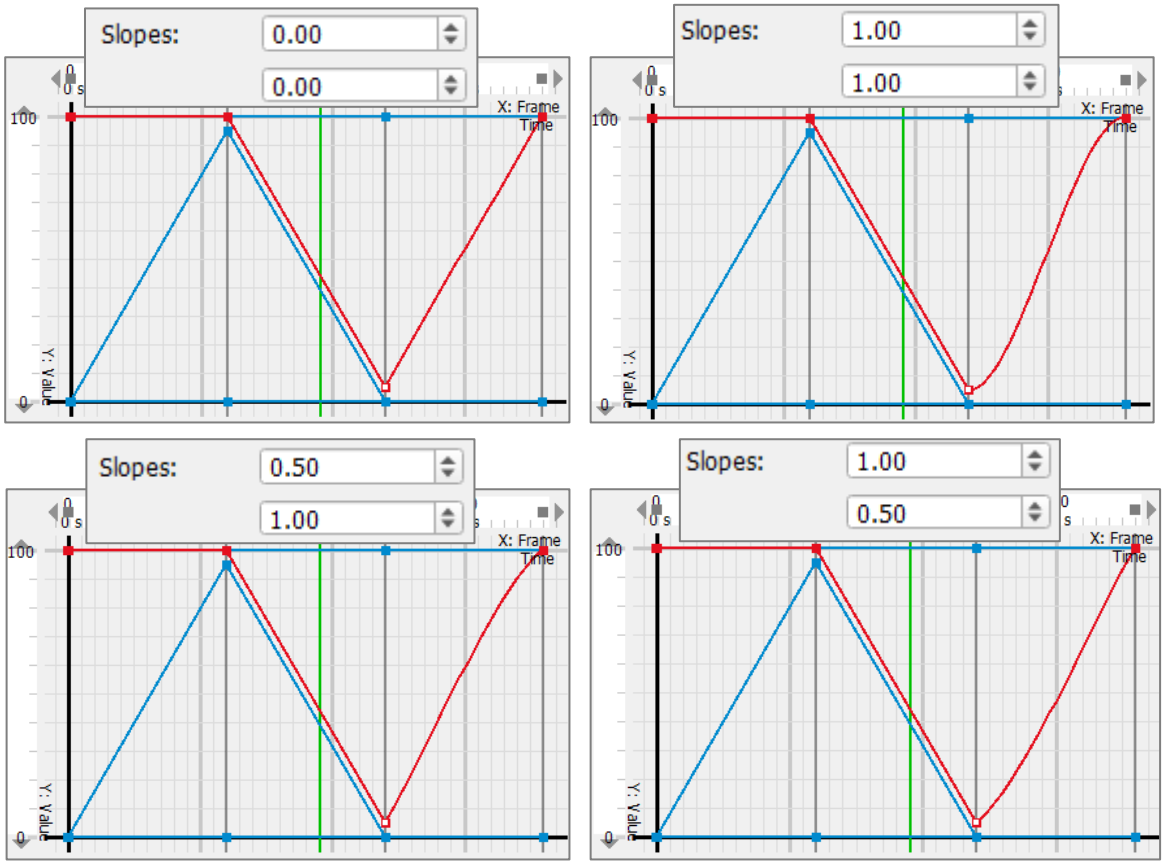
VALUE FIELD

The **Value field** enables the user to enter exact values for keyframes and data points. It distinguishes between selecting a single or multiple data points.



If a single data point is selected, the following options are available in the **Value field**:

- **Name**: The name of the property selected with this data point.
- **Frame/Time:** The frame of the data point on the X- / Time axis can be entered, and the corresponding time is computed automatically, depending on the selected frames per second in the **Output Options**.
- **Value:** The value of the data point on the Y- / Value axis.
- **Interpolation:** The type of interpolation for this data point. The types available for Interpolation are:
  - **Linear**: Linear interpolation of values between the selected data point and the next one.
  - **Constant:** The values of a data point will be constant until a new data point is reached.
  - **Smooth**: The values between the selected and the next data points will be calculated for a smooth transition. Define the left and right **Slopes** of the spline. If both slopes are set to 0, the tangential at the selected points is horizontal. Setting both values to 1 leads to straight lines between the points and thus, is the same as linear interpolation.



If multiple data points are selected, the **Name** is **Multiple Selected** and the Value field will display different options that can be modified, based on the context of the data points.

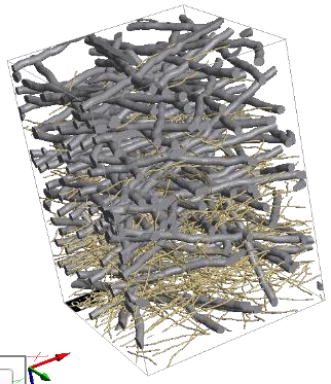
Multiple data points on the same Keyframe: If multiple data points have been selected and they all share the same keyframe, **Frame** and **Interpolation** can be changed in the value selection. All data points share the same frame since they share the same keyframe. If **Frame** is changed, all selected data points will be modified. If the data points have the same **Interpolation** applied, the interpolation will show the specific interpolation type. Else, it will show the type **Mixed**. Changing the interpolation type will apply to all selected data points.

Multiple data points on different Keyframes: If multiple data points have been selected on different keyframes only the **Interpolation** type can be changed.

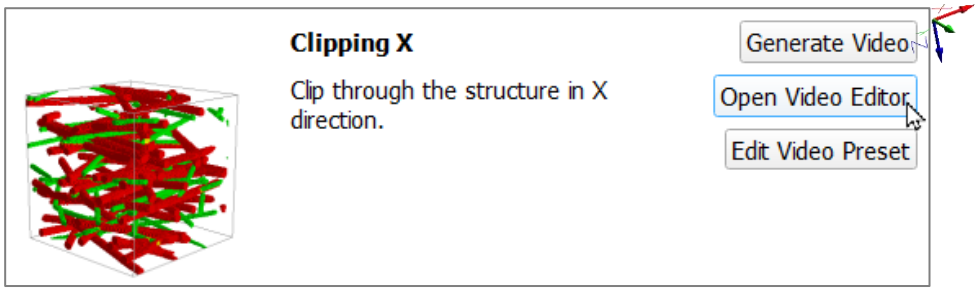
Using the Video Editor – Examples

With two examples, we show here how to change the video editor settings as desired after loading a structure in 3D.

Load a structure by clicking the icon in the toolbar or selecting **File → Open Structure (*gdt, *gad)...** in the menu bar.



Open the **Create Video** dialog (or **File → Save Video As...**) and choose **Open Video Editor** next to the Clipping X video preset.

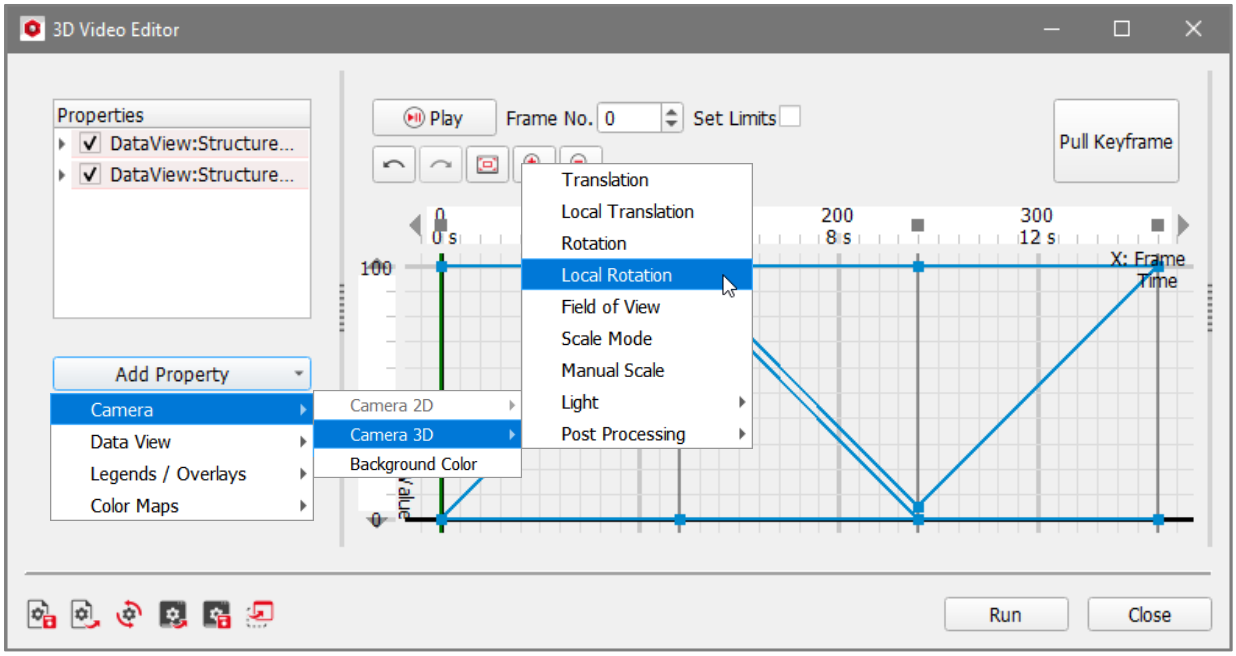


In both examples, additionally to the clipping animation, a camera movement around the Z-axis will be added. In the first example, the new property is added via the **Add Property** option and in the second example (page 33) the corresponding keyframe is pulled from GeoDict (**Pull Keyframe**).

How to add a Property

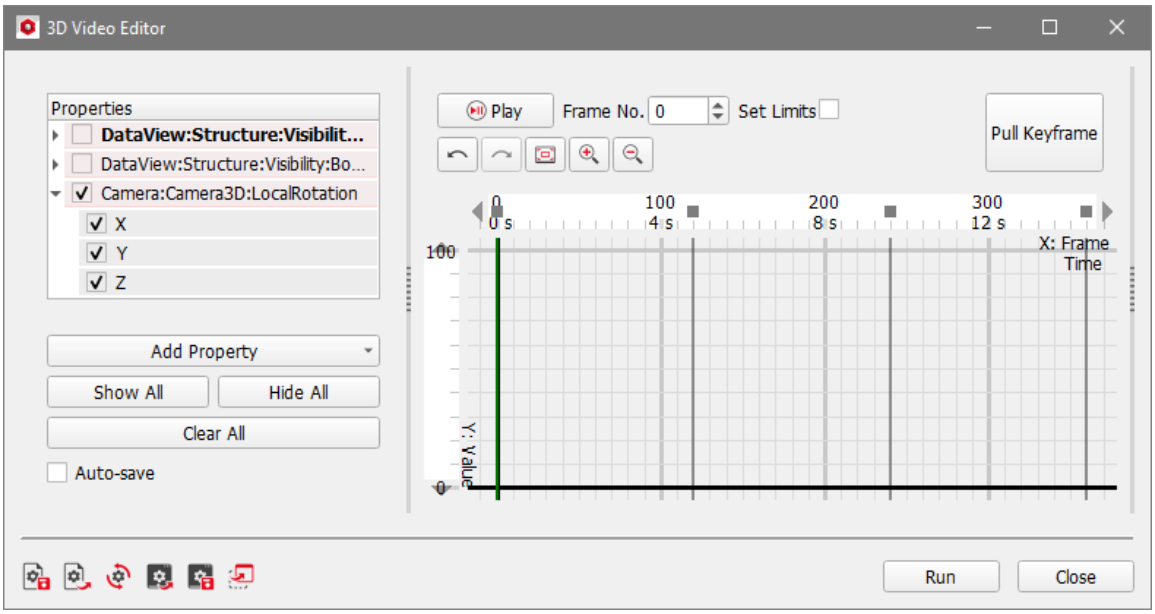
Click **Add Property** in the **Properties field** to add a new property to be changed over time in the **Video Editor** dialog.

Select **Camera → Camera 3D → Local Rotation**.

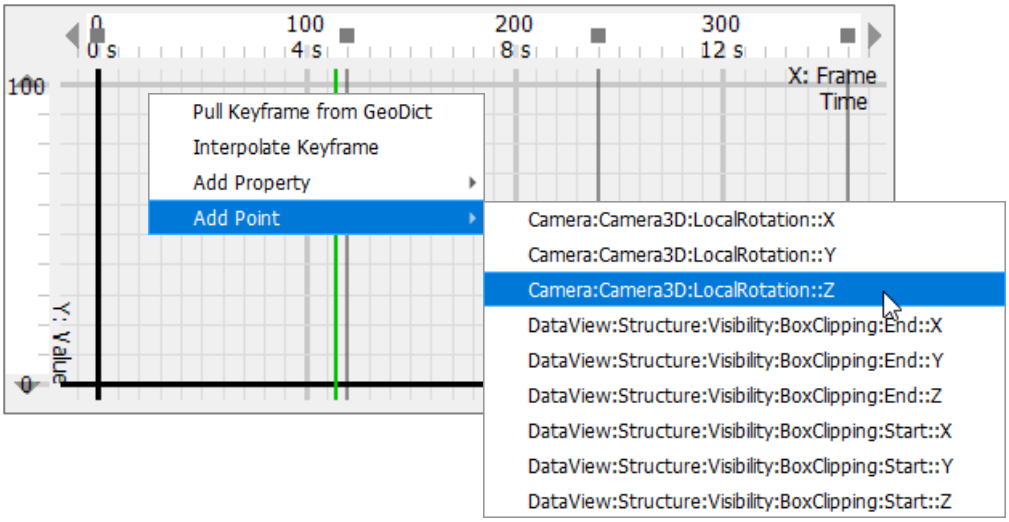


Expand the sub-properties of **Local Rotation** by clicking the arrow on the left or by double clicking on the property name.

Hide all other properties (uncheck **BoxClipping:Start** and **BoxClipping:End**) to only see the plot for **Local Rotation** in the **Graph field**. Right now, this results in an empty plot in the **Graph field**, because there are no keyframes set yet for **Local Rotation**.

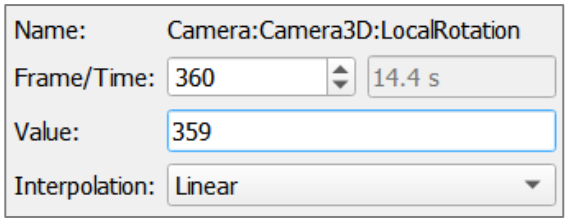


On the first keyframe, at **X-frame 0**, add a new data point for **Local Rotation::Z**, by right-clicking in the plot of the **Graph field** at frame 0. A blue marker appears.



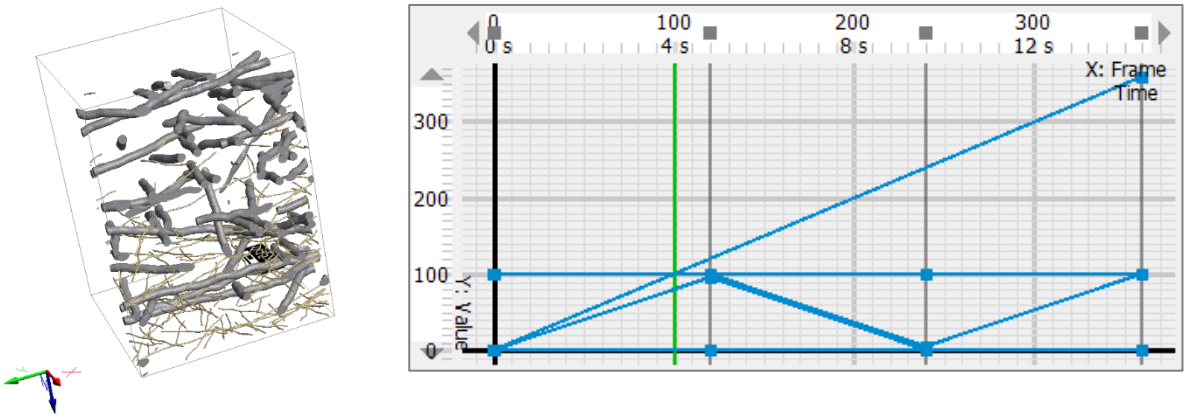
Also do this for the last keyframe, at **X-frame 360**. A blue marker also appears there.

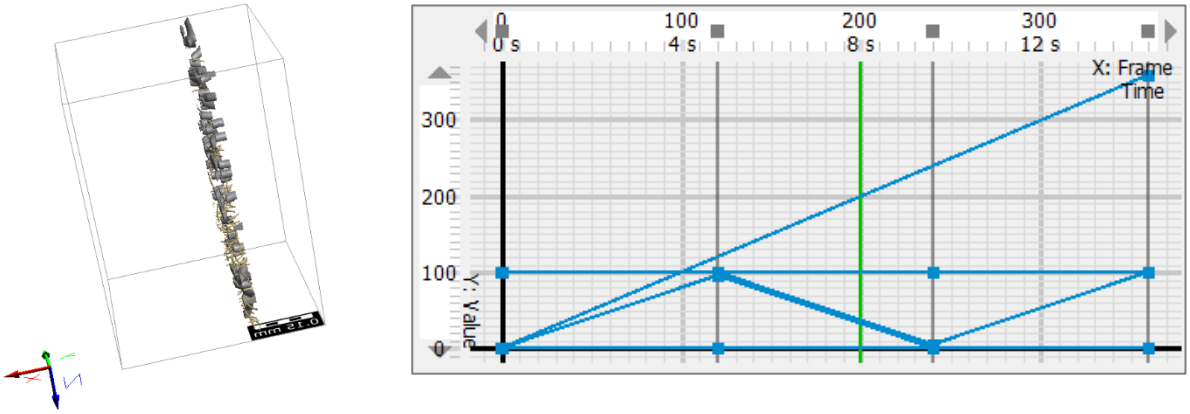
Click on the blue marker at frame 360 to select the data point **Local Rotation Z**. In the **Value field**, change its **Value** to **359**. In this way, a perfect loop will be created.

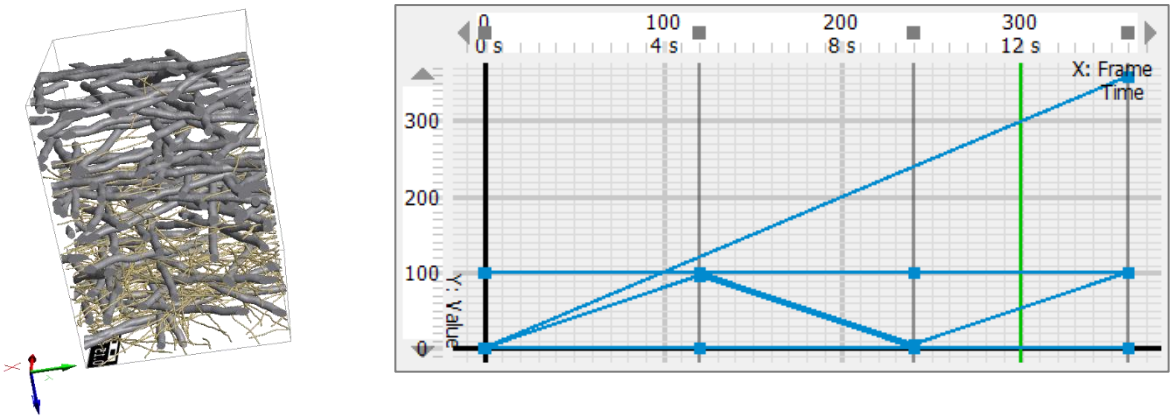


Click on different frames in the plot of the **Graph field** (Frames 100, 200, and 300) and observe different takes of the structure's rotation around its Z-axis while being clipped in the Visualization area of the GeoDict GUI. To also follow the graph of the clipping animation, in the **Properties Field** check to show the two BoxClipping properties again.

Click **Play** to see the structure in movement in the Visualization area of the GeoDict GUI, while the green line of the playhead moves by itself from left to right in the plot of the **Graph field**.







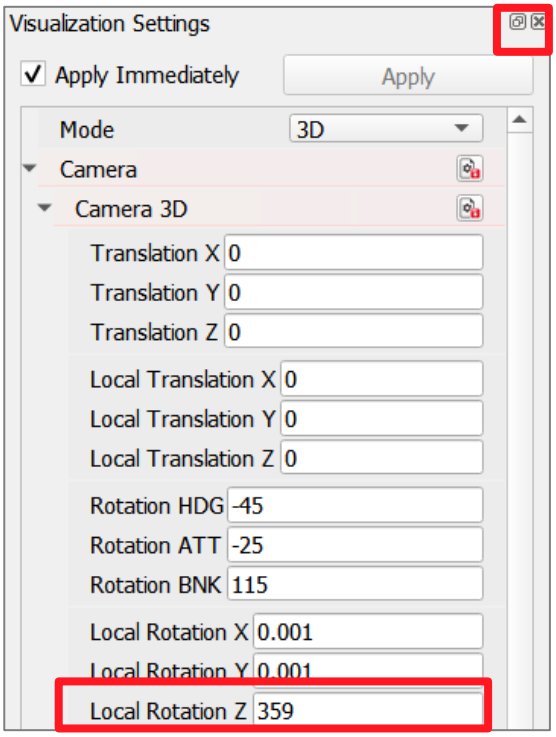
How to pull a keyframe from GeoDict

Any properties that are changed in the Visualization area of the GeoDict GUI while the **Video Editor** dialog is open, may be pulled into the plot of the **Graph field** and be part of the final video.

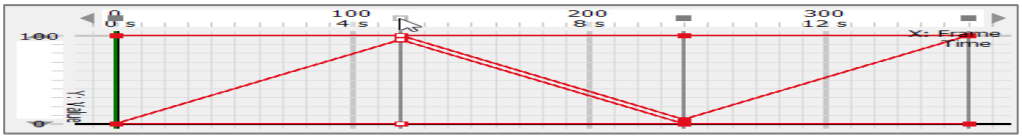
Make sure that a structure is loaded in GeoDict , and the **3D Video Editor** dialog is opened as explained on page 30.

In the GeoDict GUI, click the **Visualization** tab in the sidebar to the right of the Visualization area to unfold the **Visualization Settings**.

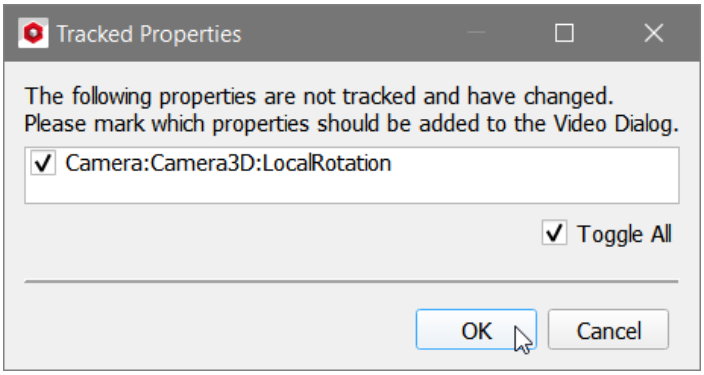
Unfold the settings for **Camera** and then, **Camera 3D**. For **Local Rotation Z**, enter **359**.



In the **3D Video Editor** dialog, click **Pull Keyframe**.



In the opening dialog, select **Local Rotation** and click **OK**.

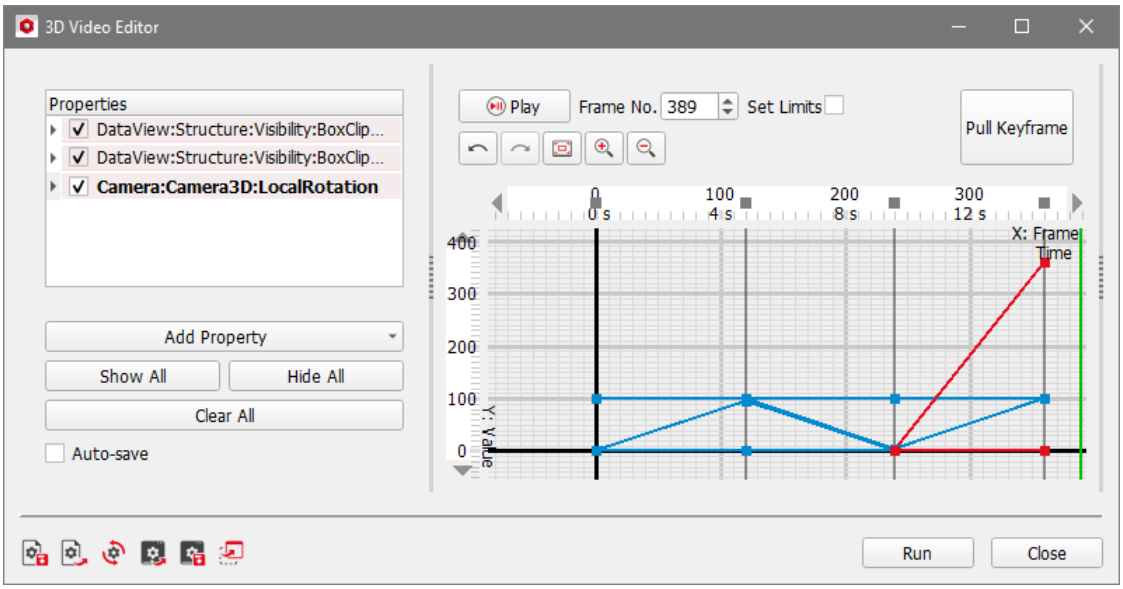


The new property appears in the **Properties field** and in the plot of the **Graph field**.

If the playhead (green line) in the plot of the **Graph field** is not placed upon an existing keyframe, a **new keyframe** is added at the playhead's position. The plot for the **new property** is added in the keyframe field between the last keyframe before and the playhead's position.

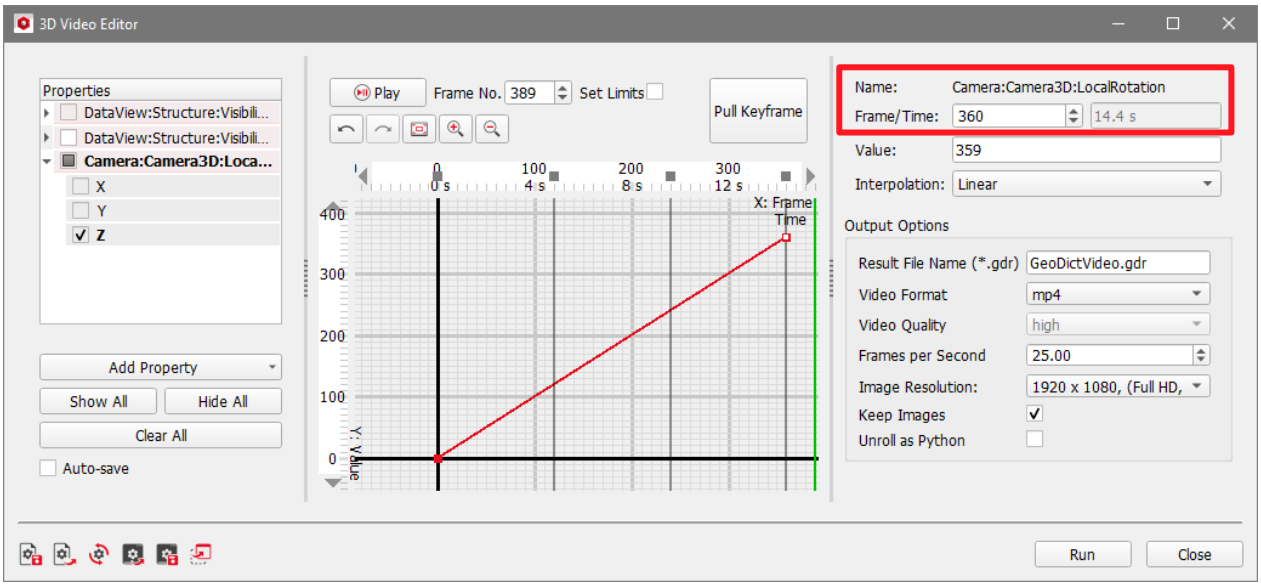
Here, the playhead was located at frame 360, which was the last keyframe from the clipping animation. No new keyframe had to be added and the keyframe before (frame 240) was used as a start keyframe for the new animation.

Here the **Local Rotation** property appears as a red line because the property is selected in the **Properties field**. To apply the animation to the complete movie, the frames of the two **data points** of the **Local Rotation** property need to be changed.



First, in the **Properties field**, hide all other properties to only see the plot for **Local Rotation** in the plot of the **Graph field**. Uncheck **BoxClipping:Start** and **BoxClipping:End**. Unfold the sub-properties for **Local Rotation** by clicking the triangle on the left, and also hide the sub-properties **X** and **Y**.

Expand the **Value field**. In the plot of the **Graph field**, select the first data point (with value 0) by clicking on it and enter **0** for **Frame** in the **Value field**. In the same way, change the **Frame** of the second data point (with value 359) to **360**.



Observe the structure's rotation around its Z-axis in the Visualization area of the GeoDict GUI while clicking on different frames in the plot of the **Graph field**.

Preview the animation in the Visualization area of the GeoDict GUI by clicking **Play** in the upper part of the **Graph field.**

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