AFP Viewer

GUIDE DOCUMENT
Ver. 1.23-a

Dec 2022

OTOMcomposite

Confidential

AFP viewer

OTOM AFP viewer software is a post-processing software tool to analyze results from the OTOMcomposite AFP Engine software. Herewith, a glance at features is represented.

Some features include:

- Load different thermal analysis outputs

- View figures data and animation at every step

- See through thickness information

- Show/hide different layers

- Extract Temporal (time-series) plots of the heated zone

- Extract Temporal (time-series) plots of the specific location

- Global and local temperatures.

- Global Lay-up at every step

- Different representation styles and views

- Generate animation video and pictures

- Crystallinity prediction
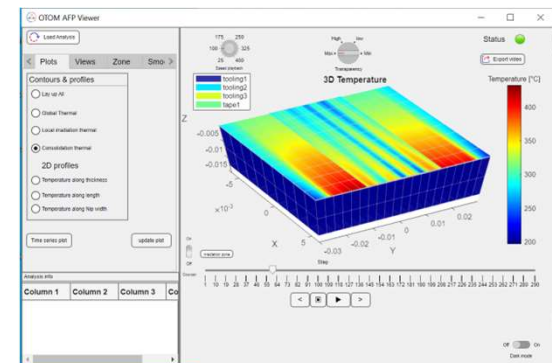
To acquire or extend your license please contact the OTOM administration address.
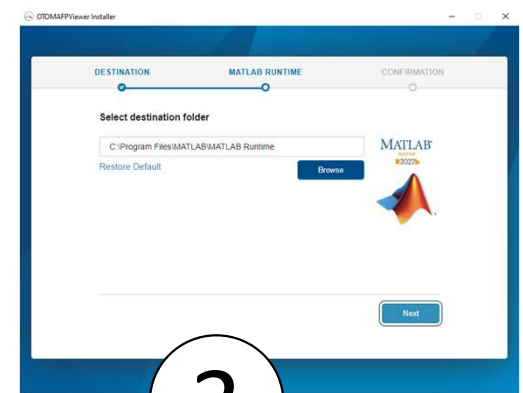
Installation

The installation of OTOM software is rather straightforward. You must click on Next and select the source directory for the installing software and the installation will be finished, You might need an internet connection to download the necessary libraries.
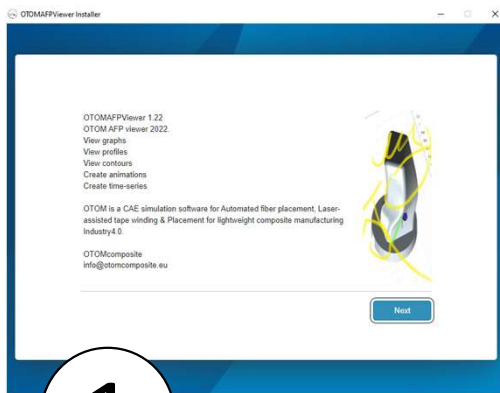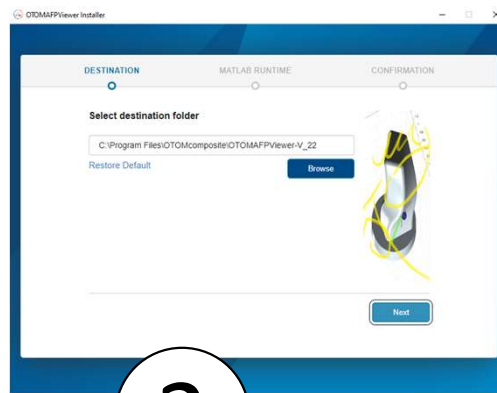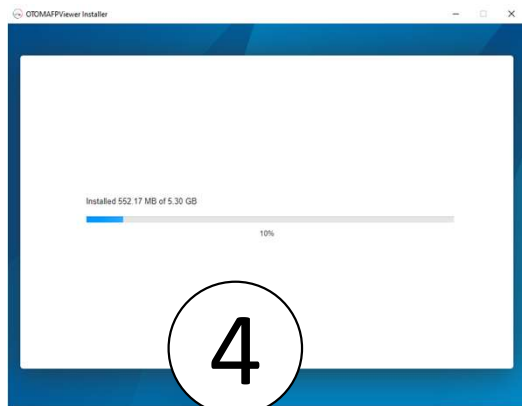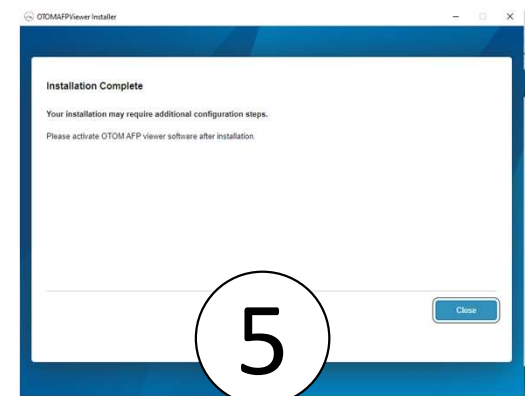
Account and licensing

After installation of the OTOM AFP viewer, the main window is locked. Your device should be registered in OTOM composite server to unlock the Software

functions.

- To unlock the program click *Start> Connect*, your device tries to connect with the OTOM license server and validate your machine. You should write your

  account name

- In order to register your machine: *Start> Share PC info*, your MAC address info will be sent to the OTOM server via your Email Microsoft Outlook

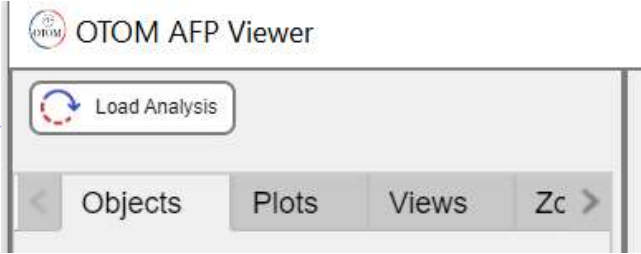 application. You can check your Email to see the shared info
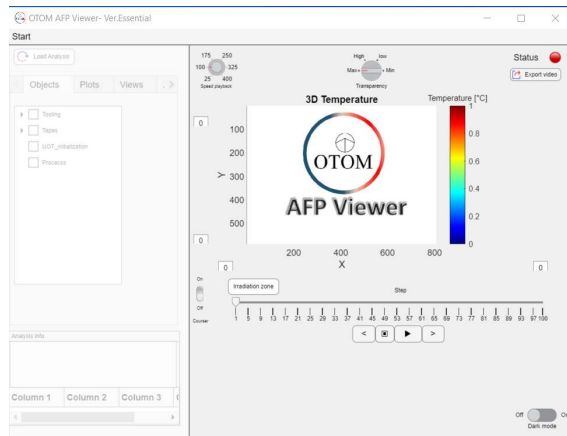
>>
License
verification
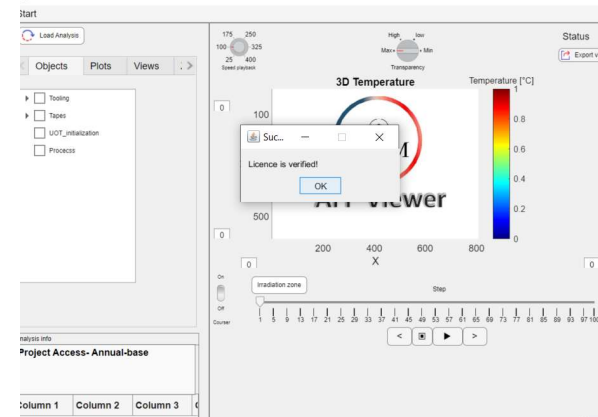
Load results

To load UOT or COT **_Thermlog_** files you could click on load analysis in the OTOM AFP viewer. Depending on the size of the file, it takes a couple of seconds or a minute.

To Load
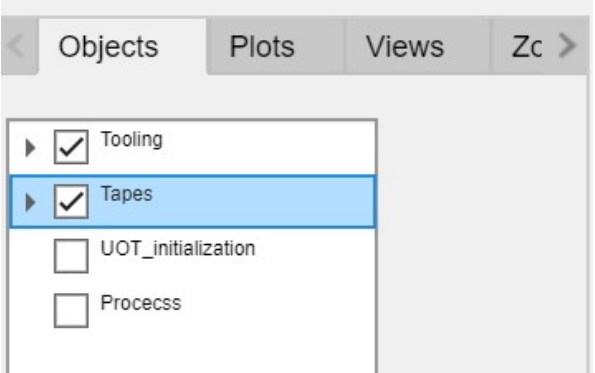*Thermlog* file

OTOM AFP Viewer

Load Analysis

| Objects | Plots | Views | Zc |

Tabs

Fig_LayUp
Global thermal- tape1
Global thermal- tape2
Global thermal- tape3
Global thermal- tape4
Global thermal- tape5
Global thermal- tape6
Global thermal- tape7
Global thermal- tape8

Intensity figure
LocalThermal
RollerConsolidation
Temp_along_length
Temp_along_thickness
Temp2D_Tape1
Temp2D_Tape2
Temp2D_Tape3
Temp2D Tape4

Temp2D_Tape15
Temp2D_Tape16
Thermlog

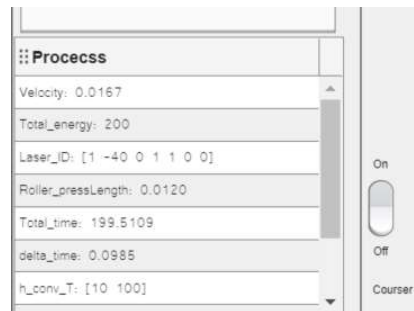| Objects | Plots | Views | Zc |

Loaded objects

- ▶ ☑ Tooling
- ▶ ☑ Tapes
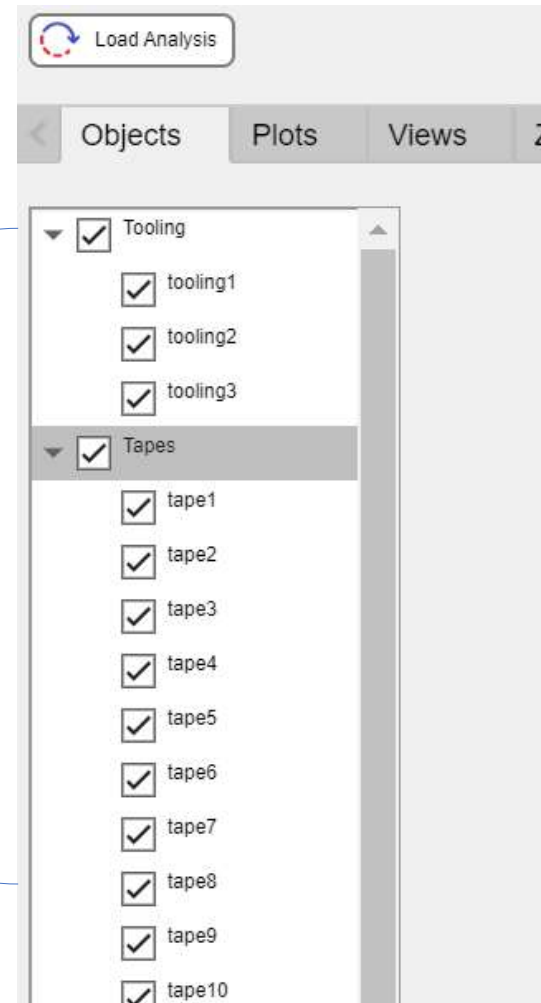- ☐ UOT_initialization
- ☐ Procecss

Confidential

Objects Tab

Check and uncheck objects in order to show or hide them. When you click on each object, information will be displayed in the object info window, left bottom corner of the OTOM AFP viewer.

Note: For representing incoming Tape placement, only check the latest Tape object. (only *for load irradiation thermal* plot)
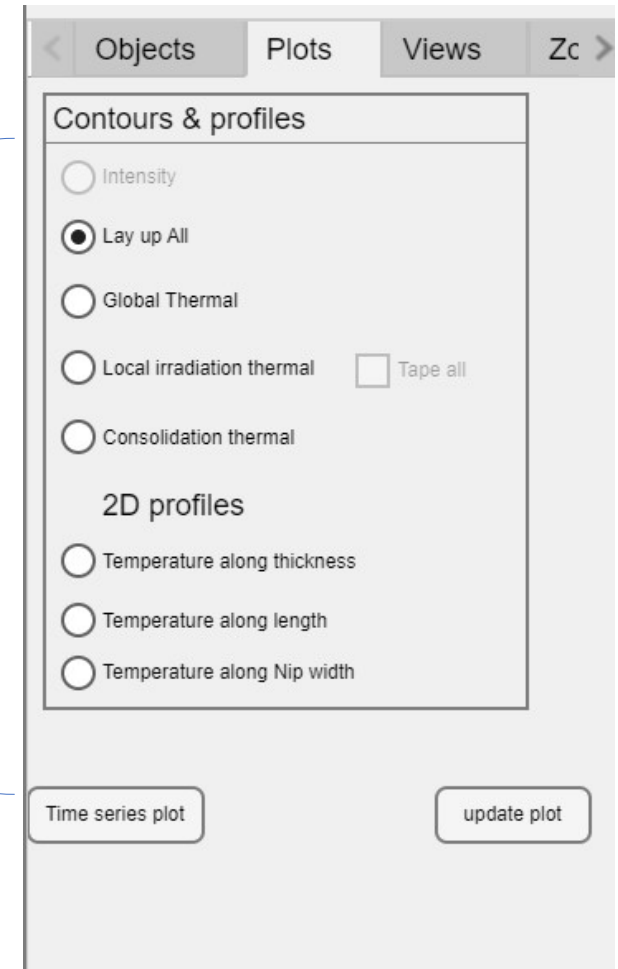
Plots Tab

In the ***plots*** tab, you could display different information on the main window of the OTOM AFP viewer, please. see below for all possible plots in the software.

- **Intensity: A**bsorbed energy on objects (not in use)
- **Lay up all**: Show global lay-up evolution
- **Global thermal: S**how the global model for each object, if tick all objects, they overlap each other
- **Local irradiation thermal**: The heated zone by the heat source. The control volume of the local models is either substrate or tape. Tick Tape all for representing the incoming tape
- **Consolidation thermal**: The consolidated press region under the Roller
- **Temperature along thickness**: The average temperature at the nip point along the thickness
- **Temperature along length**: Temperature along the heated zone on substrate and Tape
- **Temperature along Nip width**: Temperature of the heated zone at Nip width

** When you click on the radio button of each object the plots will be updated. you could also click on update plots to change the plots

Views Tab

From the *views* tab, you could select different views for representation of the main window plot in OTOM AFP viewer.
Below you see Different camera views of plots in the View Tab.

Zone Tab

With the **Zone** tab, you could control the representation of the plots. You can show or hide the edges and mesh discretization. You could change the axis system mode to represent the data and Material elements in case of a hybrid tooling object (for example if your tooling consists of steel and composite in one body). You could also use the exploded materials to display different layers with distance. Please check the tutorial videos For more information.
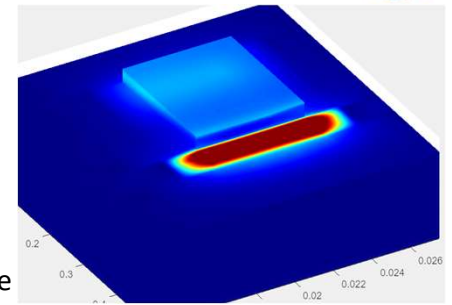
Without Edge
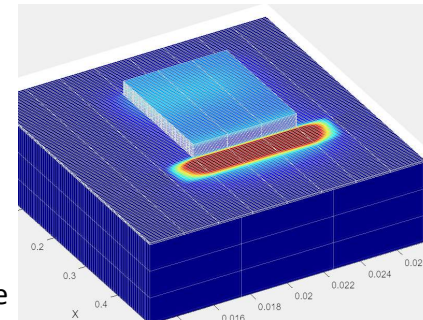
With Edge

Remove colors
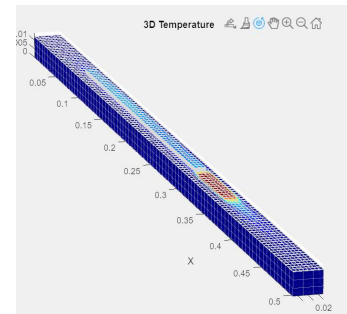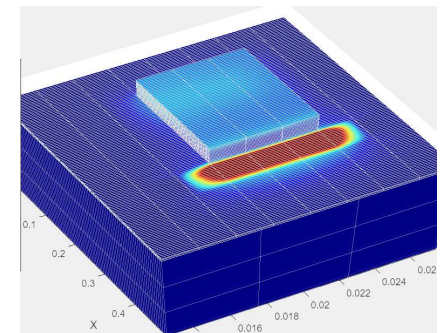Reserved (NA)
Show/hide edges
Perspective view
Material
Exploded view

Different axis mode
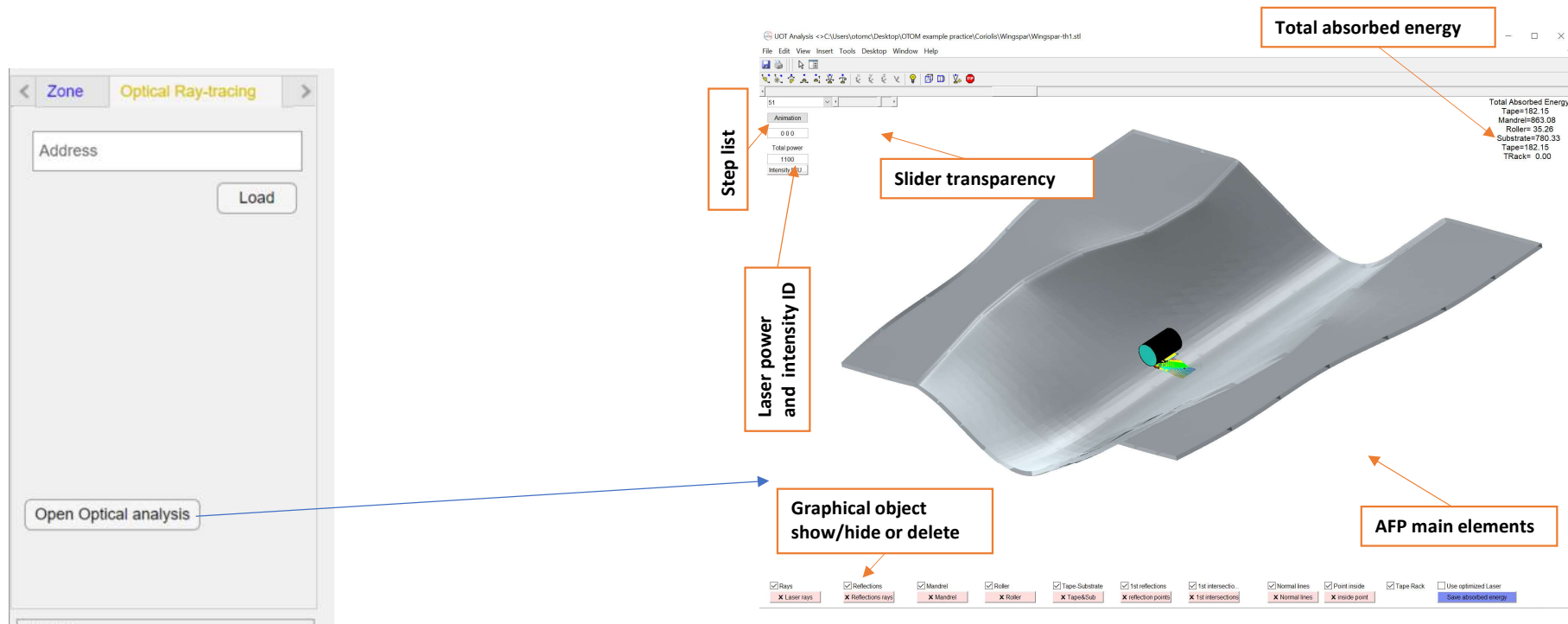
Exploded view control

Perspective equal axis

normal axis

Optical Ray-tracing Tab

With the optical ray tracing tab, you could analyze and observe all of the intersection points during the optical analysis. For observing the optical behavior you need to load optical UOT or optical COT analysis and you should have all of the intersections in the text file in the directory which was created with the OTOM AFP engine.

Click on the load button in the optical ray tracing tab from the autumn AFP viewer and select appropriate optical analysis file. Then click on open optical analysis button to display the optical analysis window. Please note that you need pre thermal analysis file as well.

Confidential

Crystallinity Tab

With the Crystallinity tab, you can predict the relative crystallinity of any point from each layers. Crystallinity could be predicted based on the thermal History and Avrami constants, to describe the kinetics of crystallization processes, such as solid-state transformations and nucleation and growth phenomena. The general trend of the crystallization are shown below.
Click on the *Avrami constants* and insert your material property. In case more information regarding the formula and the crystallization mathematical models is needed you could click on the crystallization formula guide. The crystallization prediction works based on the melting crystallization and crystallization evolution from the reference below:

** **Crystallization evolution:** Nakamura K, Katayama K, Amano T (1973) Some aspects of nonisothermal crystallization of polymers. II. Consideration of the isokinetic condition. J Appl Polym Sci 17:1031–1041. https://doi.org/10.1002/app.1973.070170404
 ** **Melting Crystallization:** Sonmez FO, Hahn HT, Hahn TH, Hahn HT (1997) Modeling of heat transfer and crystallization in the thermoplastic composite tape placement process. J Thermoplast Compos Mater 10:198–240. https://doi.org/10.1177/089270579701000301

Confidential
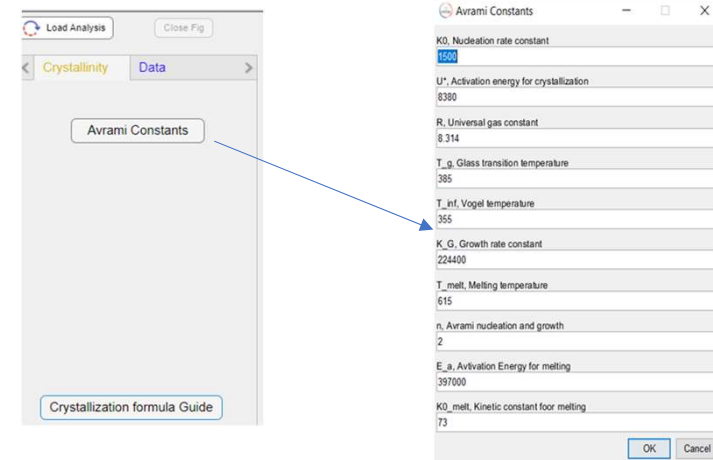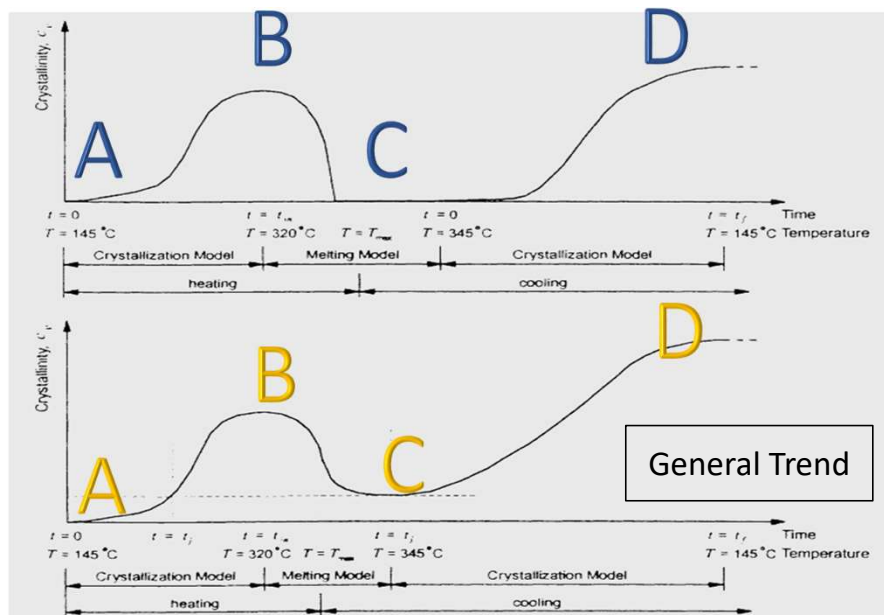
Smoothing and Data Tabs

Smoothing and Data Tabs are reserved and still under development. With these tabs, you smoothing handle data for smoothing or partial modification within the OTOM AFP Viewer software.
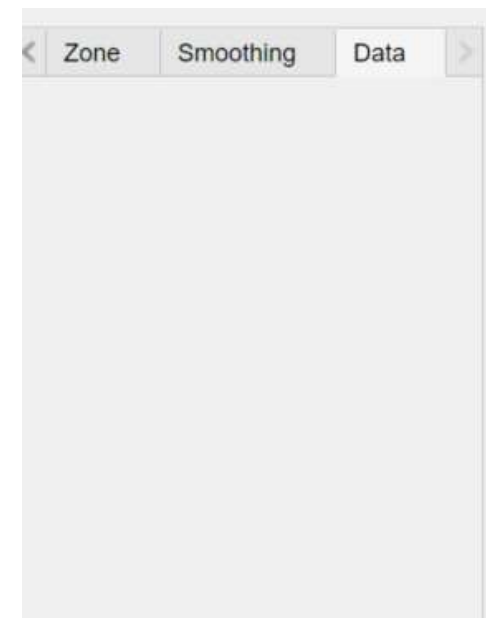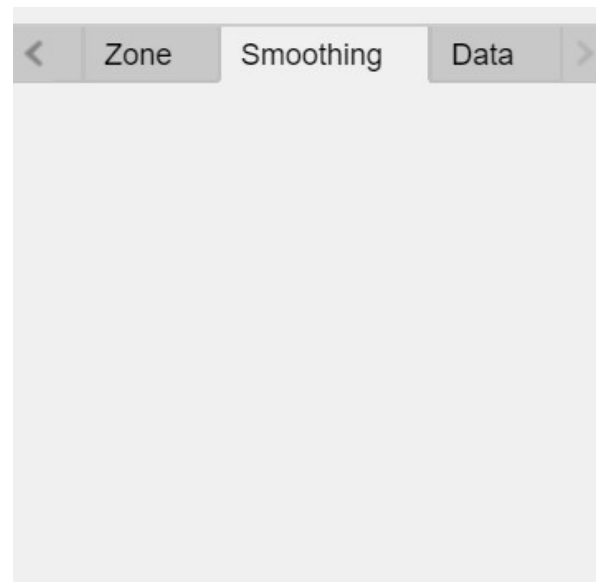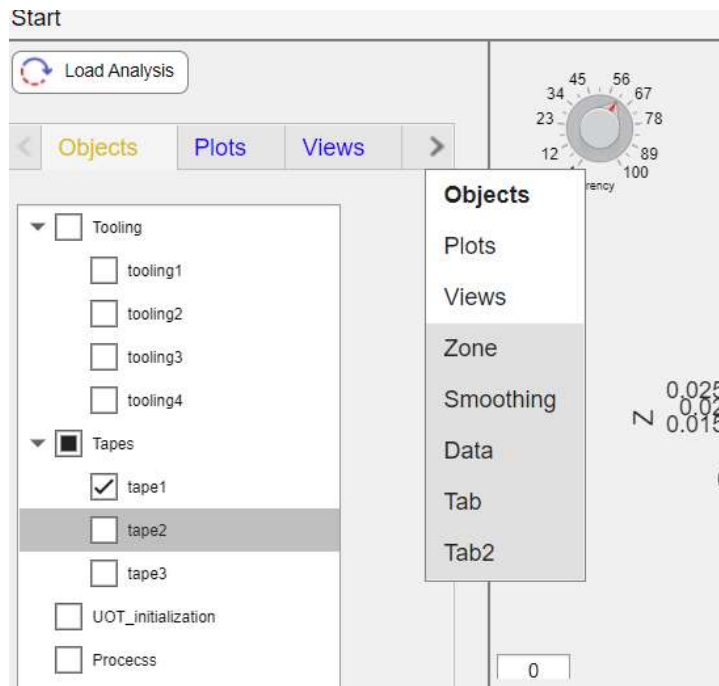
Right panel tools

With the topside right window of the what time AFP viewer, you could change the transparency click on pop-up contour plot and exporting the animations with the export video button I see the status of the progress.

Transparency gauge
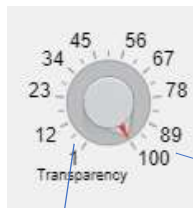
Status indicator for animation

Animation MPEG exporting
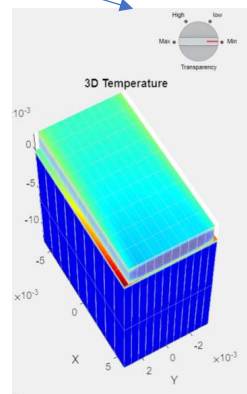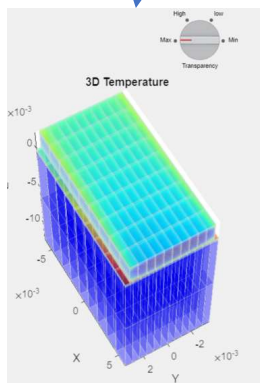
Right panel tools

With the bottom side of the right panel tools of OTOM AFP viewer, you could control the representation of the plot at every step. You could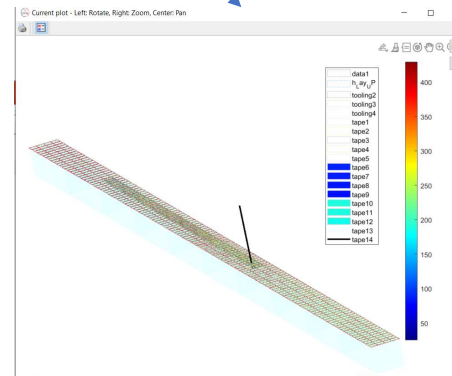 click on the play or the next or previous scene of the simulations. You could also see the call steps slider, irradiation zone performance for UOT analyzers, and courser selection to extract the data for a specific point for example to compare with the thermocouple results analysis

slider

Irradiation zone info

Max step number

Point selection on the object to extract temporal info

Previous step/stop/play/next step
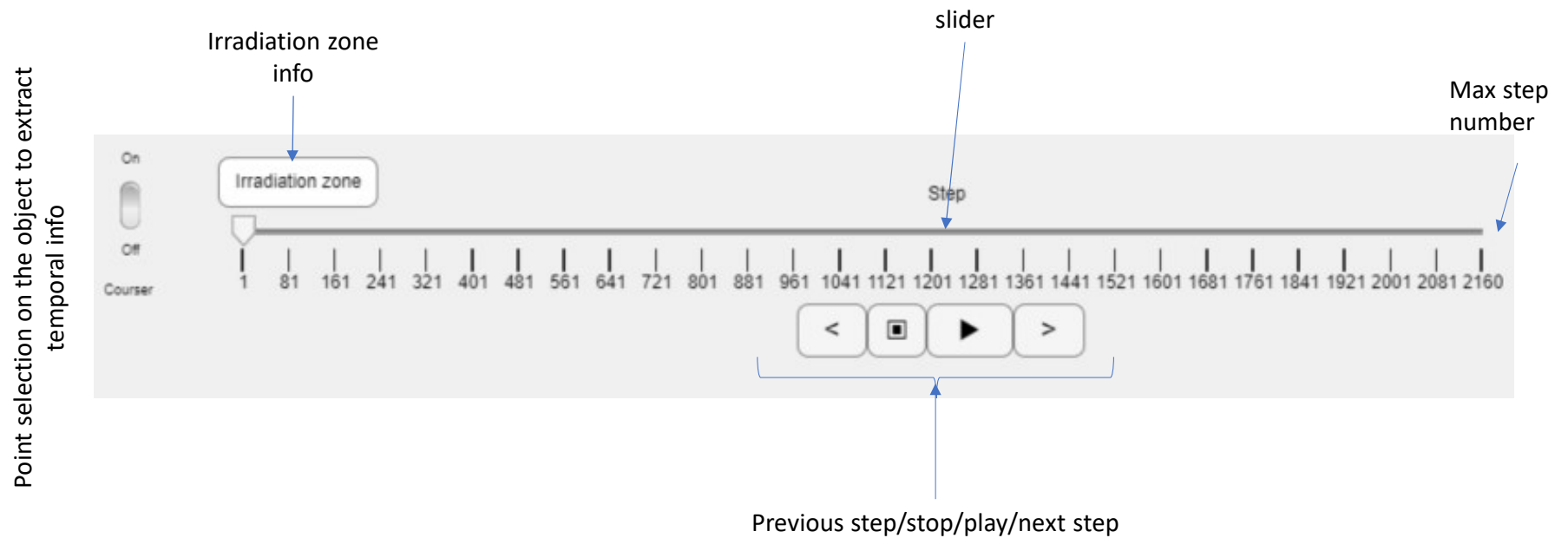
Right panel tools

You could change the AFP viewer window representation color with the dark mode. All of the panels and the background color of the object will change to a darker color click on *dark mode* and set it to ON to see the effect.
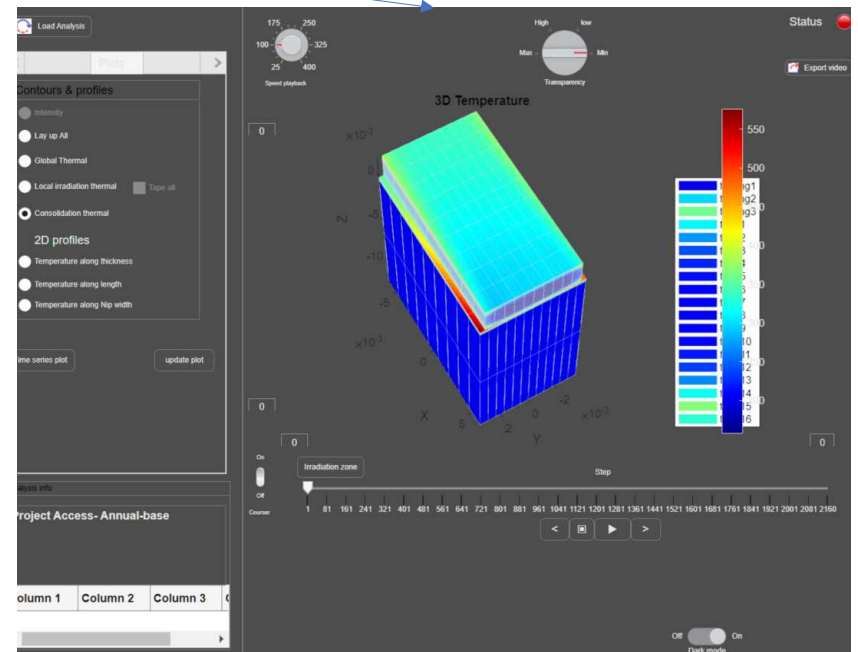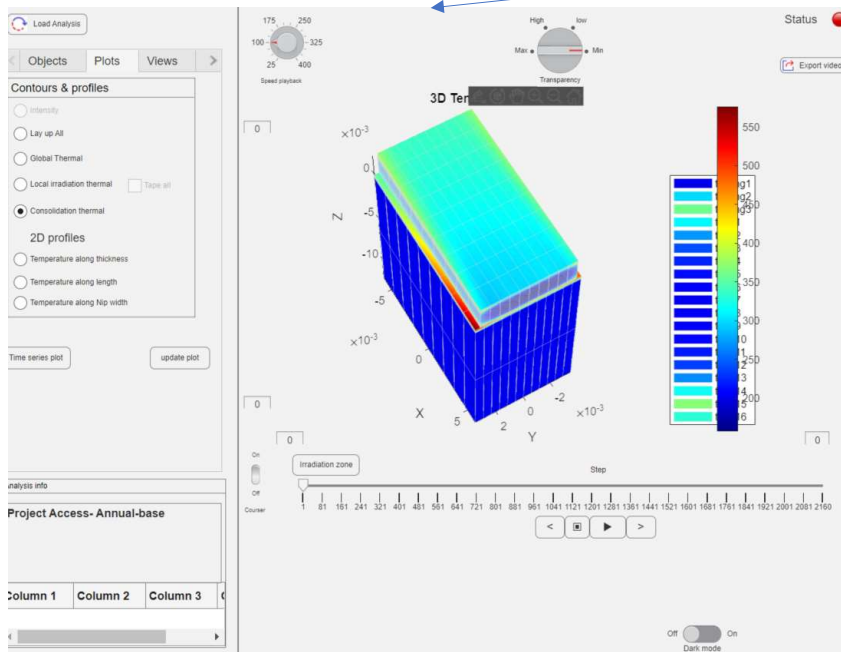
Dark mode

Courser on objects

In order to select points for temporal plots for a specific location, turn the cursor on and select the point. The point data will be represented and show the locations of the selected point and added the legend.

Cursor switch

On

Off

Courser

Time-series plot

Plot update

Time series plot

update plot
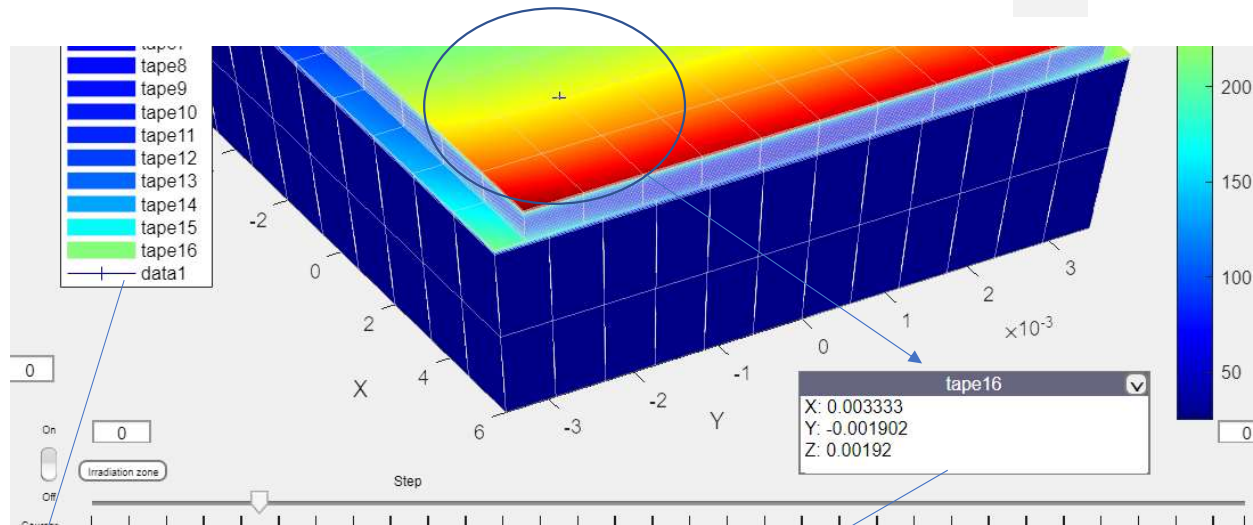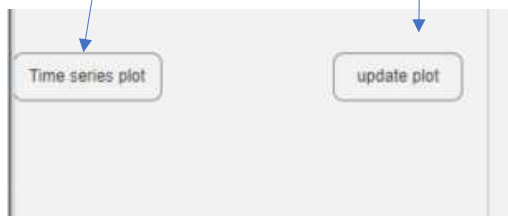
Selected point legend

Selected point coordinate

tape8
tape9
tape10
tape11
tape12
tape13
tape14
tape15
tape16
data1

tape16
X: 0.003333
Y: -0.001902
Z: 0.00192

Step

On

Off

Irradiation zone

Confidential

Temporal plots

Temporal plots show the temperature history of a specific selected point. With this feature, you could extract the temperature data through the steps and perform crystallization calculations.
For temporal plots:
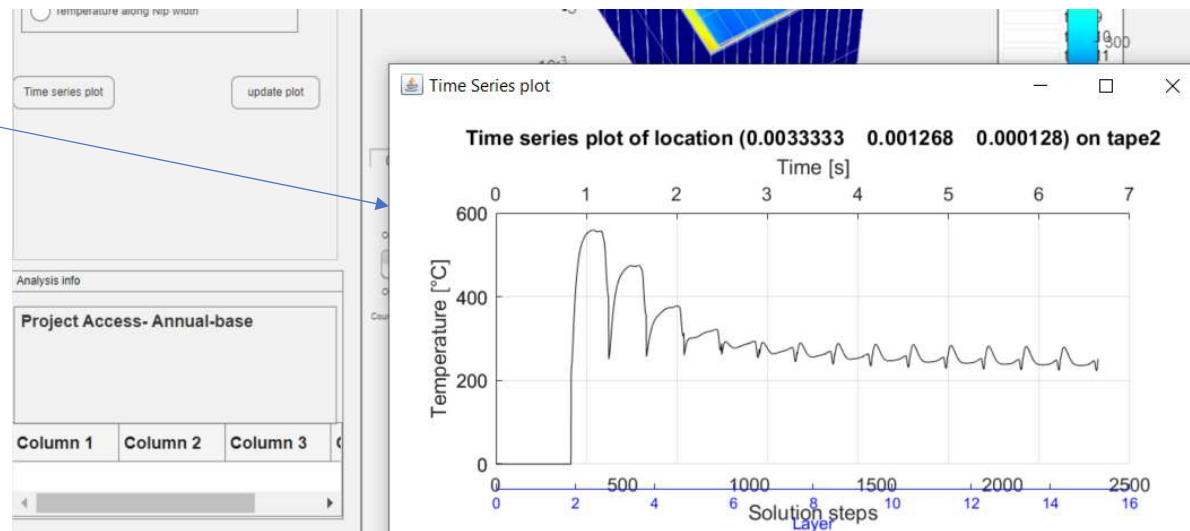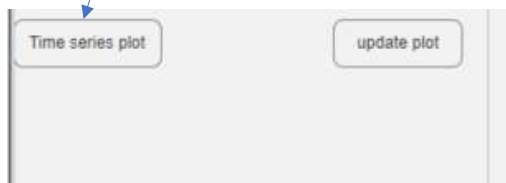1. Turn the cursor On
2. Select the point
3. Click time-series plot

Time-series plot

Irradiation zone

Temporal plots of the irradiation zones, show only the information of the points which received the optical energy. It represents the data as the mean average, maximum value, and mean value through their steps.

For temporal plots of the heated zone:

1. Turn the cursor Off
2. Turn irradiation zone On
3. Click time-series plot

Time-series plot
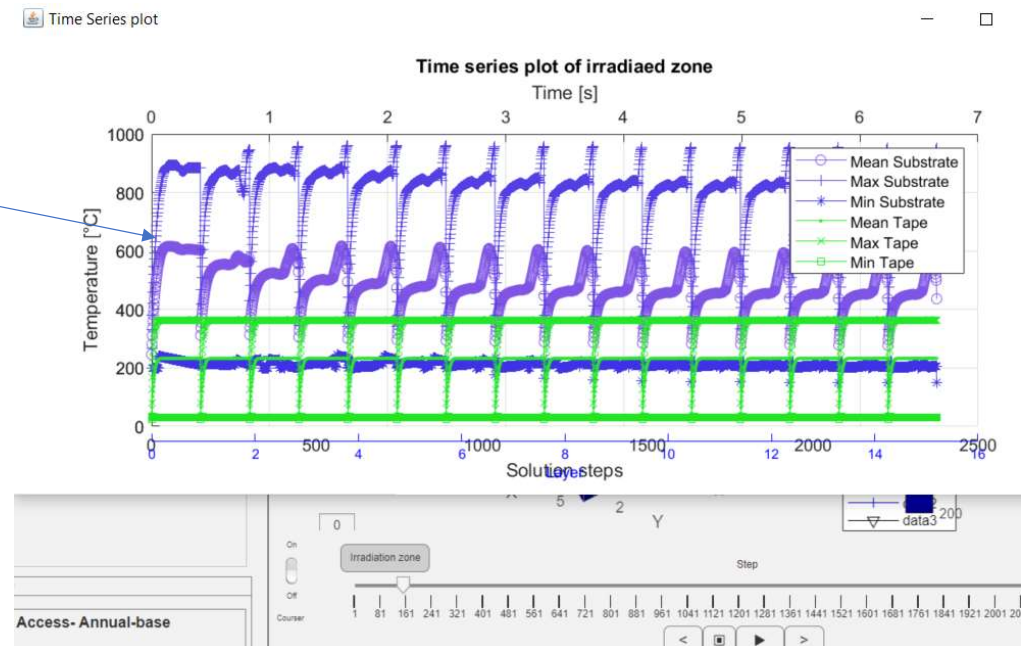
Contour limit

To change the temperature range, X-axis or Y-axis of the temperature plots as a line plot or contour plot you could use the text boxes around the main figure in the OTOM AFP viewer. The vertical axis is the Y limits and also contour limits, the horizontal axis is the only X axis limits for both line plots or contour plots.

Y-max, Contour max

Contour range

Y-max, Contour max

Contour range

X-min

X-max

Y-min, Contour min

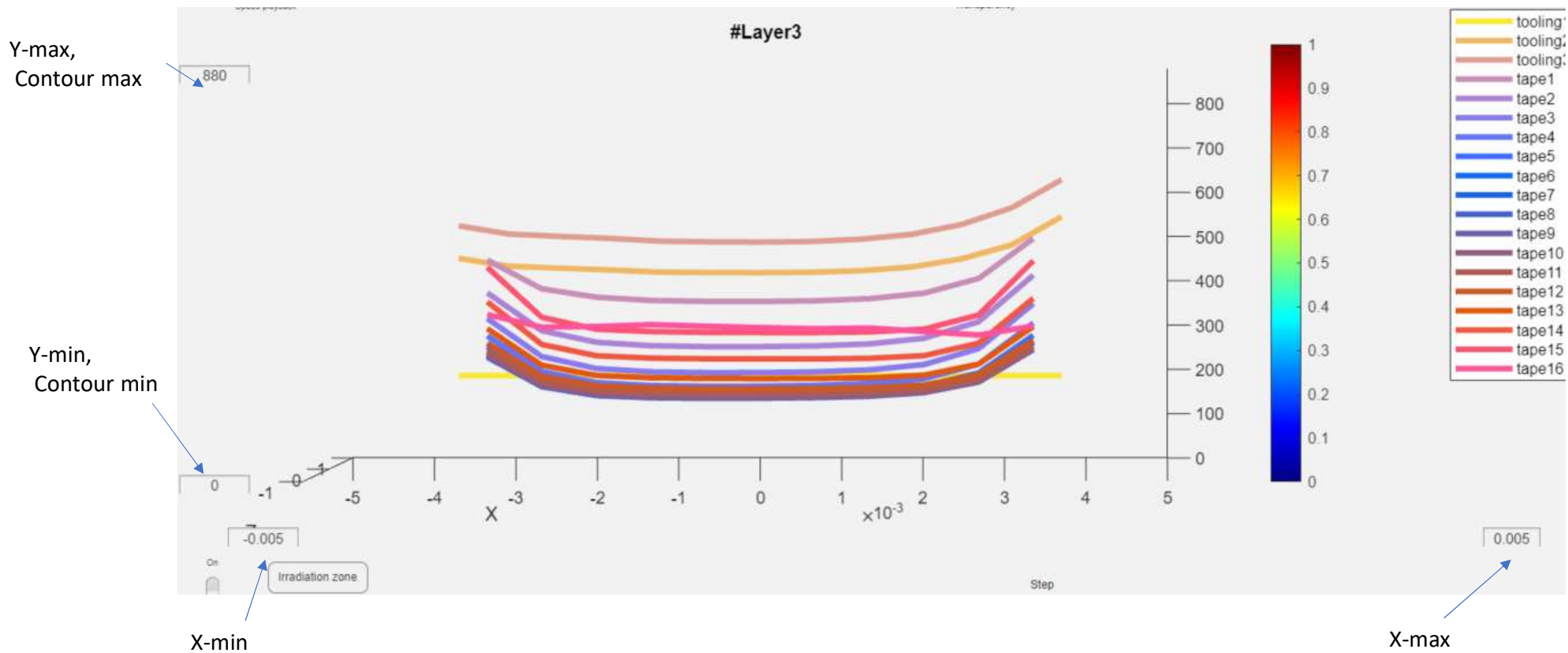X-min

X-max
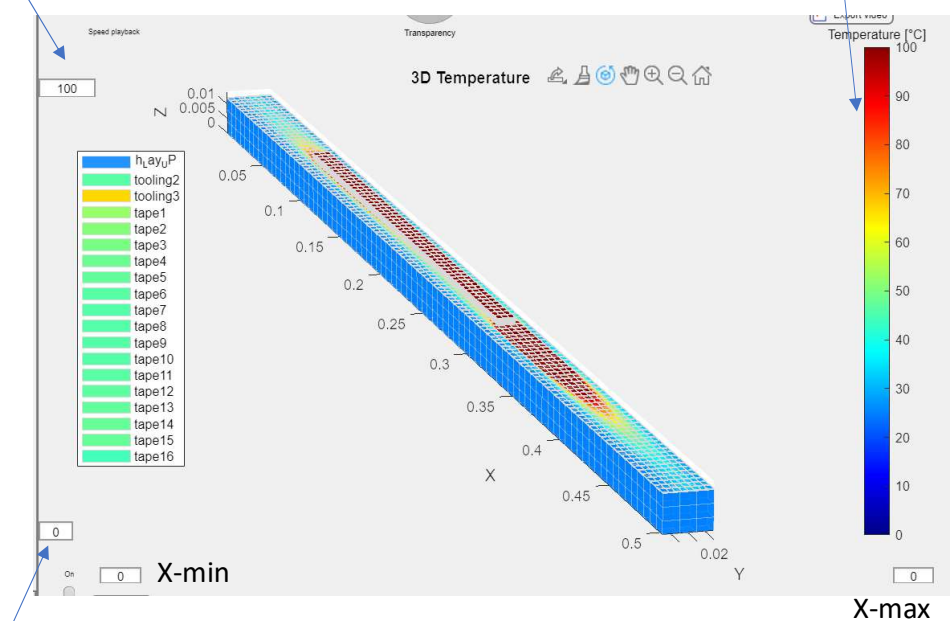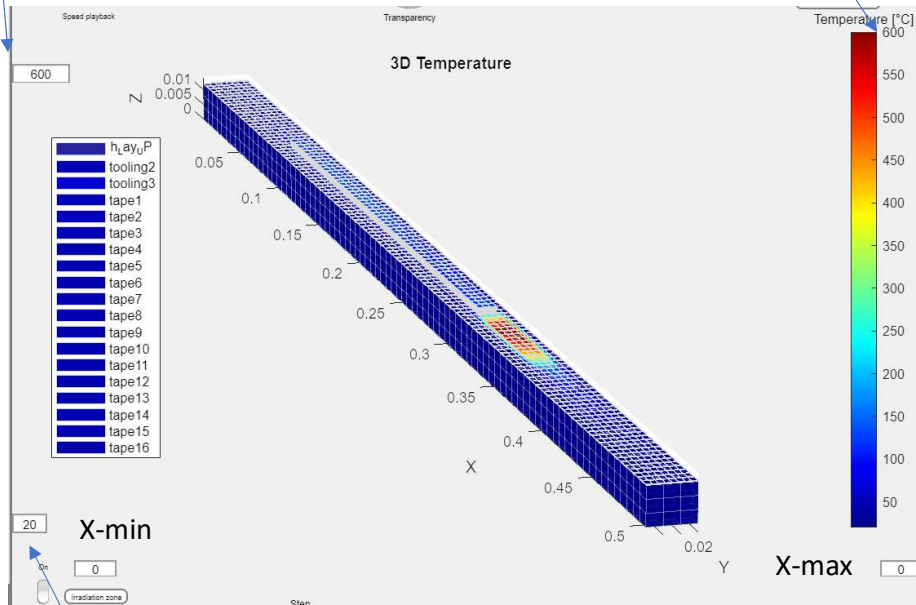
Y-min, Contour min

X-axis, Y-axis profile limit

With the Y-axis minimum or Y-axis maximum, you could change the Y-axis representation of the line plot. With an X-axis minimum or X-maximum minimum, you could change the X range of the line plot in OTOM AFP viewer.
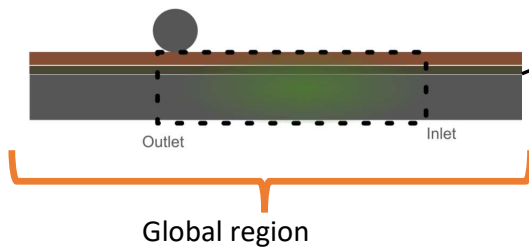
3D plots: Lay up All

With 3D plots in the plots tab, you could represent the layup of the whole manufacturing process. Below you see the global region and also the local region including the inlet and outlet of the local irradiation zone for the UOT analysis.
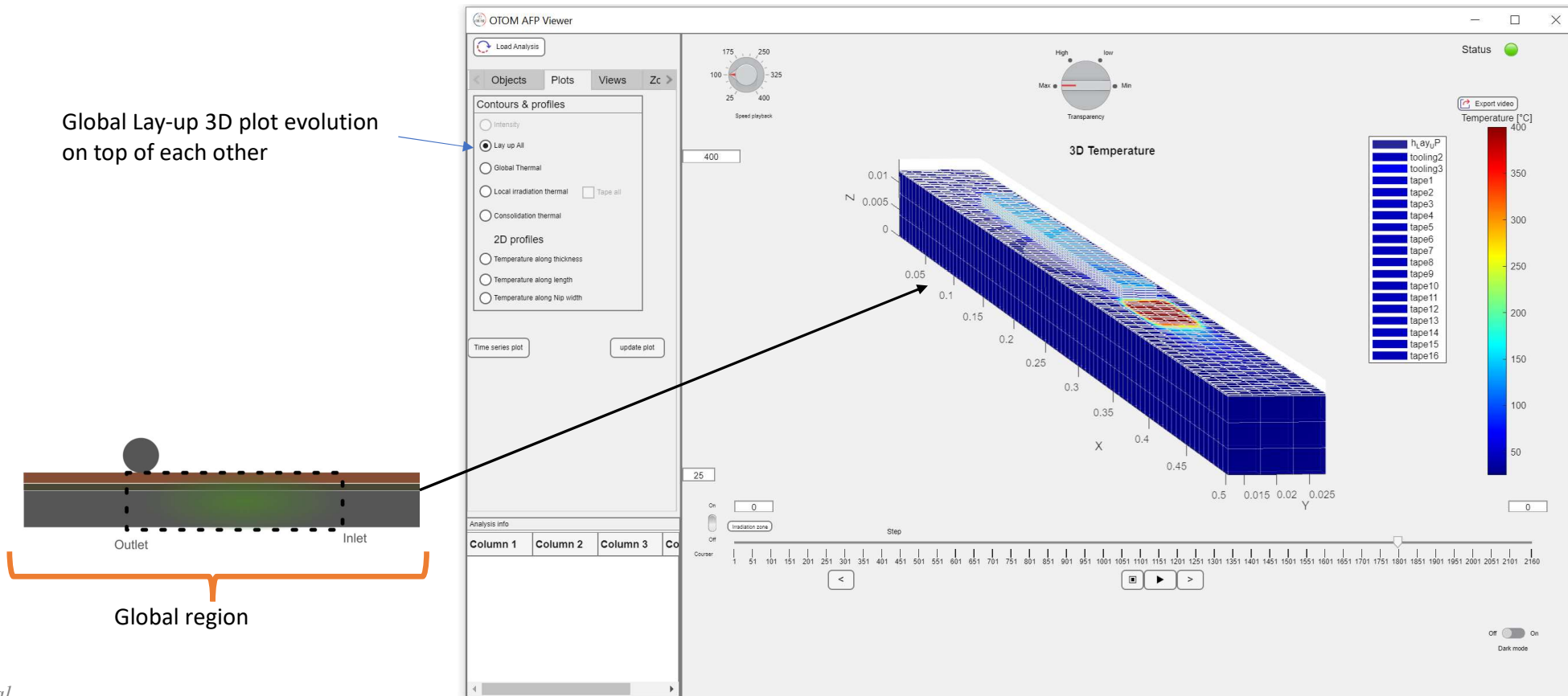
Global Lay-up 3D plot evolution on top of each other

Outlet   Inlet

Global region

3D plots: Global Thermal

With the global thermal all the objects which represented at the same location. Thus, if you select different objects the locations after each object will overlap with others. Therefore, it is recommended only to select one object and use global thermal to show the plot of the global temperature evolution of the object in OTOM AFP viewer. You could use this object to extract a time series plot in the global thermal model.
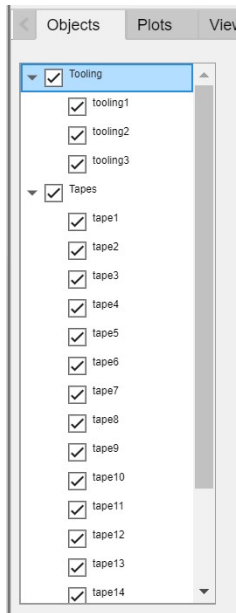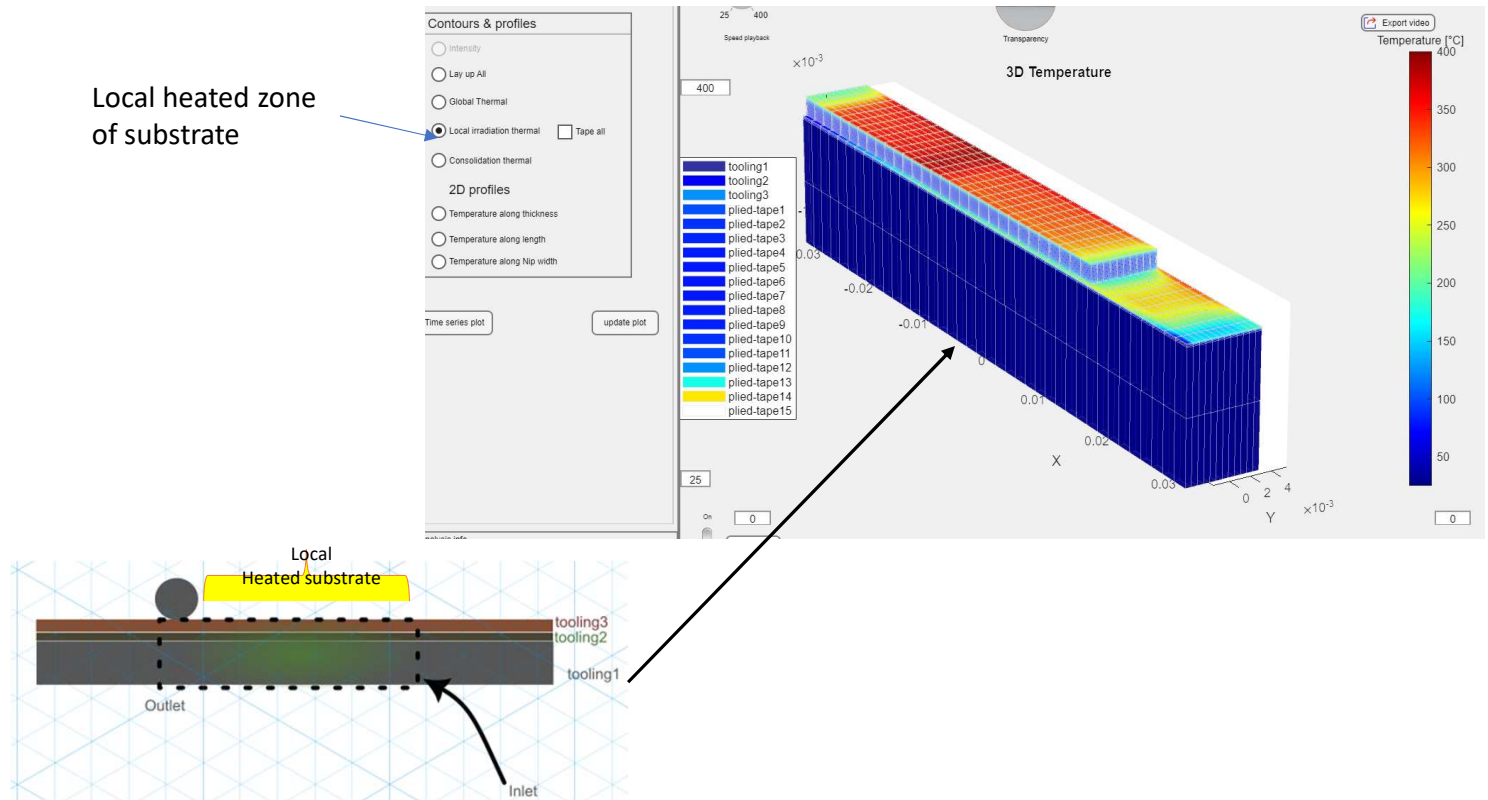
Global object 3D plot evolution
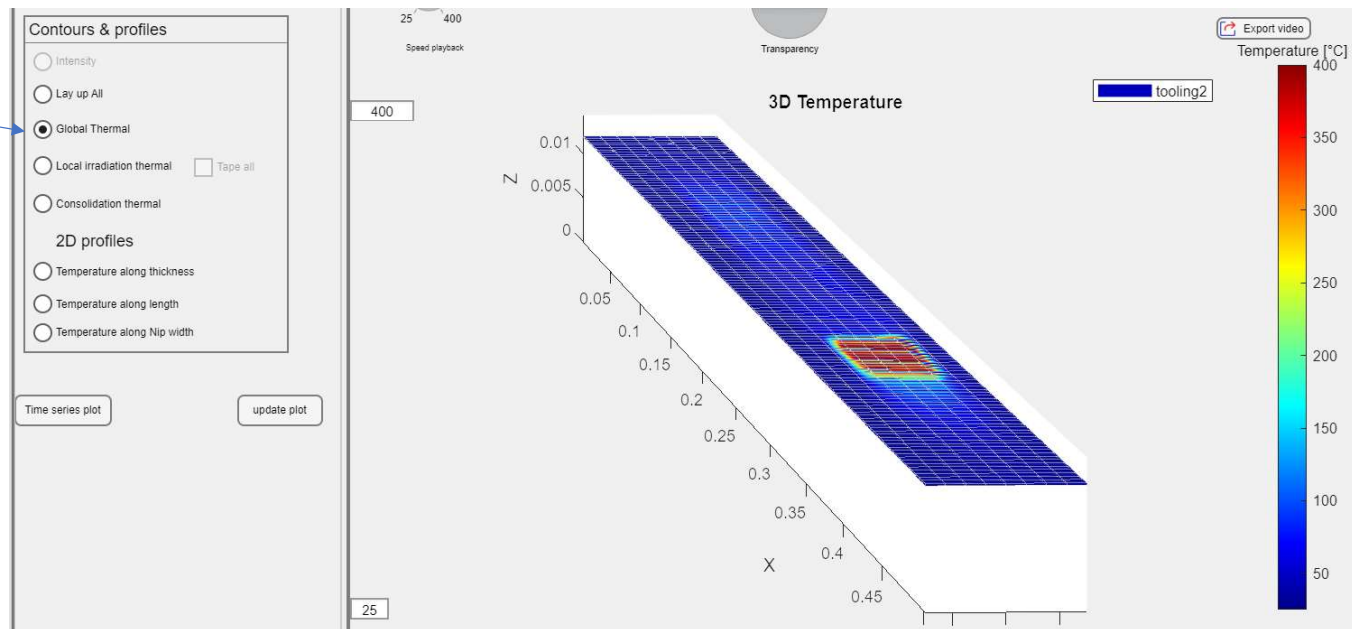
3D plots: Local irradiation (before Nip)

With the local irradiation model which is only available in UOT thermal analyzers, you could represent the data of the irradiation zone from the local finite difference model.
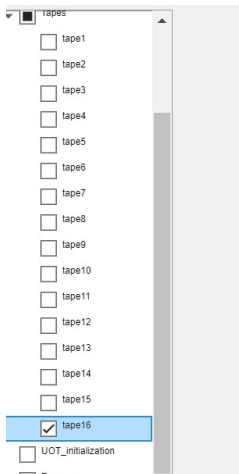
For the plied substrate/Tape

Local heated zone of substrate

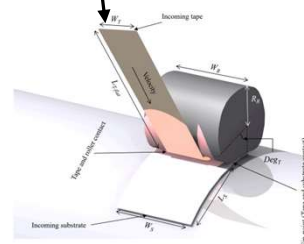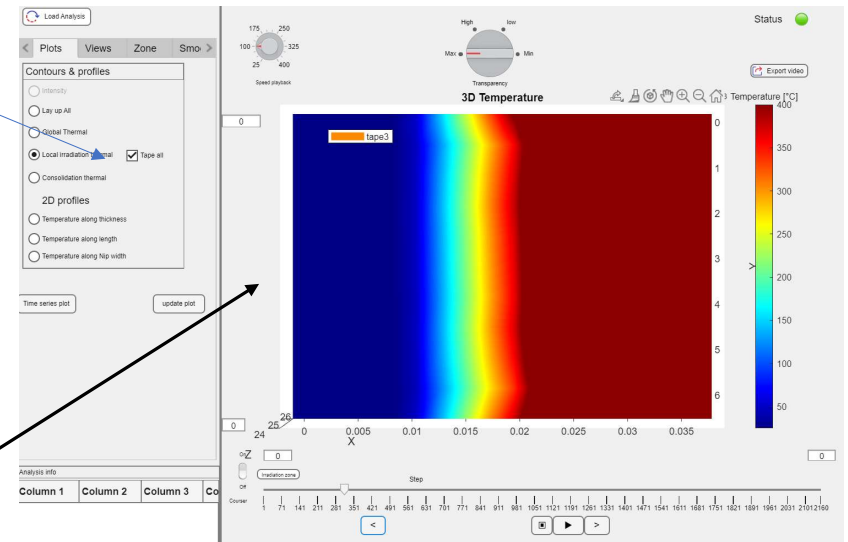# 3D plots: Local incoming Tape (before Nip)

To represent incoming tape temperature contour you could select on tape all in the local irradiation zone in the OTOM AFP viewer. It represents the temperature value from the 2D finite difference model of the incoming tape.

Local heated zone of Tape (incoming tape coming from roller)
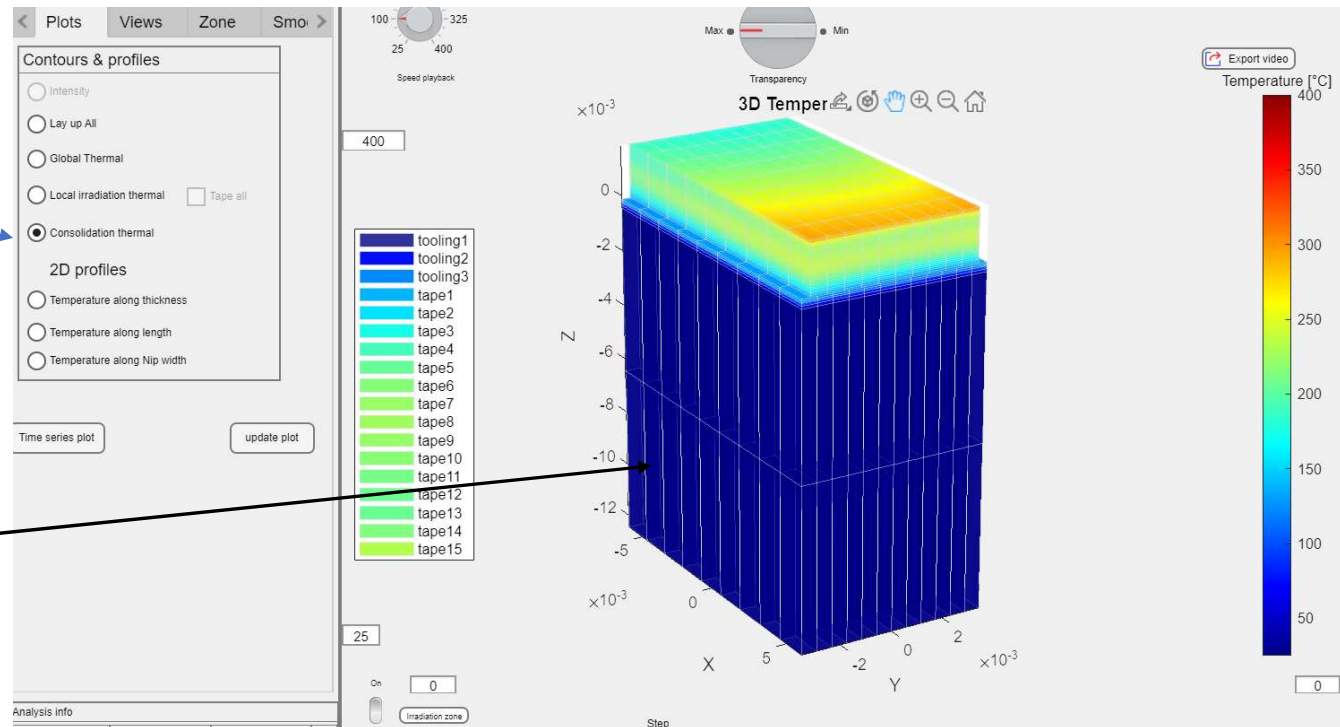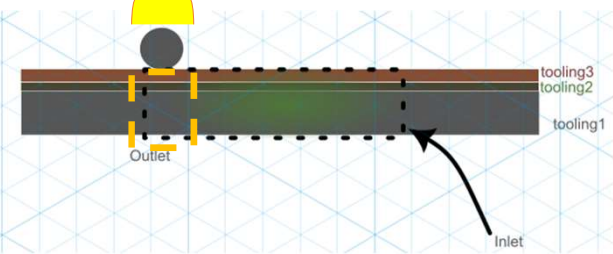
For The incoming Tape

Heated Tape

3D plots: Consolidation local thermal

With the consolidation local thermal model in OTOM AFP viewer, you could represent the temperature data of the local finite difference model for the consolidation under the roller for the UOT thermal analysis.

Local pressed consolidation under the roller
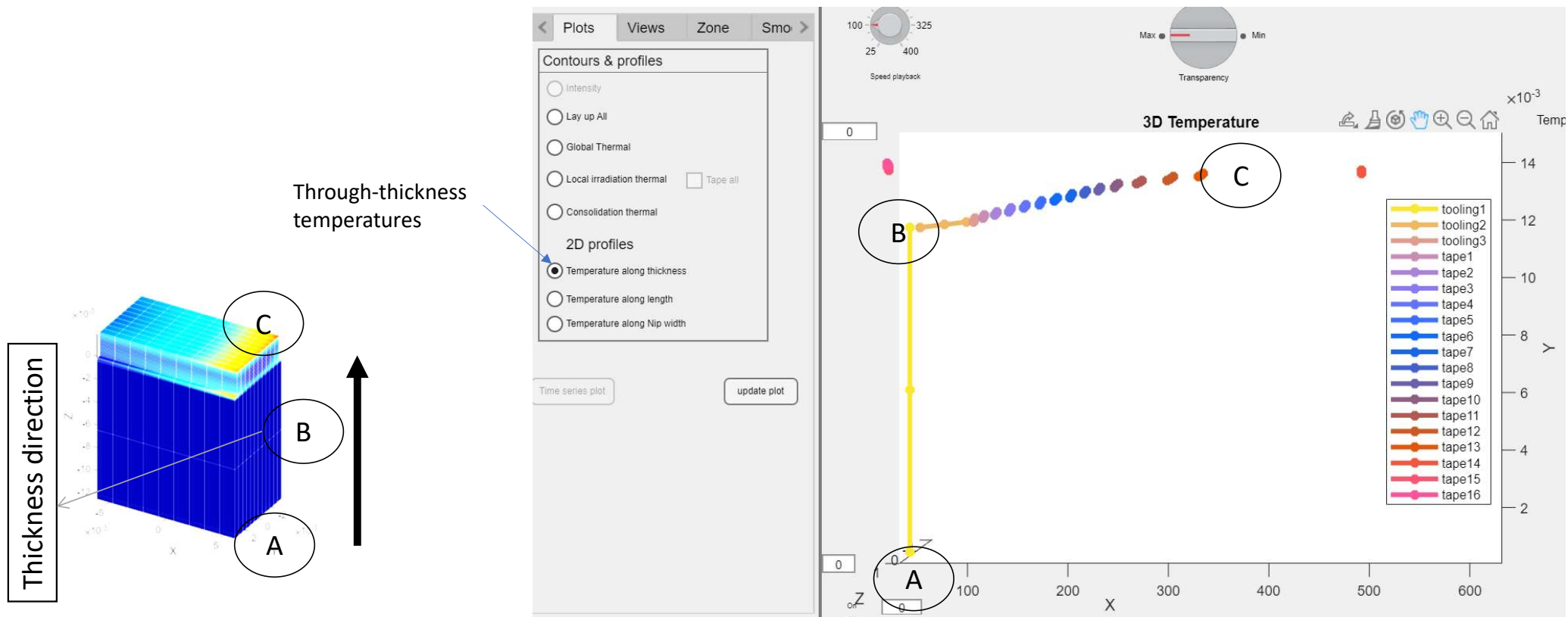
Profile plots: along thickness

If you like it to plot temperature data along the thickness value at the next point you could select temperature along thickness and autumn AFP viewer. It represents the data at the middle Nip point line through the time steps.

**Please note that this plot is currently only working for the UOT model.

Through-thickness temperatures

Thickness direction

Profile plots: along length

With temperature along lengths, you could represent the temperature data along the movement direction of the roller. This feature extracts the temperature value of the local irradiation model area, and it currently works only for UOT thermal analysis in the OTOM AFP viewer.
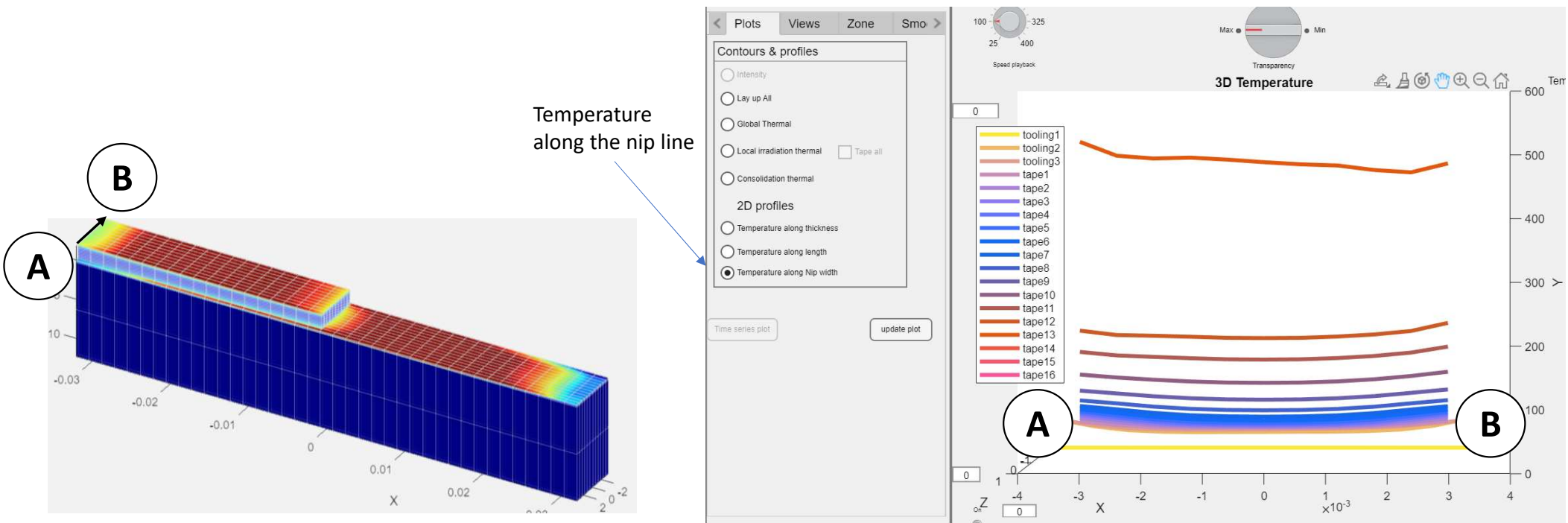

Temperature along the heated zone length
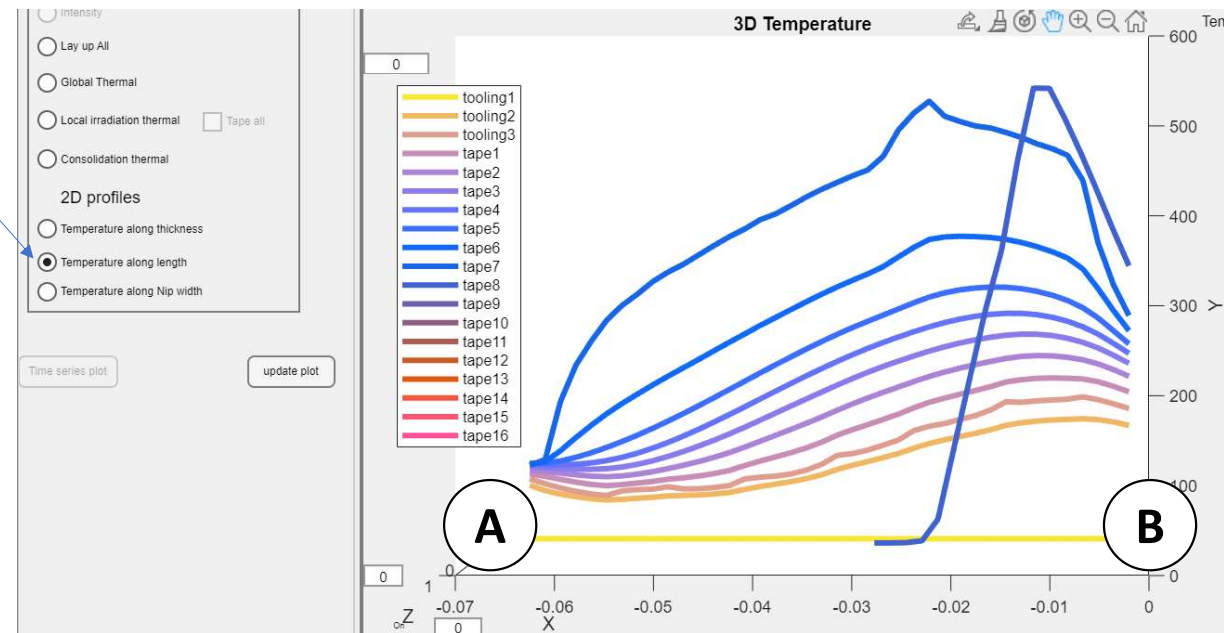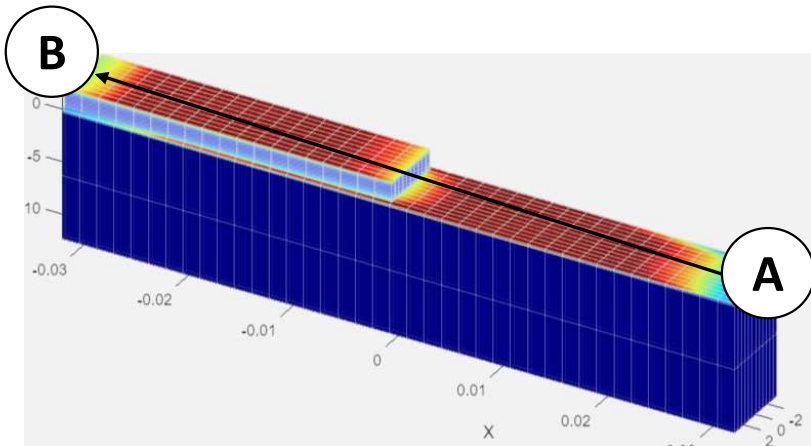
Profile plots: along Nip width

With temperature along the nip width, you could represent the data of the temperature at the nip line.
**Please note that this feature is only available for UOT thermal analysis in the OTOM AFP viewer.

Temperature along the nip line

Irradiation zone button

When you select the irradiation zone button in the OTOM AFP viewer, the information regarding the substrate-irradiated or tape-irradiated average temperature minimum and maximum will be represented. Please note that this information is only currently working on UOT thermal analysis.
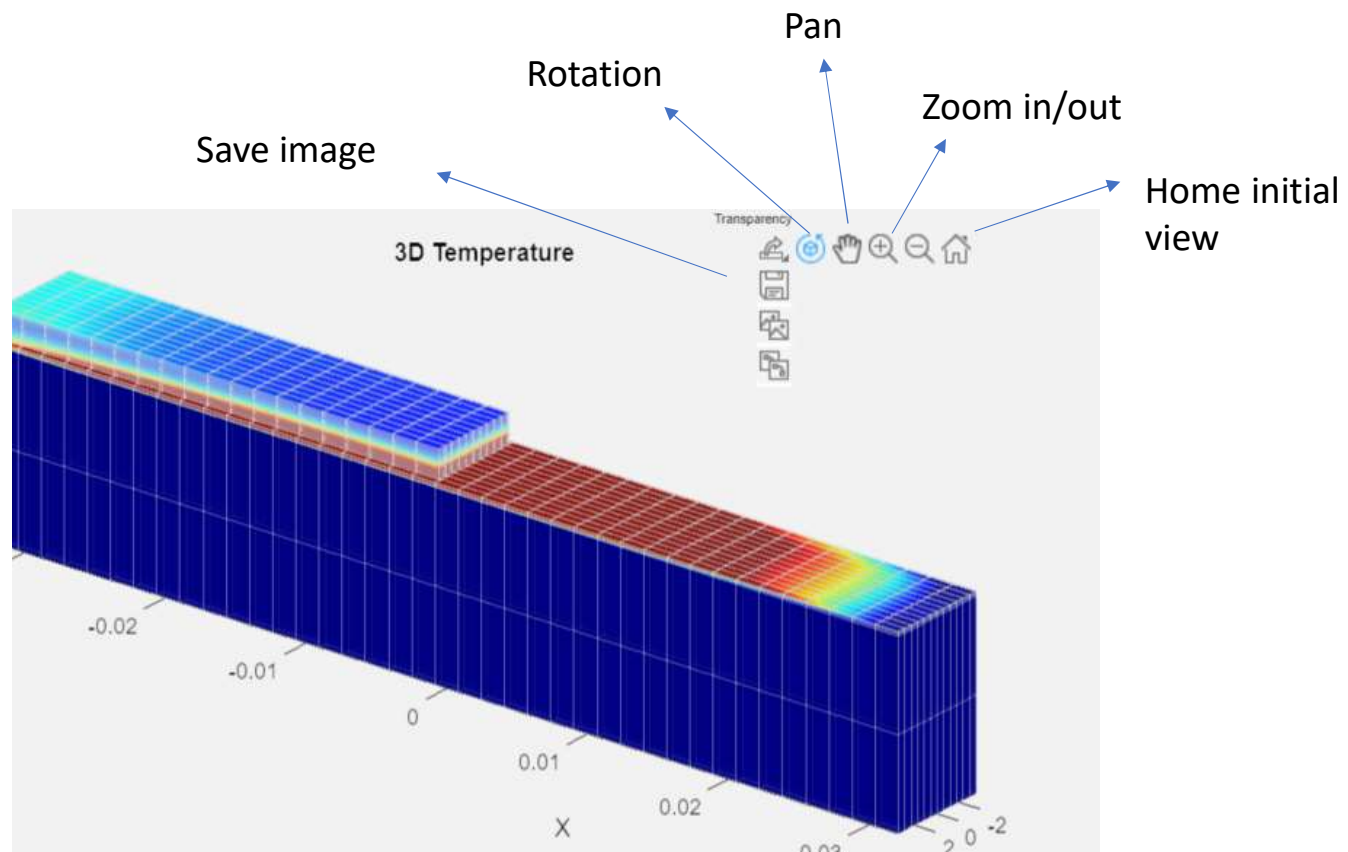
Information on heated zone

By pushing the irradiation zone
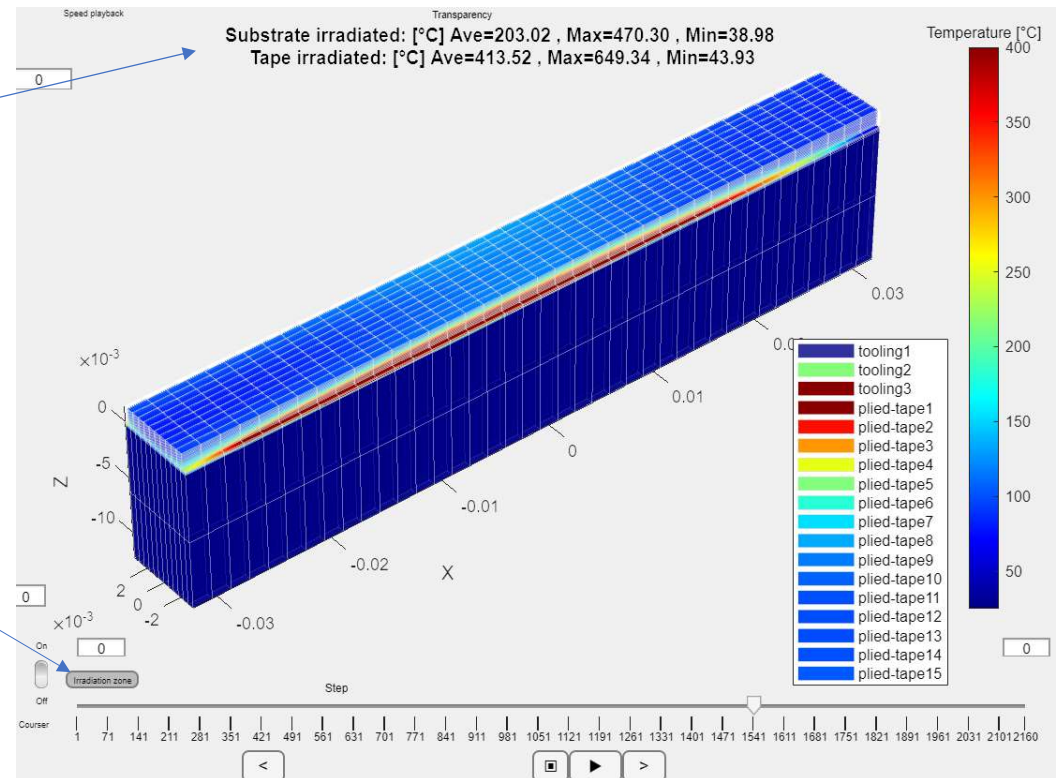
Pop-up icons

With a pop-up icon toolbar in the main figure of the OTOM AFP viewer, you could save the image or figure, rotate the main figure, move with the pan function, zoom in or zoom out, and change the view to the initial configuration.

Message Dialogue from
OTOM server

Weight analysis info box on the left side of the bottom AFP viewer window, you could see the current information regarding the licensing of the software and also the file which was loaded for the analysis in the AFP viewer.
**This message box shows the current situation of the license, its status, and the expiration date.
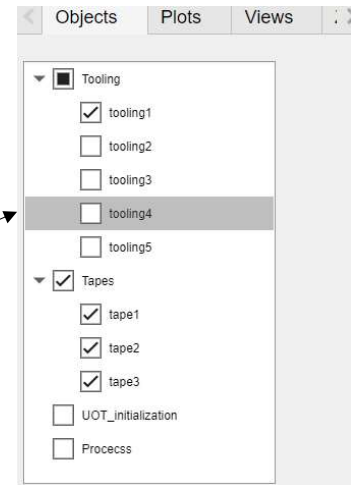
Message
Dialogue
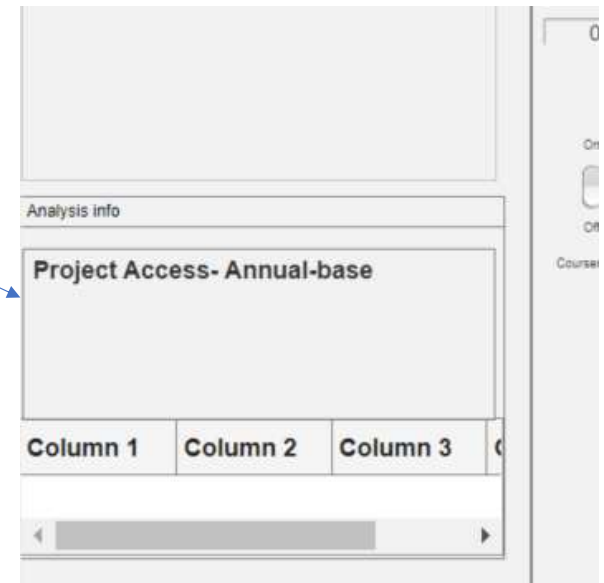
Content Table

By clicking on any object from the object tree in the OTOM AFP Viewer, the corresponding information of the objects will be shown in the content box. If you hover over the information, the information with a larger size will be shown.

Mouse click on object

Content of an object

Exploded view

Information between the layup usually is hidden and difficult to access. To make this possible in OTOM AFP viewer, the exploded views will be used to differentiate and make the distance between the layers for representation purposes.

- Exploded scene shows all objects with distances
- it is possible to play animation during the exploded view
- Combined axes could be used for exploded view (X, Y, Z)
- To reset exploded view to normal view without distance, click on Update Plot in the *Plots Tab*
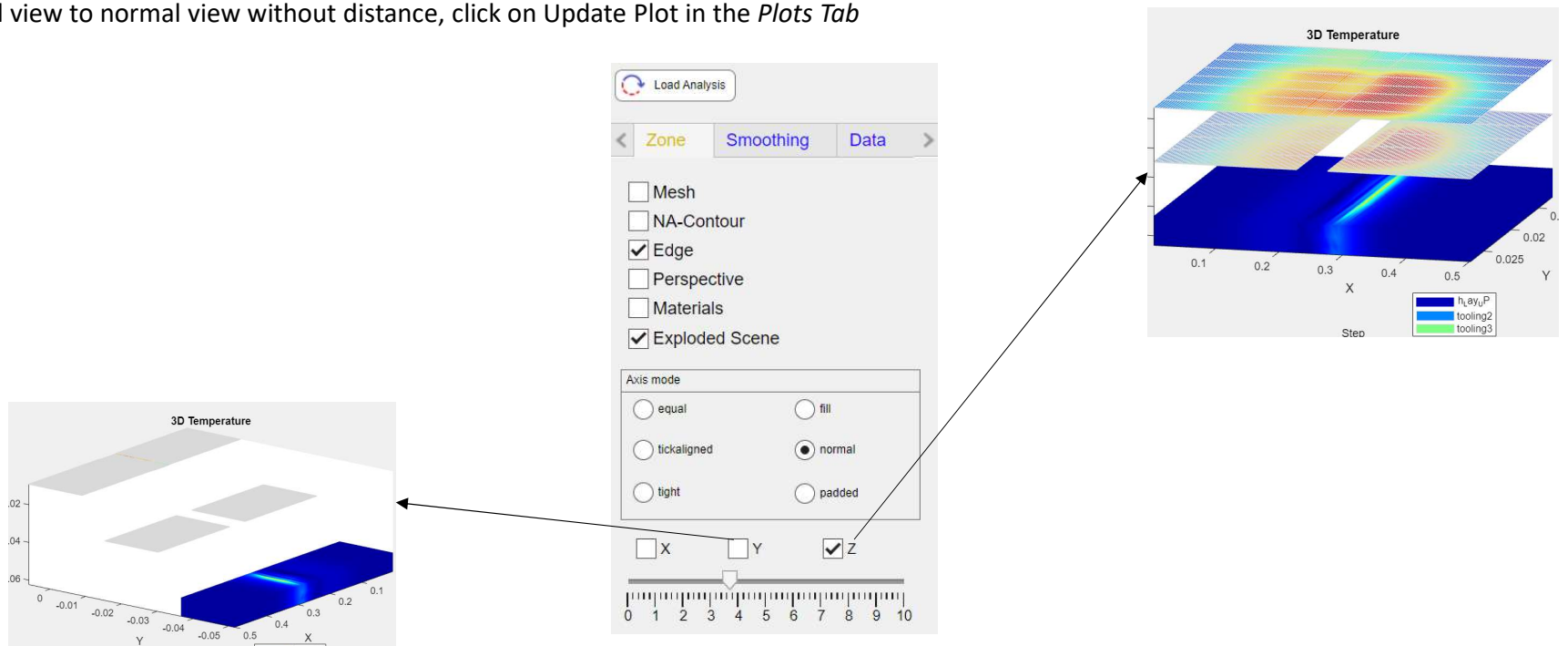
Materials

It is possible that tooling material consists of more than one material in the OTOM AFP engine. For the representation of the information material properties in OTOM AFP viewer. You could select the material and see the elements which are associated to the second or third material.

- In case an object consists of more than 1 material, it is useful to show the material combination via a material icon in the AFP viewer

- By selecting this feature and changing the transparency to a lower value, the secondary material objects can be seen

Secondary material elements

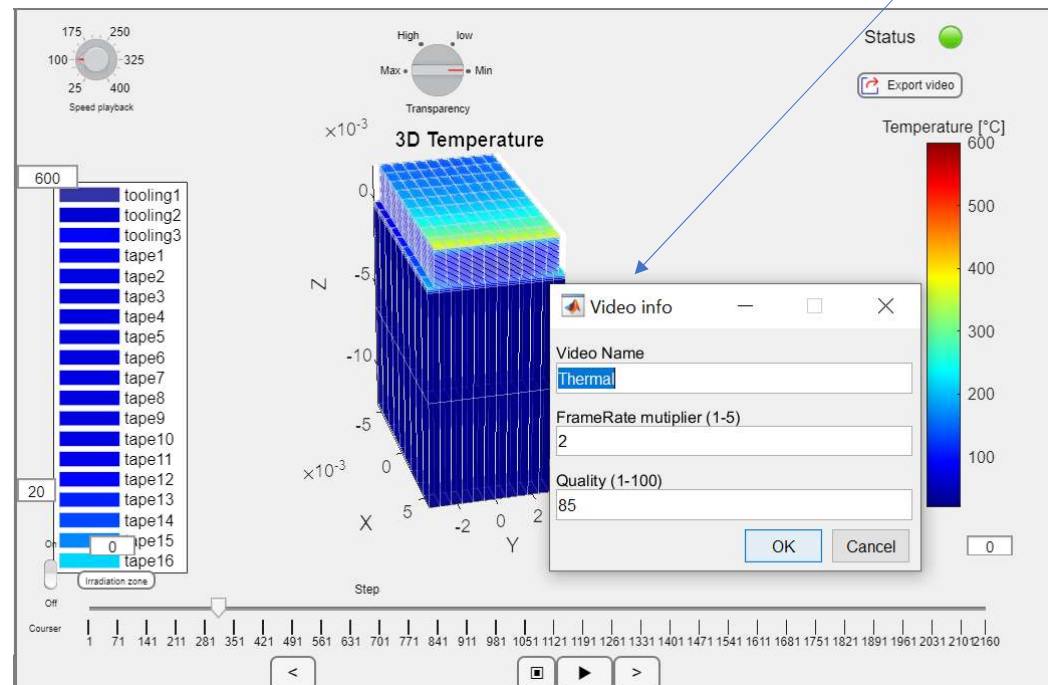Material icon

Confidential
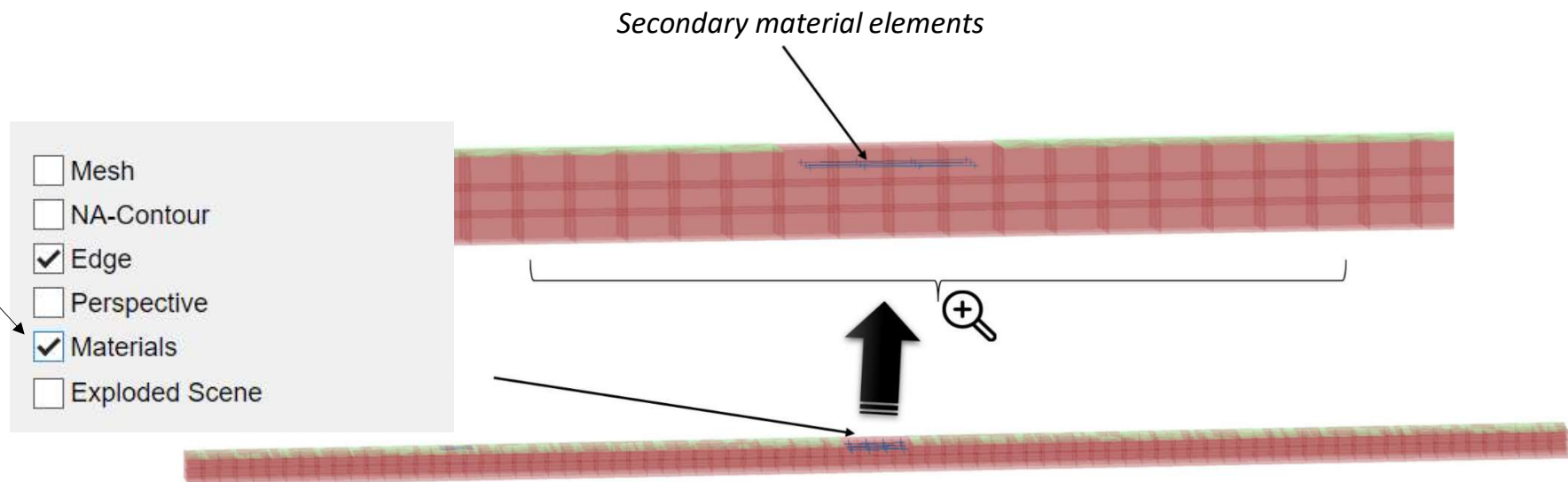
Exporting video

You could export video animations of the temperature evolution in OTOM AFP viewer.
Click on the Export video in the OTOM AFP viewer right side panel. The dialogue box provides a setting for the generated animation.
Based on the size of the models and details, it may take a longer time to generate the animation in the Thermlog file address.

Export video window

Initialization of the animation export

You could make a customized animation in OTOM AFP viewer. Click on the pop-up contour plot in the main window of the OTOM AFP viewer and then select the export animation.
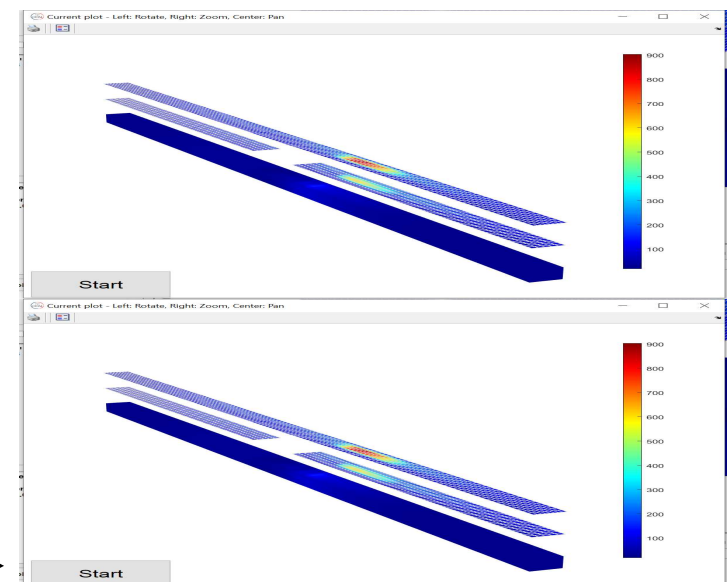
In order to have the customized animation following features could be changed:

- View of the objects

- Magnification of the setup

- Contour limits (fix/unfix) and colors

- Mesh elements boarders

Saved animation in source file directory
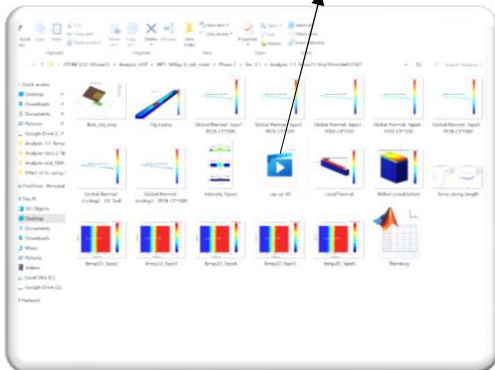
Press start to begin the animation

Customization of pop-up contour plot

Every contour plot in the OTOM AFP software could be customized. You could click on the mouse button and then right-click and go to the properties to change the representation.

- Set Min and Max values of the contour
- Specify Colormap and color discretization
- Save and import customized setting
- Print the setup lay-up
- Labeling the layers
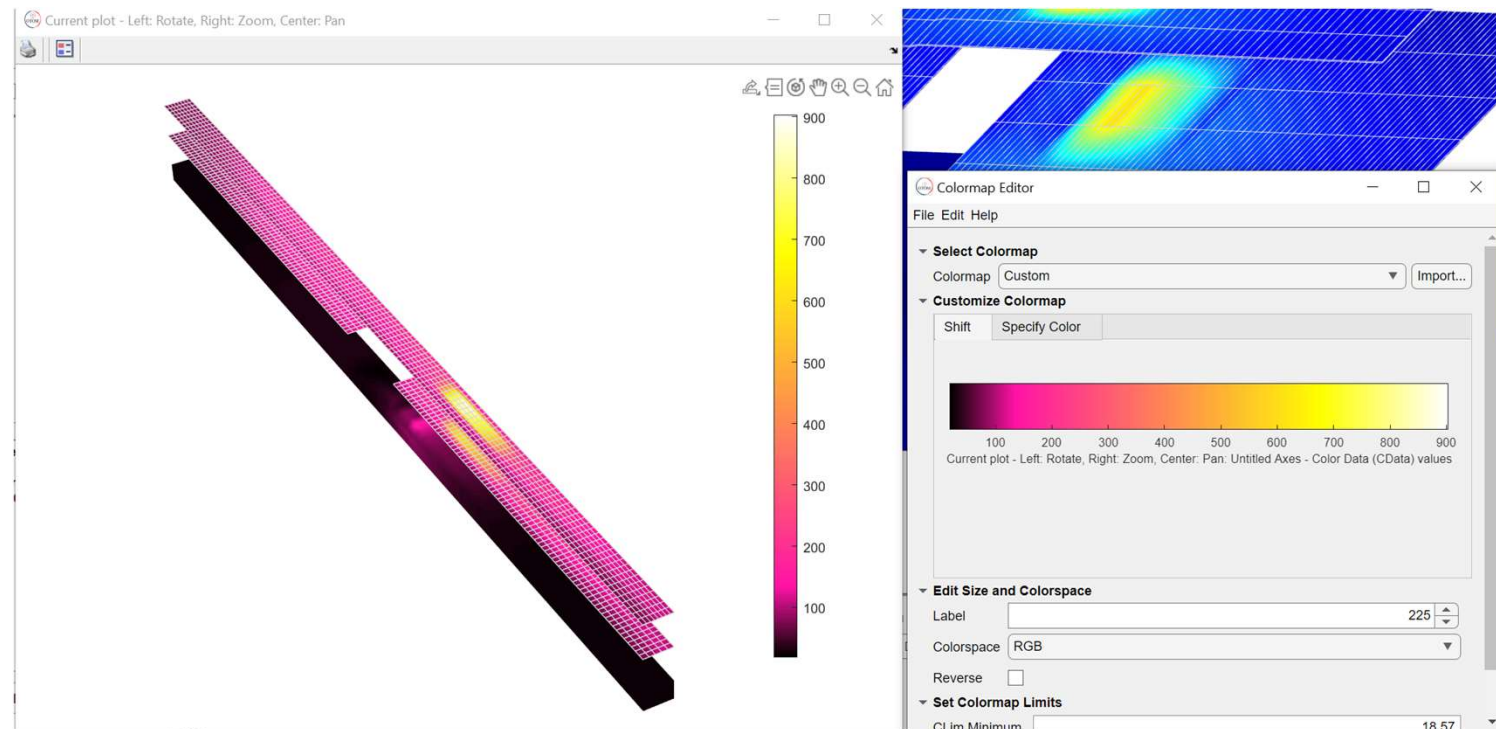
Location of the Roller

When you represent the layup progress, you could show the location of the roller press. This gives the information about the location where the new tapes will be placed. For using the Location of the Roller press update for the Global Lay-up:

1. Click on the Roller Line tick box
2. Adjust the size based on your preference
3. Click on update plot
4. Click again on the Roller line tick box to turn a modification of this feature off
5. Now when you click on play or change the step the roller position will be updated
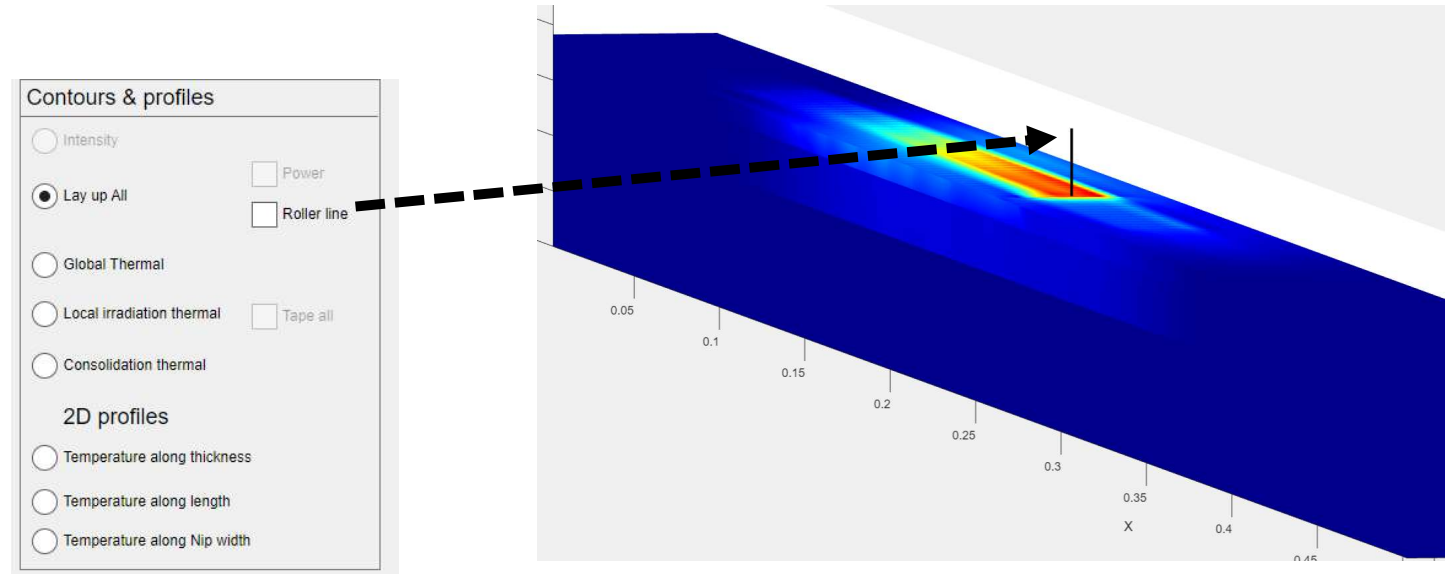
END

For suggestions and feedback please contact:

info@otomcomposite.eu