

The V³ Usage Guide

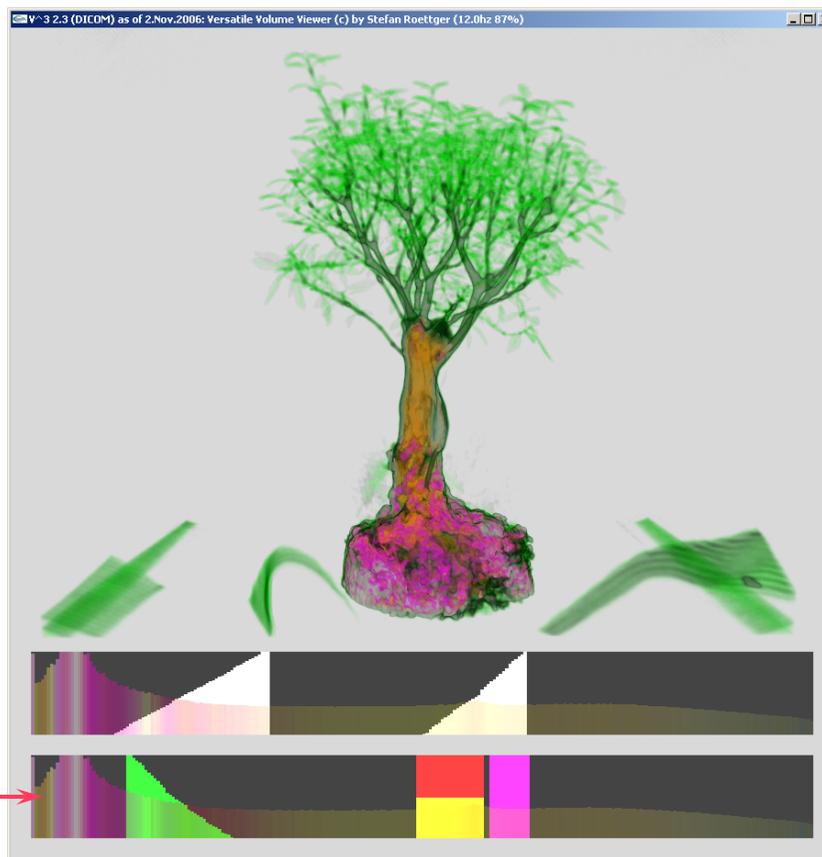
Stefan Roettger, Jan. 2007

Part #2: Advanced Features

V³ Usage

Step 15: The Manually Colored Bonsai Revisited

In part #1 of the usage guide we tried to make a standard visualization of the Bonsai. The result is depicted below. You were also invited to improve the 1D TF even further and you may have noticed that the problem with tweaking the TF is that you never know how far you might get. In the following we introduce some advanced methods that make the TF setup more convenient.



Is this an optimal setting? Which TF is optimal?

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Step 16: 2D TF

Multi-dimensional TF are an advanced and powerful visualization method, but the setup of a 2D TF can be even more tedious than a standard 1D TF. Thus, if you enable 2D TF mode in the V^3, a simplified 2D TF mode is activated first which is equivalent to gradient-magnitude volume rendering. As a starting point we enable 2D TF, adjust the opacity in x-ray mode, and draw one white ramp.

2D histogram
The arcs correspond to the boundaries that separate the materials in the volume

1D histogram

2D TF button

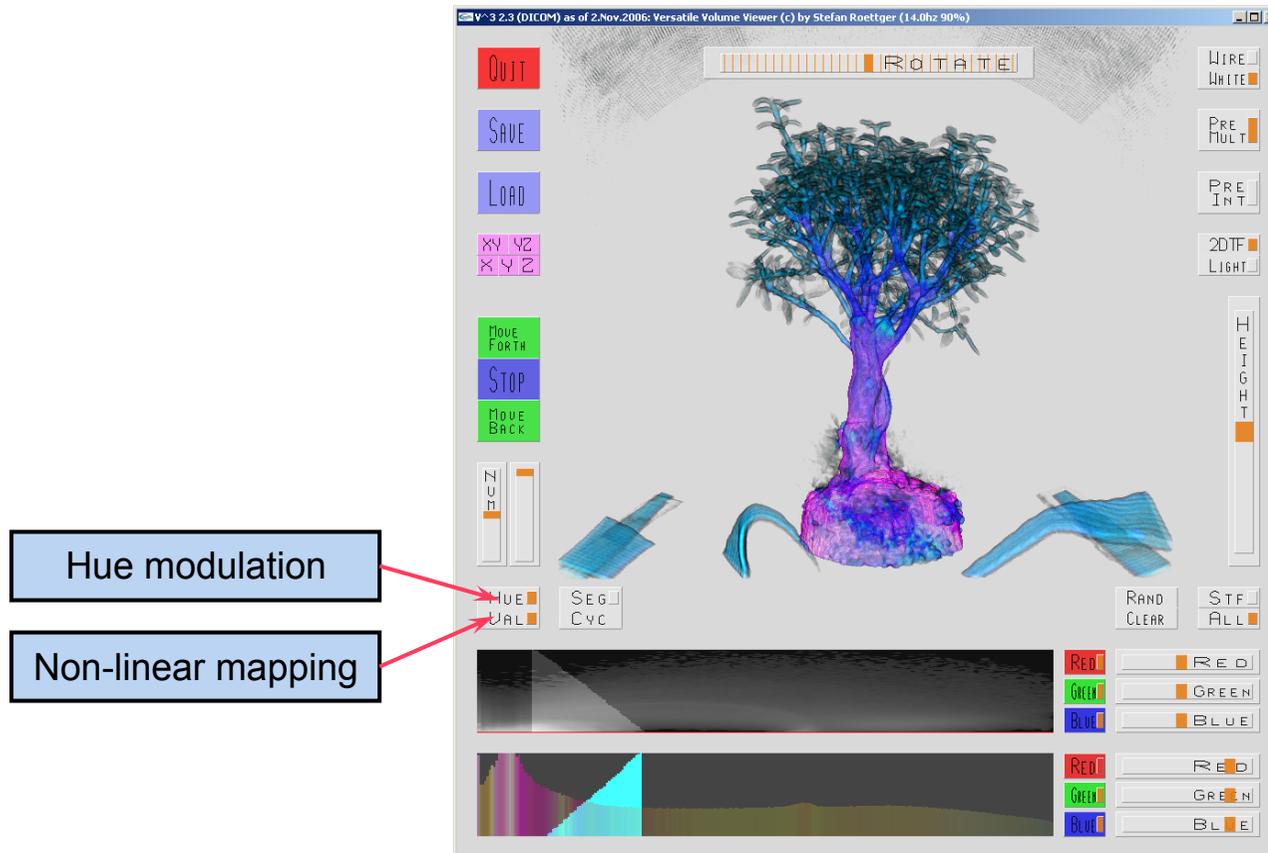
Lighting is only a prototype so far
Please do not use it unless you know what you are doing
The same holds for the "seg" and "cyc" buttons

OUT SAVE LOAD XY YZ X Y Z MOVE FORTH STOP MOVE BACK HUE VAL SEG CVC RAND CLEAR STP ALL RED GREEN BLUE RED GREEN BLUE WIRE WHITE PRE MULT PRE INT 2D TF LIGHT HEIGHT

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Step 17: Colored 2D TF

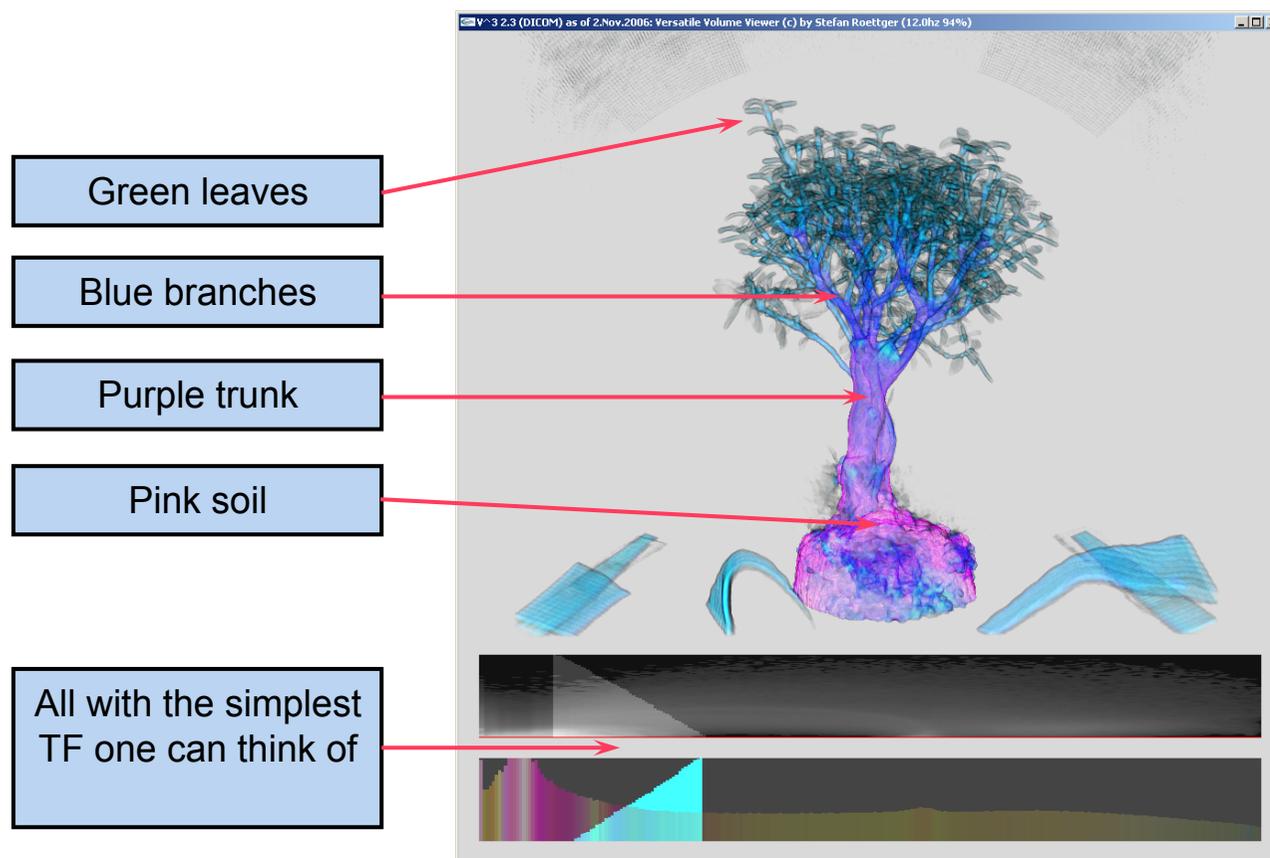
Now we bring back the color by drawing one cyan (green+blue) ramp, The entire Bonsai will be colored cyan, but we can achieve an automatic coloring by modulating the hue with respect to the gradient magnitude (hue button). We can also emphasize low contrast structures like the leaves by applying a non-linear mapping to the gradient magnituded values (val button).



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Step 18: 2D TF Result

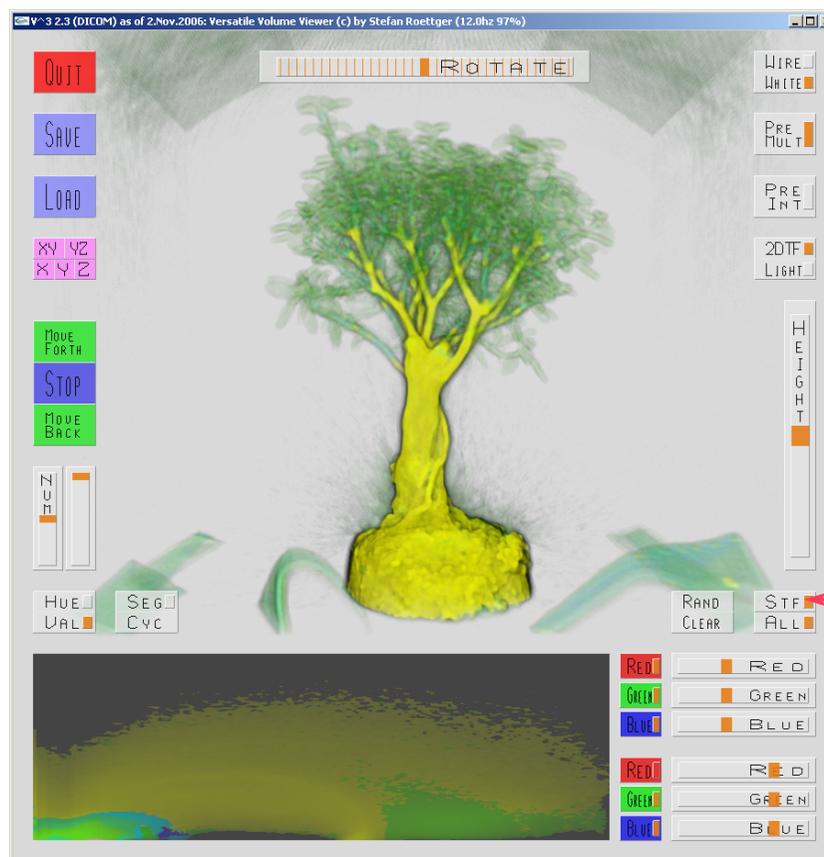
With only two ramps we have achieved an automatic separation of the leaves and the trunk. With 1D TF we needed at least two ramps and 2 different colors. Gradient-Magnitude is also much more insensitive to small changes in the TF. As a further suggestion, try to invert the ramps.



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Step 19: 2D STF

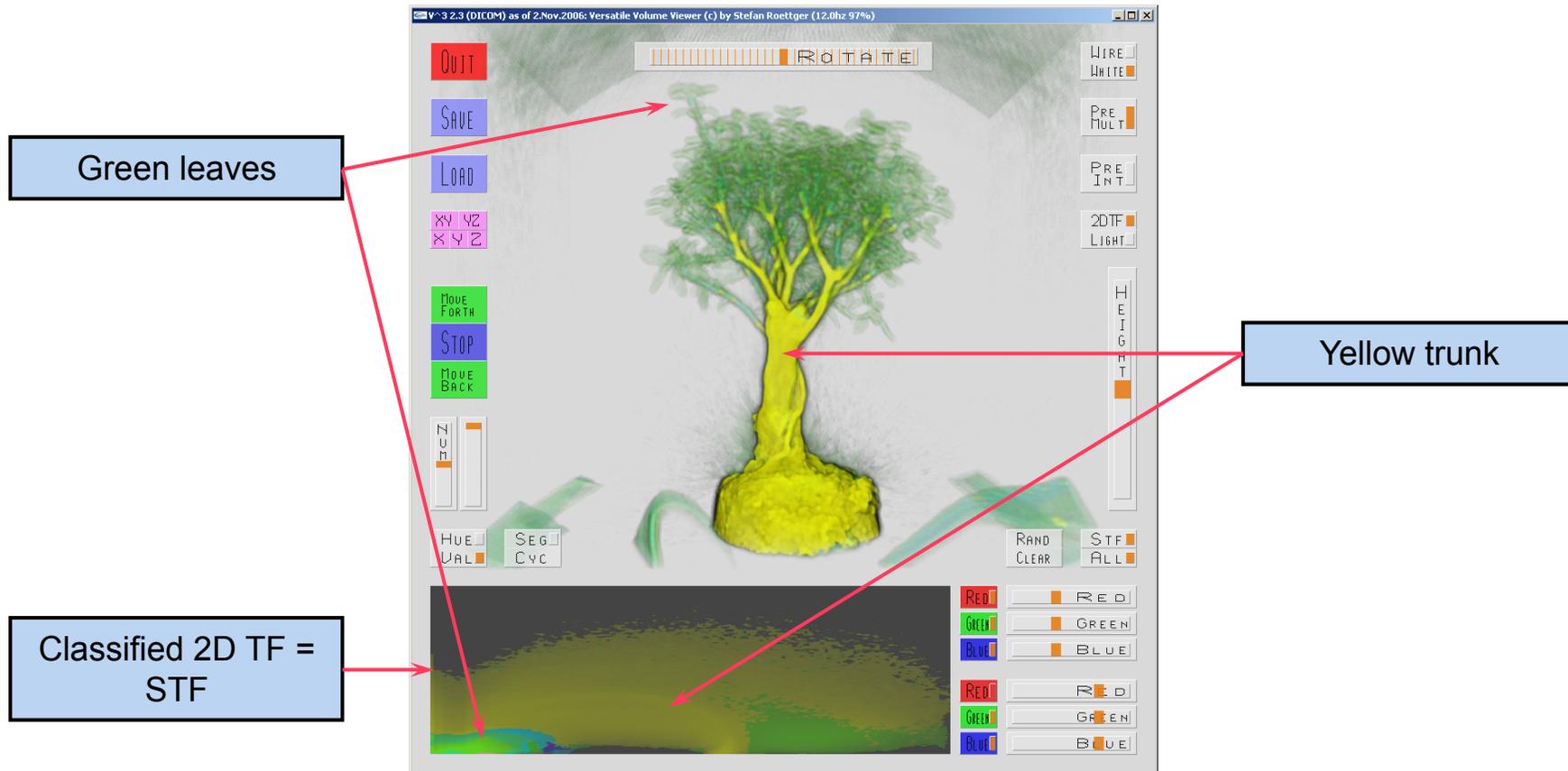
We have seen that certain regions in the TF map to certain areas in the volume. The main problem was to find those regions in the TF that map to the area of interest. Spatialized transfer functions (STF) are one approach to make the identification easier. First click the „STF“ button to get the picture below.



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Step 20: 2D TF Classification

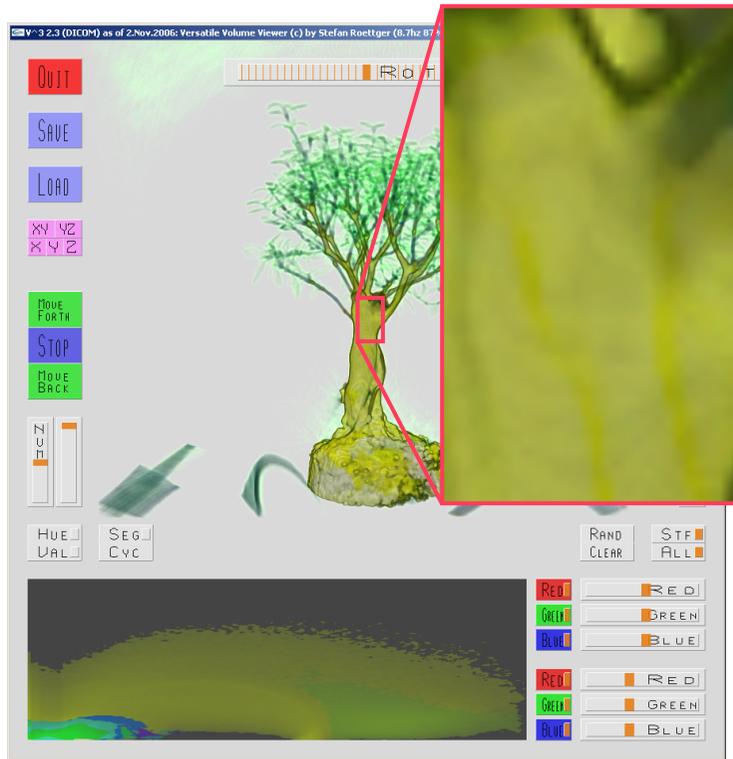
As the result, we see a classification of the 2D TF area into a set of pseudo-colored regions. The STF takes spatially coherent samples of the histogram (e.g. the leaves) and groups them together into a single region with a unique color. The only parameter needed is the number of classes. It is 4 in the example below.



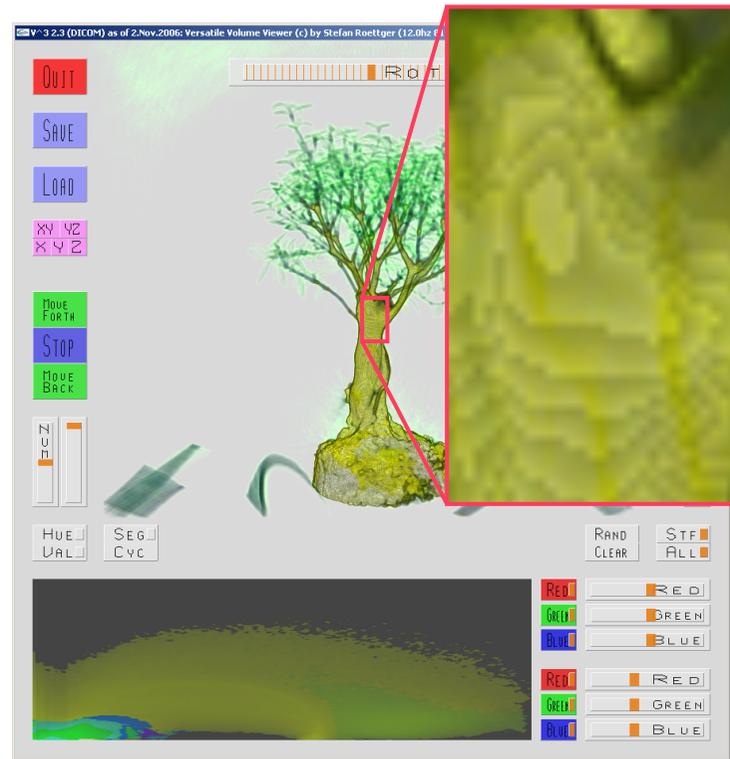
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Step 21: 2D Pre-Integration

For 2D TF the pre-integration technique also applies. However, the pre-integration time is much higher than in the 1D case. If the TF is changed the delay caused by 2D pre-integration slows down the frame rate significantly. For this reason, pre-integration should be enabled only for the final image to get the highest quality possible.



With pre-integration

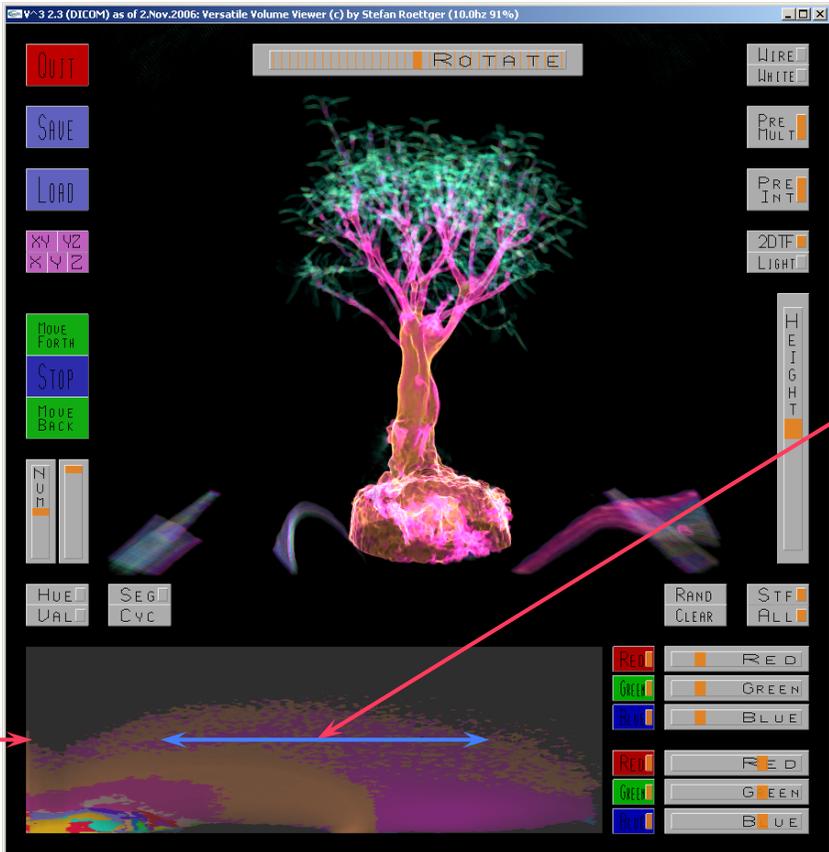


Without pre-integration

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Step 22: Modifying the Number of Classes

We can interactively modify the number of classes by clicking or dragging at the 2D TF area. The horizontal position of the mouse translates to the number of classes used to derive the STF. By increasing the number of classes the former yellow trunk breaks into two different classes, a brown one for the trunk itself and a pink one for the branches.



STF with roughly 20 classes

Click and drag to change the number of STF classes

The screenshot shows the V^3 software interface with a 3D tree model in the center. The interface includes various control panels: a top panel with 'OUT', 'SAVE', 'LOAD', 'XY VZ', 'X Y Z', 'ROTATE', 'WIRE', 'WHITE', 'PRE MULT', 'PRE INT', '2DTF', and 'LIGHT'; a left panel with 'MOVE FORTH', 'STOP', 'MOVE BACK', 'HUE', 'VAL', 'SEG', and 'CYC'; a right panel with 'HEIGHT' and 'STF ALL'; and a bottom panel with 'RAND CLEAR' and color selection buttons for RED, GREEN, and BLUE. A 2D TF area at the bottom shows a color-coded map of the tree's structure, with a blue double-headed arrow indicating the width of the STF. A red arrow points from a text box to the 2D TF area, and another red arrow points from a text box to the 2D TF area.

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Step 23: Selecting a Specific Set of Classes

By default each class of the STF is given a pseudo-random color, but we can disable or enable specific classes to blend out unwanted regions. Selection mode is toggled by clicking at the „all“ button. Then click at a class in the 2D TF area to select or deselect it. In the example below we have clicked at the highlighted green and brown classes. Double-clicking at „empty space“ disables all classes.

The screenshot shows the V^3 software interface. The main window displays a 3D tree model. The interface includes various controls: a top menu bar with 'QUIT', 'SAVE', 'LOAD', 'XY YZ', 'X Y Z', 'MOVE FORTH', 'STOP', 'MOVE BACK', 'HUE', 'SEG', 'VAL', 'CVC', 'RAND CLEAR', and 'STF ALL'. A 'ROTATE' slider is at the top. On the right, there are 'WIRE WHITE', 'PRE MULT', 'PRE INT', '2DTF LIGHT', and 'HEIGHT' controls. At the bottom, there are color selection buttons for RED, GREEN, and BLUE, each with a corresponding 'ALL' button. A 2D STF map is shown at the bottom left, with two classes highlighted in green and brown. Three callout boxes provide instructions: 'Click to toggle selection mode' points to the 'STF ALL' button; 'Double-click to disable all classes' points to the 'ALL' button for the selected green class; and 'STF with two selected classes' points to the highlighted green and brown areas in the STF map.

STF with two selected classes

Click to toggle selection mode

Double-click to disable all classes

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Step 24: Final Results

We finally have a look at the final results. Explore the Bonsai by making it more transparent (left) or more opaque (right).

