Blurate

THE CONCEPT

The theory of the Blurate user interface is that the cascading of simple building block can describe most of the space of image processing and manipulation techniques. Therefore the only thing that the user interface of an image processing framework really needs to provide is the ability for the user to define such basic building blocks and how they feed and are fed by each other. We will refer to each such a building block as a *pass* at the image.

For each pass four aspects need to be determined: (a) what the input surface is, (b) which neighboring pixels of the input surface are used to determine an output pixel value, (c) if and how the output is merged with the output of another prior pass and (d) conditions for changing a pixel value, considering an input pixel, or setting the destination pixel value.

Figure 1 illustrates the elements of an example single pass. The green encircled region determines the input surface to the pass and its function based on neighboring pixels. The blue encircled region determines if and how the output is merged with prior pass output. The red encircled region determines the various conditions on input, output and origin values for changing the destination pixel values.

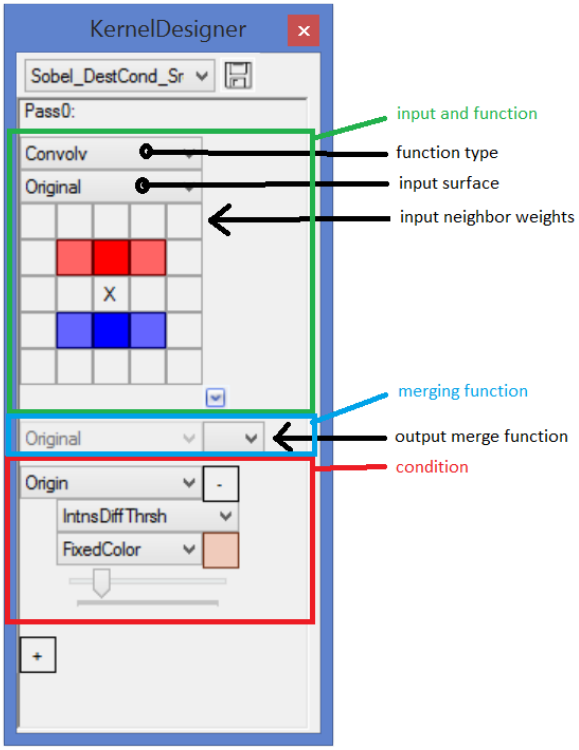

Figure 1: Basic graphical description of a pass.

THE OPERATIONS

The options for the Operation Type, the first combobox from the top available in each pass, determine what type of operation is to be performed by that phase of the filter. As illustrated in Figure 2, the options for the function types consist of Color (assigning a specific color), Convolv (taking the sum of neighboring pixel values weighed by specified amounts), NrmConvolv (taking the sum of neighboring pixel values weighed by specified amounts and dividing total by sum of weights), Reduce (reducing the RGB channels to a single averaged channel value after applying specified weights to the channels), Scale (scaling each RGB channel by a specified amount), Exp10 (replacing each channel with 10 raised to the power of the channel value), Log10 (replacing each channel with the Log to base of 10 of the channel value) and Pow (replacing each channel with the original channel value raised to the specified power).

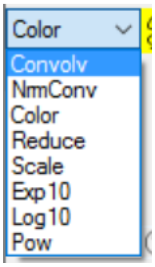

Figure 2: Main operations available per filter pass

Depending on the choen operation type, weight options may be available below the operation cmbobox.

THE PRIMARY INPUT

The options for the primary input to any pass can be selected with the second default combobox from the top available in each pass. The options for these comboboxes consist of the Original image or any preceding pass of the filter.

THE NEIGHBORING PIXELS

The neighboring pixel weights can be manipulated in the grid that follows the primary Input combobox. The center of this grid indicates the pixel that will be modified in each instance and how its neighboring pixels will be weighed when applying the specified operation. Right clicking on each neighbor allows you to manipulate its weight. The value can be set to fixed float values. Alternatively multiple neighbors can be selected and their values specified as a standard x/y math formula where x and y are the coordinates of each neighbor relative to the center pixel. In order to select multiple neighbors hold the Control key (in Windows) or Command key (in Mac OS) and click on neighboring pixels. You can also select all neighbors in a given pass by pressing the Control and ‘a’ buttons simultaneously (in Windows) or holding Command and Option keys while clicking any neighbor cell (in Mac OS).
The scope of visible neighboring pixels can be expanded by clicking on the expand button at the bottom right corner of the neighbor cells.

Note that not all primary operations use the neighboring pixel weights. With such operations, the weights of the input values only affect the pass conditions that test Source values (see Conditions section for more details).

THE MERGE INPUT AND OPERATION

The options for the secondary input to any pass, to be merged with the output of the operation of that pass can be selected with the first combobox that follows the neighboring pixel cells. The options for these comboboxes consist of the Original image or any preceding pass of the filter. To the right of this combobox is another that selects the merge operation (i.e. the operation that is used to merge the secondary input with the output of the pass's operation output).
As illustrated in Figure 3, there are six merge operations available. The minus operation subtracts the secondary input from the output of the pass's operation output, the **a-** operation provides the absolute of the same, and the **^+** operation provides the vector sum of the pass's output and secondary input.

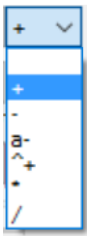

Figure 3: Merge operations available per filter pass

THE CONDITIONS

At the very bottom of each pass, there is a plus button. Clicking this button will add a condition on applying the pass's output at all. Failing the condition for any pixel makes the effective output fall back to the pass's primary input value for that pixel. Various conditions on the Source, Original and output values can be applied with these conditions. Figure 4 illustrates such a condition.
The first combobox in each condition specifies the source surface that the condition will be checked on. The available options for this combobox consist of Source (the primary input value to the pass), Destination (the output value of the pass after merging with secondary output) and the Origin (the original value of the pixel at input to the whole filter). To the right of this combobox is an eraser button to delete the whole condition.

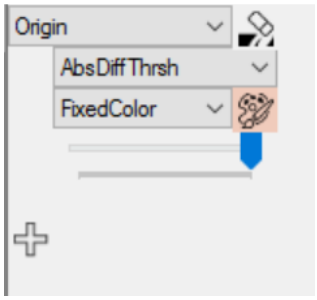

Figure 4: Default pass condition

Below the combobox for the source to the condition is another combobox to select the type of condition operation. Current condition operations consist of AbsDiffThrsh (a threashold on the maximum allowable absolute difference between the condition's check source and compare-to value) and PrcntDiffThrsh (a threashold on the maximum allowable percentile difference between the condition's check source and compare-to value).
The last combobox in each condition specifies what the condition's source is compared to. The options for this combobox consist of FixedColor (to compare against a specified fixed color) and Origin (to compare against the original input value to the filter).
At the bottom of each condition is a trackbar to manipulate the threshold of the condition.
Multiple conditions can be applied on each filter pass.

THE NUMBER AND ORDER OF PASSES

In order to change the number of passes of a filter, right click on any existing pass to find the options displayed in Figure 5. Click the New option, for instance, to insert a default pass. Passes can also be copied, pasted and deleted in this manner. Note that inserting/deleting passes in the middle of a filter may affect which pass numbers should be used as input to following passes.

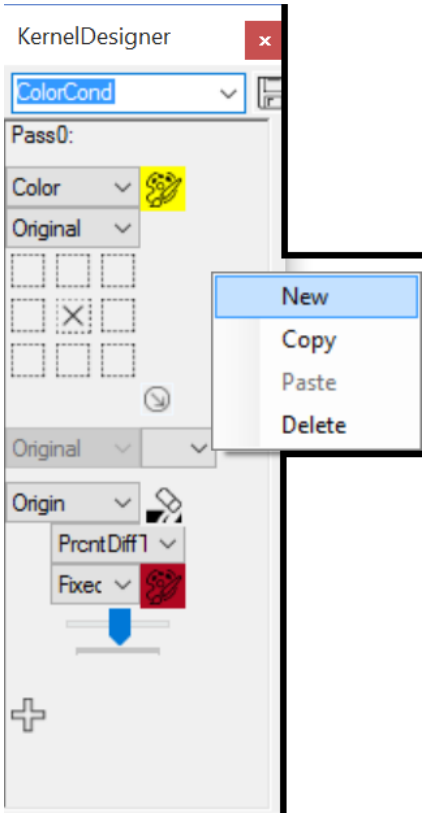

Figure 5: Right-click options for any given pass of a filter.