

FDKeyConfigPro

User's Guide

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SoftLab-NSK, Ltd.

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Table of Contents

1	<i>FDKEYCONFIGPRO MAIN WINDOW</i>	4
1.1	Saving of keying parameters.....	5
1.2	Video settings. <i>Select Video Source</i> dialog	5
1.3	Format and output settings.....	6
1.4	Settings of the scene parameters.....	8
2	KEYING SETTINGS	9
2.1	Video input frame on the panels of <i>KeyConfigPro</i> dialog.....	9
2.2	Status bar	10
2.3	Toolbar.....	10
2.4	<i>Mask Filters</i> and <i>Alpha correction</i> groups	11
3	<i>FDKEYCONFIG. ALGORITHM UNIVERSAL KEY</i>	13
4	<i>FDKEYCONFIGPRO. ALGORITHM UNIVERSAL KEY</i>	15
4.1	Mask building. The ellipsoids in the color space	16
4.2	Statistics of colors distribution in the frame	16
4.3	Color correction	17
4.4	Recommendations.....	18
5	<i>KEY FROM ACTOR ALGORITHM</i>	19
5.1	Mask building by video frame.....	19
5.2	Color correction and a mask filtration	20
5.3	Toolbar and menu	21
5.4	UV Colors and colors statistics	23
5.5	Advanced settings of algorithm.....	23

1 *FDKeyConfigPro* Main window

Applications *FDKeyConfig* and *FDKeyConfigPro* are used for setting keying parameters. Both can be opened by finding the directory for the *ForwardT Software* using the standard system *Windows Explorer*. *FDKeyConfig* and *FDKeyConfigPro* only differ slightly in the way they set keying parameters in the **Universal Key** algorithm (see 3). Thus they will both be referred to as *FDKeyConfig* for the remainder of this document.

After launching *FDKeyConfig* the Main window *Key Configuration for Board #* (Figure 1) is presented. From here access the dialog *Select Board and Preset* (Figure 2) to select the particular *FD300* board and any previously defined presets for the particular *FD300* board selected. Once selected, the Board Number is then displayed in the heading of the Main window. It is also possible in the *Select Board and Preset* dialog to choose and load any previously saved presets.

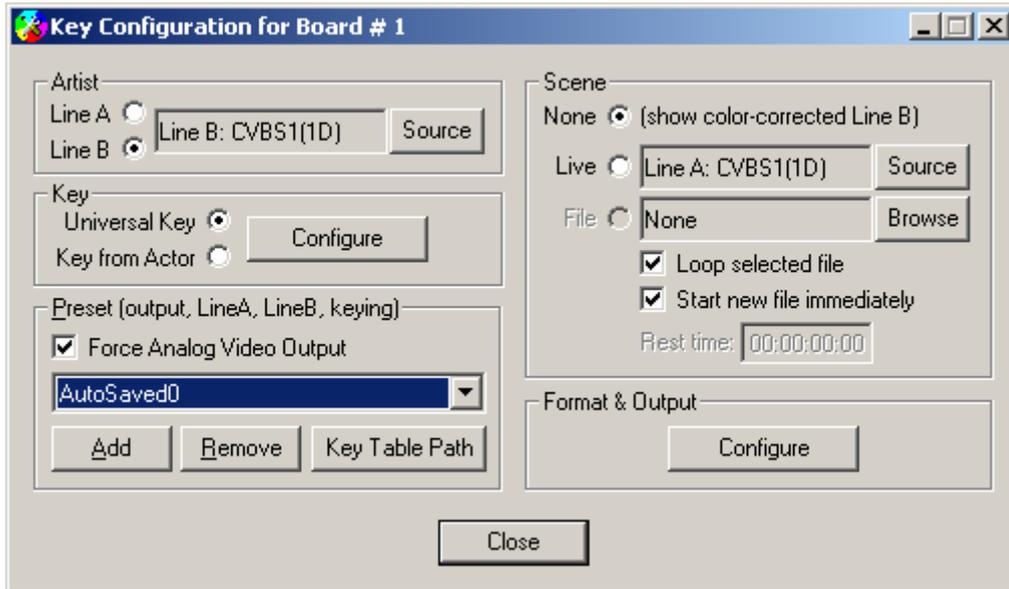


Figure 1. Main window of *FDKeyConfig*

Use the drop-down list in the *Select Board and Preset* dialog to find the **Board index** number list of the *FD300* boards installed.

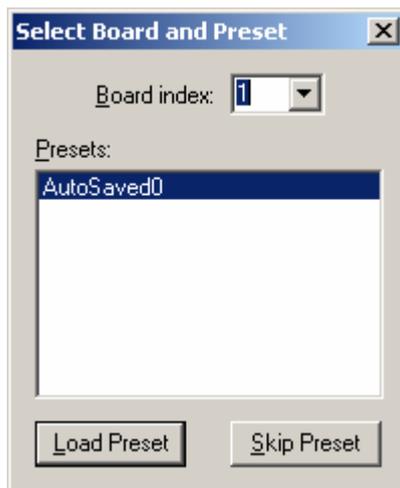


Figure 2. Select board and preset

The list of all saved previously defined presets is displayed in the **Presets** window. To load a particular preset it is necessary to select it from the list using the mouse cursor and then click on the **Load Preset** button. Pressing the button **Skip Preset** closes this dialog without preset loading.

The Main window of *FDKeyConfig* contains the following parameters groups: **Artist**, **Key**, **Scene**, **Preset (output, LineA, LineB, keying)**, **Format&Output**, which are described below.

1.1 Saving of Keying Parameters

Parameters in the **Preset (output, LineA, LineB, keying)** group of the Main window of *FDKeyConfig* will save/restore keying parameters for both inputs. Clicking on the **Add** button saves keying settings to the system register (Figure 1). The **Remove** button deletes these settings.



Figure 3. Settings dialog

The **Key Table Path** button in the **Preset** group opens the *Settings* dialog shown in (Figure 3). Using the **Browse** button opens the standard *Save As* dialog for directory selection for storing the preset and its path to a file. Along with presets the palette of colors for the actor and the background in **Advanced Key** mode in the algorithm **Key from Actor** will be saved to the same directory.

Check-box **Force Analog Video Output** automatically set output mode **Internal->Analog Output** at preset loading.

After defining the preset for both input lines in dialog *Select Board and Preset* (Figure 2) this name is saved automatically and kept in the system register and will then appear in the **Preset** list of the *FDOnAir* Main window. For removal of any preset, select it in the list **Preset** of the Main window with the mouse cursor and to press button **Remove**.

 *Attention! To the state of BOTH video signal sources will saved, it is not possible to only save one channel. If one of the inputs is not adjusted, the program will not save the current adjustments, and you will receive the error message shown in (Figure 4).*

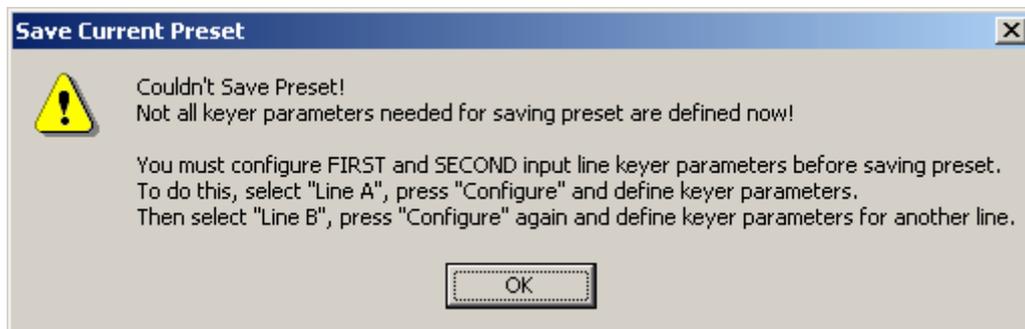


Figure 4. The warning message requiring configuration of both inputs before saving

1.2 Video Settings. *Select Video Source* dialog

Switching between video sources in real-time is easily performed with the *Select Video Source* dialog. To select a video source in the **Artist** parameters group of the *Key Configuration for Board#* dialog (Figure 1) first check either **Line A** or **Line B**. Then click on the **Source** button to open the dialog *Select Video Source* (Figure 5). From the drop-down **Input** list select a source. Below the source list are sliders for appropriately configuring the source and establishing keying parameters for the source.



Figure 5. Select Video Source dialog

If the Component video input (YUV or RGB) is selected in this dialog, then the three adjustments **U gain**, **V gain**, **Y/C Delay** are accessible. They adjust brightness and chromaticity of the image. For Composite input or S-Video input the color tone adjustments become accessible along with saturation, brightness and contrast of the input image. In mode **Half resolution** the **X offset** specifies adjustments to the placement of the image within the limits of 16 pixels.

The result of any adjustment changes is dynamically displayed in dialog window. Once the desired parameter values are set click on the **OK** button to save these settings. When selecting a new video source all adjustments sliders return to their initial setting. It is possible to restore preset values for a source with the button **Default**.

1.3 Format and Output Settings

The parameters group **Format&Output** of the Main window (Figure 1) contains the **Configure** button. A click on the **Configure** button opens *Format Properties* dialog (Figure 6) to access the *FD300* board parameters. In the **Format** panel (Figure 6) of this dialog is located the field **Board index** for selecting the correct board number for the specific *FD300* board currently in use. The format of the input video signal (PAL or NTSC) is set in field **TV Standard**. In drop-down list **Image Size** the size of the image is determined either **Full resolution** or **Half resolution**. Fields **Width** and **Height** show values of the horizontal and vertical resolution in pixels. Format adjustments are valid for both video channels.

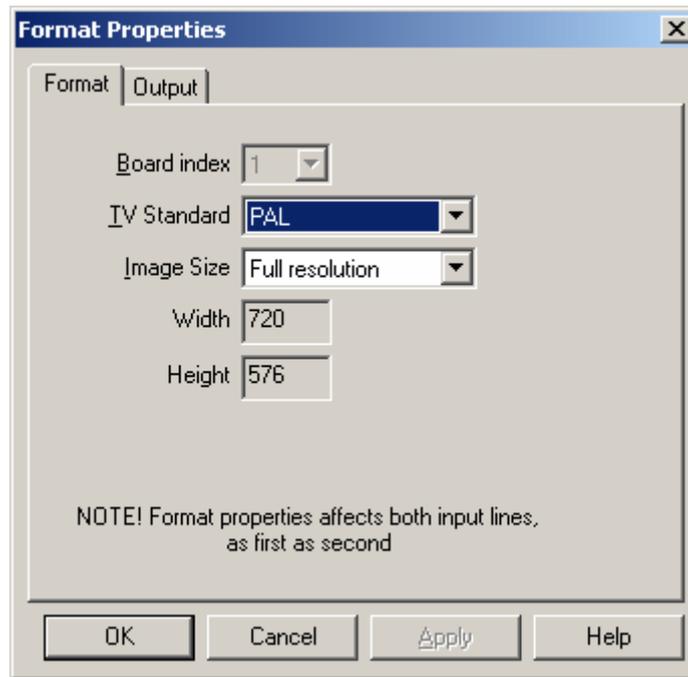


Figure 6. Format Settings

On the panel **Output** (Figure 7) of the dialog *Format Properties* output video channel adjustments are made.

In the top drop-down list **Video Output Switching** the type of data; output for the coder of analog video signal is set. It can be either video data from the internal video mixer – **Internal** or input data from the external digital bus – **Digital bus**.

- **Internal -> Analog output** – the data from the internal video mixer goes on an analog output; data from the external bus is not used.
- **Internal -> Analog output + Digital bus** – the data from the internal video mixer is outputted to both analog output and the digital bus working in output mode. The device connected to this bus, must also work in input mode. It can be used for SDI-output.
- **Digital bus -> Analog output** – the data from the external digital bus goes on an analog output; the data from an internal video mixer is not used.

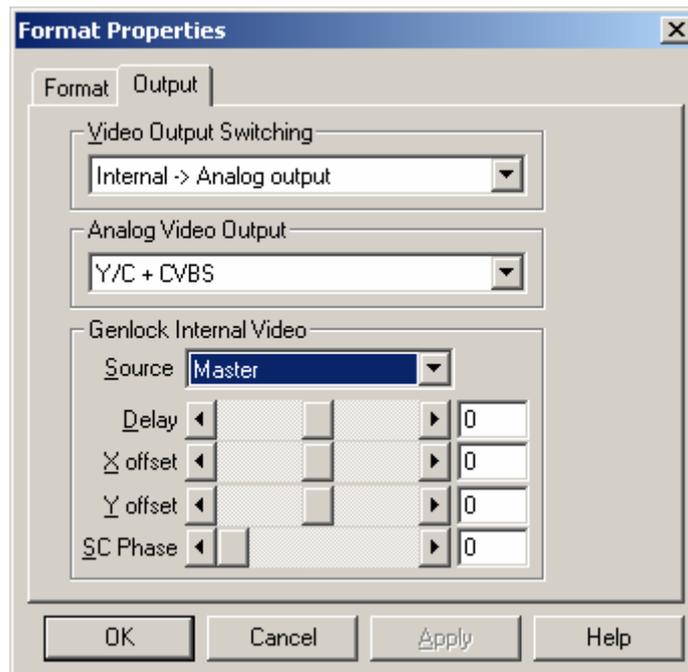


Figure 7. Output Settings

In drop-down list **Analog Video Output** the available combinations of output signals is given. Four connectors are available including **CVBS** for a composite signal and **Sync** – synchronous signal. The basic output combinations are:

Y/C + CVBS	S-Video signal plus composite signal;
YUV + CVBS	component signal with Y -synchronization plus composite signal.
YUV + Sync	component signal without Y -synchronization plus synchronous signal.
nsRGB + Sync	component signal RGB (without synchronization) plus synchronous signal.
YUV + sKey	component signal plus Key -signal (synchronization in Key).
ns(Key on Y)UV+sY	component signal, in which component Y with synchronization is sent on a «single» output. For the remaining group of three outputs there is no synchronization. On an output, where any of the usual modes are used for component Y , then signal Key (without synchronization) is given.
nsRGB + Key	component signal RGB without synchronization plus Key -signal.

Three additional modes beginning with **ColorBar** are available. Below the text of the name and types of signals for these modes coincide with one of the descriptions above. These modes always display the test image of color strips.

The parameters of **Genlock Internal Video** group set the video data synchronization of internal video mixer **Internal**.

The source of synchronous signal is selected from the **Source** drop-down list:

- **Master** – internal synchronization, which can to be used, for example, if no external synchronous is available signal;
- **Line A** – synchronization to a video source connected to the board's first channel;
- **Line B** – synchronization to a video source connected to the board's second channel.

X offset and **Y offset** – offset of the output image relative to the synchronous signal.

1.4 Scene Parameters

Scene parameters provide the opportunity to control switching between two video sources in real-time. There are three options available – **None**, **Live**, **File**. If option **None** is selected, then on the *FD300* board output the image with color correction from the chosen source of video **Line A/Line B** is displayed.

Option **Live** allows use of a live video feed image from a video camera. After selecting **Live**, use the button **Source** to open the *Select Video Source* dialog (Figure 5) for configuration of the appropriate video source and setting keying parameters (see 1.2).

Option **File** allows the use of an existing file as the scene. Press the button **Browse** to open a standard file selection dialog for scene. The option **Loop selected file** is used to repeatedly play back a file over and over. With the option **Start new file immediately** plays back the newly chosen file immediately. If this option is switched off, the new file is added at the end of the playback list. In the field **Rest time** a pause time before the ending of a file or the files in the play list is displayed.

2 Keying settings

Actions controlled by the keying parameters include:

- Selection of the video camera (video source).
- Positioning of the camera on a dark blue or green background.
- Setting background illumination.
- Calculation of the keying table.

For each input line (**Line A/Line B**) of the *FD300* board the keying parameters are adjusted separately. From the group of parameters **Artist/Key** in the application Main window (Figure 1) the keying algorithm is chosen either **Universal Key** or **Key from Actor**. Clicking on the **Configure** button in this group opens the *KeyConfigPro* dialog, which contains the available adjustments for the chosen algorithm.

The algorithm **Universal key** (Figure 12) provides a background colors test using the ellipsoids in the 3D YUV color space. This method successfully works when the background is of high quality and with a great deal of illumination.

If the algorithm **Key from Actor** is selected (Figure 14) a mask is built by indication of background colors and actor colors in the image of the captured video frame in the **Input** panel. This method is more flexible, but the adjustment can require more time to complete.

For repetitive shooting conditions the use of **Presets** considerably reduces preparation time. When using presets, most cameras will change colors of the whole image and background colors with a change of the brightness setting. Therefore it is recommended to switch off in the camera any automatic adjustment of balance white, trimming of aperture etc.

For each algorithm keying parameter settings can be automatically adjusted with the buttons **Adjust keying parameters automatically**  or **Auto selecting background and actor colors areas** with the icon  found on the toolbar. To the right of each parameter editing field is a small button.

When clicked on the button turns red  indicating that the parameter is fixed and will not be altered when using the automatic keying setting. A second click on the button turns it to green  making the parameter adjustable by automatic keying. The state of the button is switched with a click of the mouse button.

Features of keying adjustments for each algorithm are discussed in the chapters 3, 5. Further in this chapter the common elements for all variants of dialog *KeyConfigPro* are described. These include buttons on the toolbar for the video input frame and icons for the stages of key building on the panels of dialog *KeyConfigPro*, and a description of the functionality of control groups for spatial mask filtration and correction of color ratio of actor color (that is α , opacity, mixing degree).

2.1 Video Input Frame of *KeyConfigPro* Dialog

The input video frame is initially received when the dialog is opened. Its transformation over the stages of key building is shown in the panels of the *KeyConfigPro* dialog. The scale of the image can be increased or reduced by buttons on toolbar (see 2.3) or the **Zoom** menu command (Figure 14).

The frame can be replaced by clicking on the button **Capture image from device**  on the toolbar.

Input – the captured frame from the input video signal (an example is shown in Figure 12).

Color corrected – the result of color correction. Color correction removes the added background color from the actor image. For example, in places where light reflected from the background falls, or on the transitions from the actor to background. Color correction is adjusted, when the parameters for mask building are selected correctly. When set correct adjustment the area of a background on the image of this panel will be sulfur.

Mask – an initial mixing mask (Figure 8, at the left) with a transparency. Black color – the background (completely displays graphics only $\alpha = 0$), white – «actor» from input video (it is completely opaque), gradation of grey color – a degree of mixing of input video and graphics.

Filtered Mask – result from the use of the algorithms influenced by the values for degree of mixing of input video and graphics. In particular, the algorithms spatial mask filtration (**Mask Filters**) and

(**Alpha correction**) adjustments to the actor color ratio (see 2.4); and also includes features for setting up keying, transparency of input video and sharpness of actor borders.

Decoration – a background that is mixed with the input frame. This can either be pure color chosen by clicking on the toolbar button **Decoration color**  or a file picture if the button **Decoration mage**  is pressed.

Result – result of mixing the input video frame (panel **Input**) with a background (panel **Decoration**) with use of the filtered mask **Filtered Mask** (Figure 8).

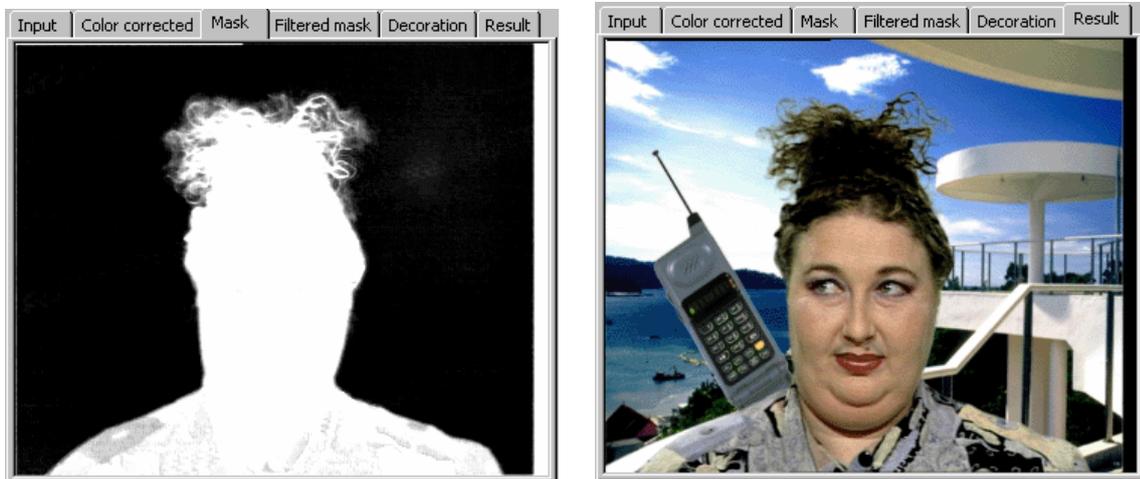


Figure 8. Initial mixing mask and result of mixing with decoration from a file

2.2 Status bar

in: 169 -40 -51 cc: 0 0 0 a= 199 fa= 198 d: 189 -1 0 r: 42 -1 0 x= 110 y= 108

The status bar at the bottom of the dialog displays information about the pixel directly under the mouse pointer. Coordinates of the pixel are shown in the right most section. In other sections there is information about the pixel at different stages of the keying build, with more details graphically represented on the dialog panel. The information about color is represented in the system **YUV**. After a prefix and the symbol ":" the values of brightness **Y** and differences of colors **U** and **V** are presented. The value of the actor color weight (α) can change from **0** up to **255**.

- **in, Input**, YUV-coordinates of a pixel prior to color correction – initial color on the captured frame of input video.
- **cc, Color corrected**, YUV-coordinates of a pixel after color correction, color after color correction.
- **a, Mask**, value of weight of actor color (α) in the initial mask.
- **fa, Filtered mask**, value of weight of actor color (α) after spatial filtering.
- **d, Decoration**, YUV-coordinates of a set (background scene).
- **r, Result**, YUV-coordinates of a pixel in the resulting image after the subject when the set of colors have been mixed.
- **x, y** – the current coordinates of a mouse point on the image.

2.3 Toolbar

The toolbar buttons for the dialog *KeyConfigPro* for each algorithm **Universal key** (see 3) and **Key from Actor** (see 5) are listed below. Additional buttons are described in the appropriate sections.



Captures a frame from input video. This image is displayed on the Input panel and its various transformations at different key building are represented on other panels.



Loads parameters and the key table to the *FD300* board, this may take several seconds.

-  Selects the background color to be used as scenery (panel **Decoration**). Repeated pressing of this button opens dialog *Select Decoration Color* for choosing a new color.
-  Selects an image file to be used as scenery (panel **Decoration**). Repeated pressing of this button opens the *Select Decoration Image* dialog for selecting a graphical file in any of the formats tga, png, dib, bmp, jpg.
-  Increases scale of the image on panels.
-  Reduces scale of the image on panels.
-  Closes dialog after saving the parameter settings.

2.4 Mask Filters and Alpha correction groups

The algorithm parameter groups of the *KeyConfigPro* dialog control keying functions. During adjustment of these parameters their effects on the images can be seen in the **Result** and **Filtered Mask**.

In the group **Mask Filters** (Figure 12 or Figure 14) the mask filtration parameters are located.

The degree of a spatial filtration across the image governed by the **Horizontal** setting while the **Vertical** setting controls up and down spatial filtration. The **None** parameter turns off all directional filtration. Within the list are icons, which represent the number of pixels number utilized during the filtration process. The required degree of filtration is determined by the quality of the background, the uniformity of illumination, quality of the video signal from the camera and other factors. Under adverse conditions, as a rule better quality results are obtained when the filters are used at their maximum setting. For each parameter in the list, when the small button on the right of the parameter is in the depressed condition (red ) , this fixes the parameter at the current setting. When the parameter is not fixed, then it can be altered during, automatic keying.

The amount of time for interframe filtration is set by the parameter **Time**. The **None** setting turns off interframe filtration. The **Custom...** parameter sets any adjustments in dialog *Custom Mask Time Filter* (Figure 9). This dialog is opened by pressing of the button  to the right of the parameter list (Figure 12). In this dialog two selectors set values for control of the actor color (or α , opacity, a degree of mixing) between the current and the next two frames. The **Noise** setting determines the amount of noise that will be allowed (the camera, illumination etc.). If the Noise setting is a higher value than the **Max Delta A** setting, then no corrections will be made. Intermediate values change will cause incremental changes. The buttons in the middle of the dialog coincide with settings from **Time** parameter. These are predetermined values for the appropriate degree of time filtration – **None, Small, Medium, Large**.



Figure 9. Custom mask dialog

Alpha correction. Correction of value for weight of the actor color (or α , opacity, degree of mixing) is used to increase sharpness for the transition between the actor and the background thus allow the extraction of fine objects such as hair from the background. Parameters **Min** and **Max** vary from between **0** up to **255**. The difference between these values should not be less than **128**. If a value in the mask at any point is less **Min** the pixel will become completely transparent (**0**) if it is more than **Max** – then it will be opaque (**255**); values α between **Min** and **Max** vary accordingly. In the diagram: **Min** – small square below at the left, the **Max** – at the upper right. When placing the cursor above small square while pressing the mouse button, it is possible to change the opacity value, by moving the small square to the right or to the left.

As a rule, to increase sharpness, the value **Min** should be increased just a little (by a shift to the right), this results in geometrical reduction of the mask inside of the actor.

3 FDKeyConfig. Algorithm *Universal Key*

Application *FDKeyConfig* differs from application *FDKeyConfigPro* only in the keying settings in **Universal Key** mode. Pressing the **Configure** button of the main window of *FDKeyConfig* opens the dialog *Input and Key Configure* (Figure 10) along with the **Source image** window.

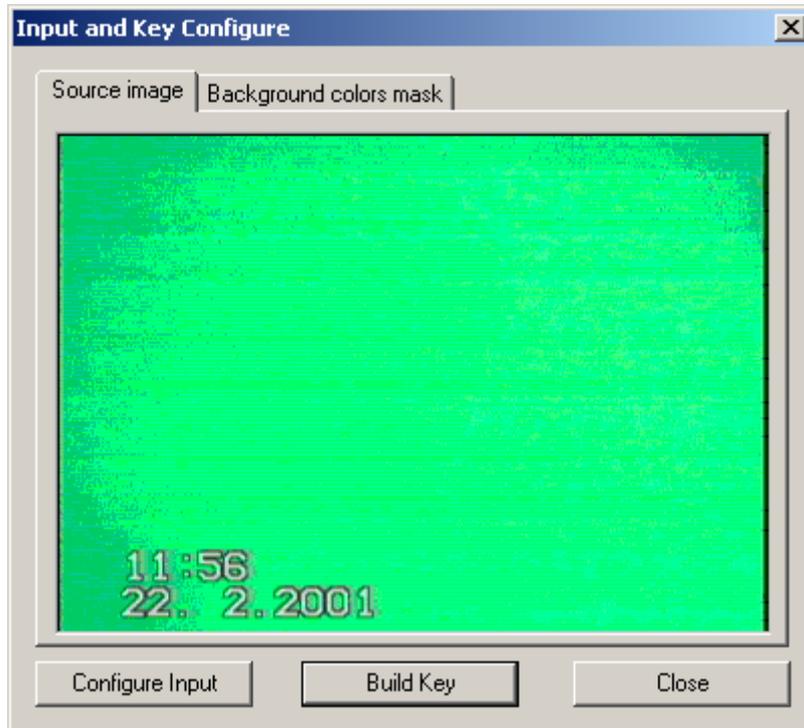


Figure 10. *Source image* window in the dialog *Input and Key Configure*

To check background setting correctness you must click on the **Background colors mask** tab in this dialog. The image mask created by the automatic keying function is displayed. Prevalence of white color in the mask indicates the settings for the camera and illumination are ideal (Figure 11).

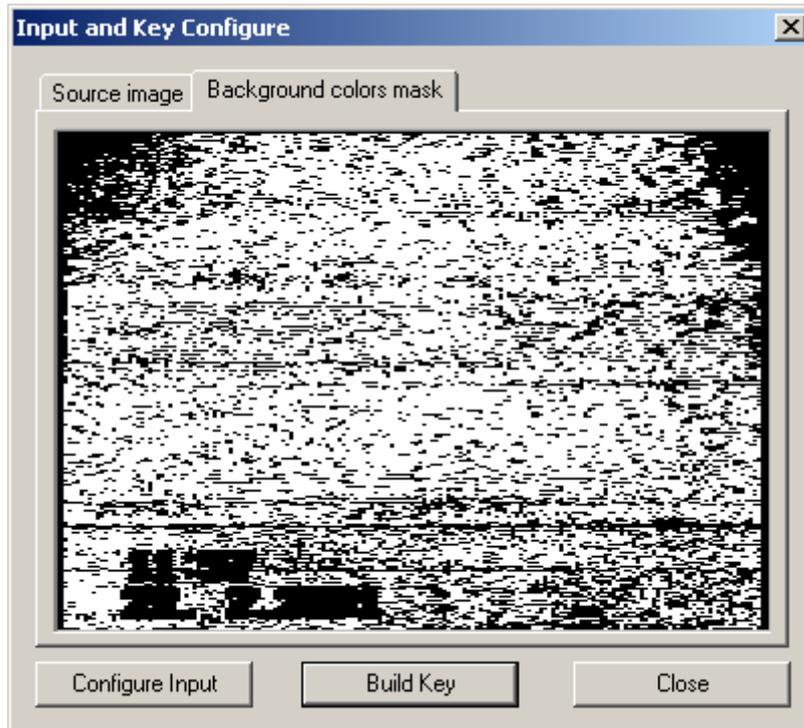


Figure 11. Example of a background setting

In this example with the obvious prevalence of white color – the background is adjusted correctly. The ideal would be a completely white screen. Further adjusting the camera and illumination factors, will help approach the ideal, then press button **Build Key** to re-build the key table. By pressing this button the program automatically defines the keying parameters for the current image. After adjustment of keying parameters the program closes the dialog *Input and Key Configure* and returns to the application main window.

Button **Configure Input** opens settings dialog of input/output video parameters *First (Second) Line Properties* (see 1.2, 1.3).

4 *FDKeyConfigPro*. Algorithm *Universal Key*

Another variant of keying building is found in the dialog *KeyConfigPro* (Figure 12), by pressing button **Configure**, and then in group of parameters **Artist/Key** of the Main window *FDKeyConfigPro* (Figure 1) select the parameter **Universal Key**.

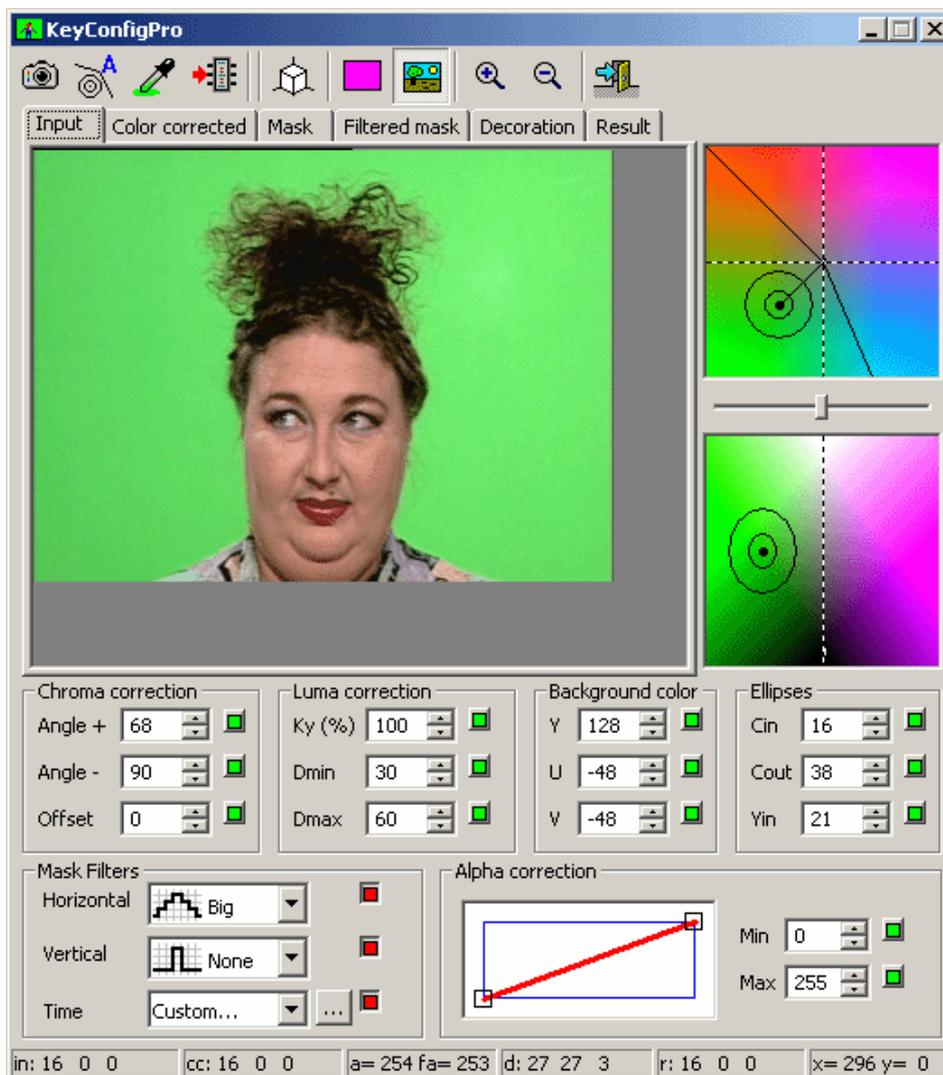


Figure 12. Dialog *KeyConfigPro* of algorithm *Universal Key*

The order of initial mask building (using parameter groups **Background color** and **Ellipses**) is described in section 4.1. Then if necessary you can apply color correction (see Chapter 4.3, and the parameter groups **Chroma correction** and **Luma correction**). Spatial mask filtration using the parameter group **Mask Filters** and balancing the actor color in the **Alpha correction** parameter group for elimination of fringe effects is described above in section 2.4.

In chapter 2 other elements of dialog, in particular, the input image frame at all stages of keying building (see 2.1) is also described. Except for those described in section 2.3, the toolbar has the following buttons.

-  Automatically adjusts keying parameters by analyzing the frame shown in the **Input** panel. To capture a new frame, press the button .
-  This is used to select a background color from the **Input** image. After clicking on this button, move the cursor to the **Input** image and to click above a pixel that is in the desired background color. **Background color** parameters are discussed more fully below (see 4.1).
-  Show/hide *3D-statistics* dialog (see 4.1).

4.1 Mask Building. Use of Color Space Ellipsoids

Separation of the background color from the actor color is carried out in color space **YUV** by using two ellipsoids with a common center (Figure 12). Colors outside of the external ellipsoid (known as actor colors) will be opaque in the input video. In the space between ellipsoids is the transparency colors. The degree of mixing between the actor and background is reflected by how smoothly changes from opacity at external sides of the transparency colors to area near the internal ellipsoid which contains the background colors. The common center contains the colors most typically in the background. The area covered by the internal ellipsoid is background colors produced as a result of irregularity of illumination and noise. Coordinates of the center are in the group **Background color: Y** – value of brightness, **U** and **V** – color components.

Parameters for the group **Ellipses** determine the sizes of ellipsoids. In the right part of dialog are two windows showing sections of color space **YUV**, which are based on the displayed common center. In the top window the value of brightness **Y** is fixed. The dotted lines show projections of axes **U** and **V**. Ellipsoids in this window are displayed as circles with the radiuses **Cin** (internal ellipsoid) and **Cout** (external ellipsoid). In the bottom window the section other YUV color space is the section with the axis **Y** and background color is displayed, here the dotted line shows the projection of the axis for the brightness **Y**. The parameter **Yin** is defined as half of the height of internal ellipsoid. For the external ellipsoid half of the height of external ellipsoid is calculated as **Yin*Cout/Cin**.

When the cursor is moved to either the top bottom edge of an ellipse or the common center of ellipsoids the cursor will take the form of a hand . When the cursor takes the form of a hand, it is then possible to change the ellipsoid's parameters or their center. The ellipse edge in the bottom window can be moved only upwards or downwards, changing thus parameter **Yin**; the center of ellipsoid can be moved to any side.

Pressing of the right button of the mouse in the color plane causes the display of the local menu, which has commands that can change the scale of the display: **Fit to window**, **Zoom: x1**, **Zoom: x2**, **Zoom: x4**, **Export Key Table...** Option **Export Key Table...** opens the standard *Save As* dialog. From the *Save As* dialog it is possible to save the current state of the key table to a file with the extension *.kkt for further use.

Based on the initial masking and keying parameters, the mask and result of applying the mask with the chosen image are shown on panels **Mask** and **Result** (Figure 8). The background colors in the mask at the correct adjustment should be black, and colors of actor should be white. Presence of shades of grey in the actor mask means colors of in the background are being added to the mask. This can occur, for example, if a reflection of the background color hits the actor. If definition of colors of a background by the ellipsoids is close to the optimum, they it can be eliminated from the mask by color correction (see 4.3).

4.2 Frame Colors Distribution Statistics

Pressing the mouse button anywhere above the frame image opens a window displaying sections of color space (see 4.1) for the color of the pixel where the mouse cursor is positioned. On planes for color space sections, the amount of the color in the captured video frame is designate by grey gradations. The darker shade of grey, the more pixels with specified color of the pixel there are in the captured video frame. Changes for statistics are shown by sliding the following regulator between YUV windows .

The toolbar button  of the *KeyConfigPro* dialog shows/hides the *3d statistics* dialog (Figure 13). In this dialog the ellipsoids and colors statistics for the frame are displayed.

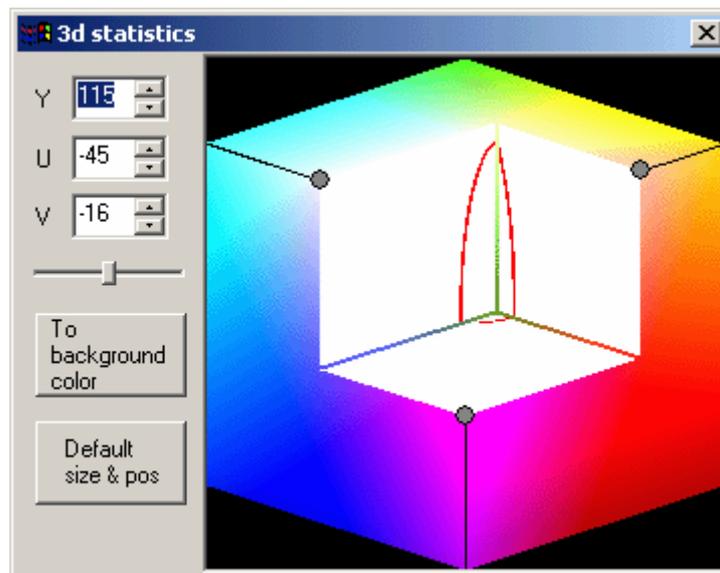
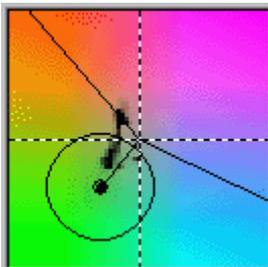


Figure 13. 3D-statistics dialog

In dialog *3d statistics* parameters **Y**, **U** and **V** are the coordinates of the internal point of the «cut out» shown in figure 13. These values can be changed by moving the grey points on the border of a color cube. Clicking on the button **To background color** sets in fields **Y**, **U** and **V** the values of the ellipsoids center, i.e. parameters for the group **Background color** of the dialog *KeyConfigPro* (see 4.1).

4.3 Color Correction

The groups **Chroma correction** and **Luma correction** of the *KeyConfigPro* (Figure 12) contain the color correction parameters. Color correction is used to remove any mixed in background colors from actor in the video image. For example, on transition borders between actor-background and in places where light reflected from the background falls. To adjust color correction properly, the parameters for mask building (the center and the ellipsoids sizes) need to be picked correctly.



For color correction the color space is separated into two parts by two half-planes, which are perpendicular with planes **UV**. The crossing line of these half-planes is in a plane, which passes through the ellipsoids center and axis **Y**. On plane **UV** in the figure at the left, a line radiate out from the center point of the ellipsoid connecting to the crossing point of the dotted line axes.

From this straight the **Angle-** (clockwise) and **Angle+** (counter-clockwise) are counted in degrees. These Angle values can be edited in the group **Chroma correction**. Arms of the angles can also be altered with the mouse

button when the cursor takes the form of a hand . By changing the parameter **Offset** it is possible to displace the point of the arms beginning at the crossing axes (from axis **Y** in space), to distinguish from grey colors. For example, by using a small amount of displacing, the arms begin further from the ellipsoids center; it is then possible to restore the natural light color on the actor's hair. In the above figure **Offset = 0**, and the angle values are approximately 100 degrees.

All colors, within the area of the ellipsoid center, close colors in the background are replaced by the nearest colors from the area on border of sector. Colors in other areas remain constant, i.e. those not exposed by color correction. If on the actor there are colors, which should be saved, but they are within the color correction area, it is possible to change the color correction parameters so they are preserved. It is possible to completely switch off color correction by setting the values **Angle-** and **Angle+** to equal **0**.

Besides the color correction, the algorithm provides correction for the brightness of the colors, which are inside the color correction sector. Brightness correction is executed by changes to the parameters for the group **Luma correction**. Parameter **Ky(%)** defines the amount of brightness correction. Value **0** cancels brightness correction. Value of **100%** alters the brightness to all colors, whose

brightness is lower than background brightness to black color, and all colors, whose brightness is higher than background brightness – to white color. The recommended value is about **30%**.

Parameters **Dmin** and **Dmax** limit brightness correction in order to reduce noise influence. If the difference between brightness value of the current color and brightness of the ellipsoids center, i.e. background brightness, does not exceed the value of **Dmin**, then brightness correction is not executed. If the brightness difference is between the limits from **Dmin** up to **Dmax**, the brightness correction is proportionally increased up to specified value **Ky(%)**. It is recommended to set value **Dmin** to allow for a bit more amplitude of background colors noise, i.e. about equal to value **Yin**. Value **Dmax** should exceed **Dmin** by approximately 2-3 times.

4.4 Recommendations

The sizes of the internal ellipsoid **Cin** should exceed the noise level on the appropriate axes. As a rule, the noise level of brightness is higher than the noise level for color, therefore value **Yin**, as a rule, exceeds value **Cin**.

As the common image brightness is altered, for the majority of cameras to produce the fewest change colors of the full image (including background color), it is desirable to increase the size of the internal ellipsoid. To reduce changes to background color by the camera it is desirable to switch off all automatic adjustments in the camera, such as white color balance, auto-focus and others.

The external ellipsoid as a rule is not involved with the axis **Y**, as grey colors (all colors from black up to white), are present on any actor. Small differences of the parameters **Cin** and **Cout** can result in the creation of sharp transitions between the actor–background. It may result in tremors of the actor's edges. It is desirable, that the distance from the background color (the center of ellipsoids) up to axis **Y** exceeded noise level as a minimum by three times.



*After making all the parameters settings you always can check the result in the dialog **KeyConfigPro** in the panel **Result** (Figure 8, at the right).*

To load the keying parameters to the board you can press the button  on the toolbar of the dialog **KeyConfigPro**.

5 Key from Actor Algorithm

This variant of keying building shown in the dialog *KeyConfigPro* (Figure 14), is available by clicking on the button **Configure**, if in the group **Artist/Key** of the Main window of *FDKeyConfig* (Figure 1) option **Key from Actor** is selected.

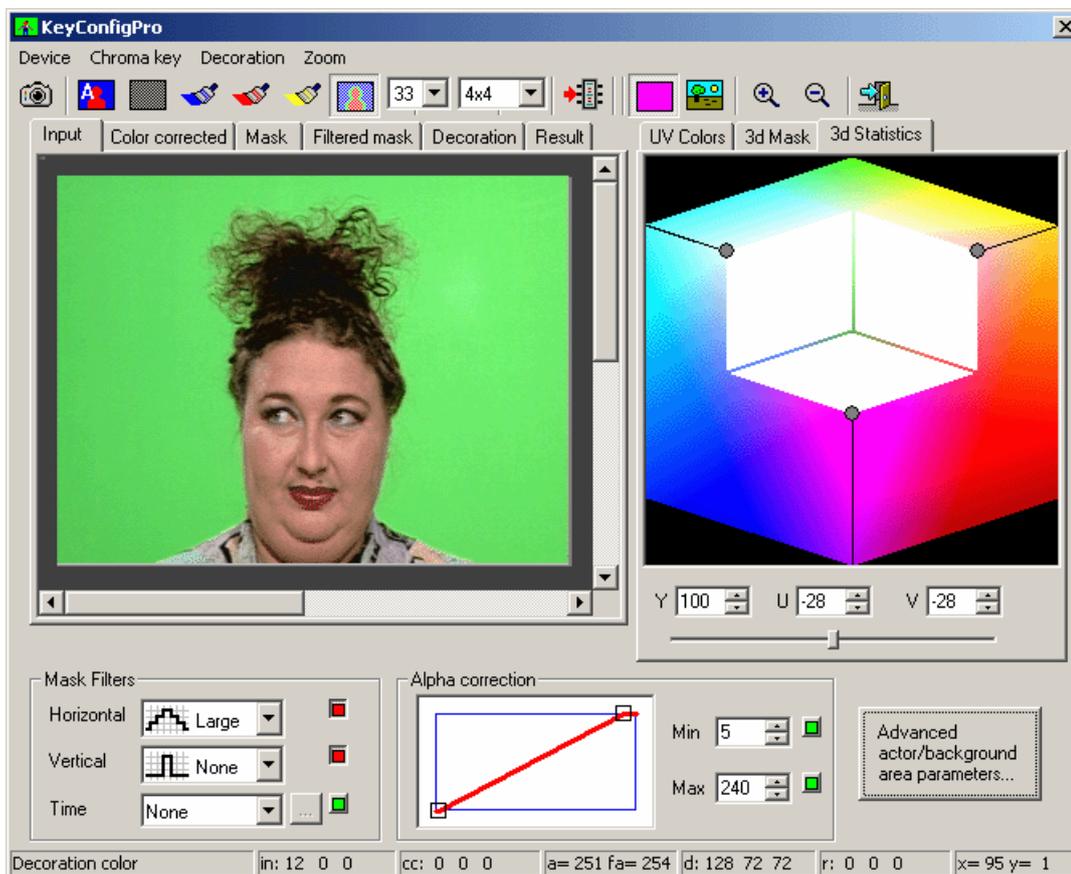


Figure 14. Dialog *KeyConfigPro* for algorithm *Key from Actor*

5.1 Mask Building by Video Frame

Mask building occurs by indicating background colors and actor colors on the captured video frame on the panel **Input**. To specify background colors, it is necessary to click the button with a dark blue brush . Then the cursor should be moved to the background area on the frame image and, while depressing the left button of the mouse, paint over the background in the frame with the brush see Figure 15.

When the button of the mouse is released, all areas to be included in background colors will be tinted by a dark blue color. If there are no tinted dark blue background parts, they must be painted over using the above procedure. The size of a brush can be chosen in the drop-down list on the toolbar to the right of yellow (last) brush. The background colors can be erased (de-selected) by pressing the right button of the mouse, for example, where the actor touches the background.

To exit background color selection mode, either click on the button with a dark blue brush  again or click on another brush button.



Figure 15. The indication of a background colors (at the left) and the actor colors (at the right) in dialog *KeyConfigPro*

In addition to defining background colors it is necessary to select the actor colors by pressing the button with a red brush  to paint over the actor colors (Figure 15). Then with the yellow brush  it is possible to execute color correction, details of this procedure are discussed in section 5.2 above.

To find which colors are painted over, click on the button , then pixels in the **Input** frame will be tinted: pixels with the background color will be dark blue, pixels for the actor color will be red, with any color correction pixels – green. Grey color is mixed with others pixels. For example, in Figure 15 (on the right) the indication of actor colors follows the first «stroke» of brush; the differentiation into background colors and actor colors still is not present. Pressing the button  resets the keying adjustments. All colors, except for a trace of a brush grey color are intermixed. To see the effect of painting with the color brushes, compare Figure 15 with Figure 14, where all brush buttons have been applied to the image. On Figure 15 (at the right) the indication of the actor colors has only just begun, with a trace of the brush in red. The majority of actor image remains grey, however if the background colors were already adjusted, then pixels for these colors would be tinted dark blue.

During filming or capture, new colors can appear in the frame. They will not be designated as an actor color. When this occurs, the subject and/or object comprised of colors, which are greatly different from those colors designated as actor colors, will appear transparent. Whenever it is necessary to add colors to the actor palette, simply paint over. For example, if a new image is captured with the new frames (button) . It is also possible by clicking on the red brush button to choose all colors in the **UV Colors** window that are a great distance from the background colors so they will be less transparent. In Figure 14 notice the green background are tinted dark blue in Figure 15. After painting colors click on the button  to illuminate the painted over colors.

In the **Mask** panel it is possible to see result of designated colors as part of the mask building process.

5.2 Color Correction and Mask Filtration

After color designation for mask building in places of transition between the actor/background there can be background colors on the actor. This can occur due to illumination of the actor by the light reflected from the background. To see any background colors on the actor the image should be viewed in the **Result** panel. The example of the transition between an actor/background before and after color correction is shown on Figure 16.



Figure 16. Edge of the actor image against the background before color correction is in the left picture and after color correction on the right

For color correction it is necessary to choose an appropriate frame size for the display and to then reduce the size of color brushes (see 5.3). At the pressed button with yellow brush  it is necessary to paint over the background colors on the actor (Figure 17). If the background illumination is still visible, the operation with the yellow brush should be repeated several times for optimum results. If the result of this color correction includes colors far from transition. It is possible to erase the effect of color correction pixels in the image (see Figure 17), by pressing the right mouse button while passing the cursor over these pixels.

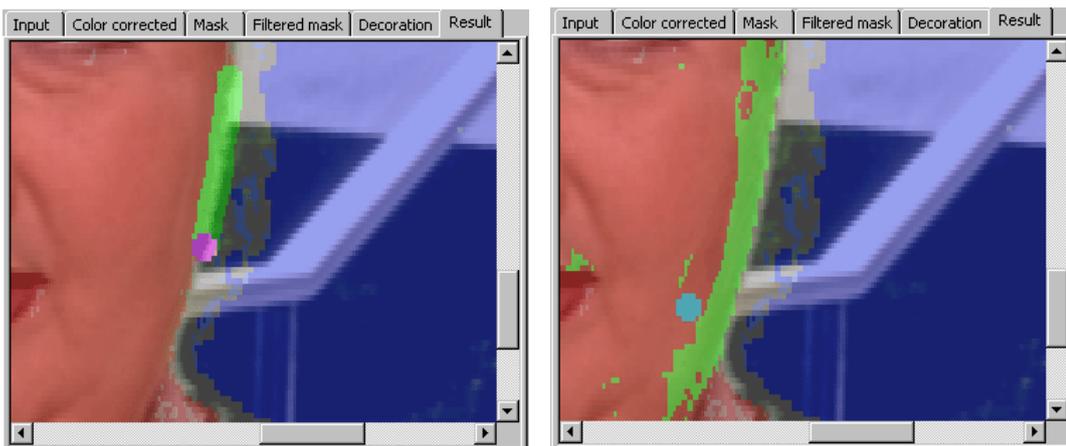


Figure 17. «Painting» of transition (at the left) and reconstruction of the actor colors after superfluous color correction

By using the parameters in groups **Mask Filters** and **Alpha correction** (see 2.4) you can more precisely create a filter mask and improve the transition between the actor and background.

5.3 Toolbar and Menu Commands

In chapter 2 above, tools for keying building (see 2.1), using groups **Mask Filters** and **Alpha correction** (see 2.4) are described.

The *KeyConfigPro* dialog (Figure 14) contains the menus **Device**, **Chroma key**, **Decoration** and **Zoom**. Buttons on the toolbar duplicate the majority of commands of these menus. These buttons are described in section 2.3.

Menu **Device** has four commands: **Capture input image** () , **Load parameters into device** () , **Export key table**, **Input video...**. The option **Input video...** opens the dialog for video settings (see 1.2 and 1.3). Options on the **Decoration** menu allow selecting of decoration with the image and the background color. Commands on the **Zoom** menu allow change to the image size.

Below the toolbar buttons are described some which are duplicated by commands of the menu **Chroma Key**.



Auto create keying. Automatically adjusts keying parameters, analyzing the frame in the panel **Input**. Any previous adjustments are reset with this action. Note, the appropriate commands of menu **Chroma Key** automatically choose either only actor colors or only background colors (see below).



Clear key table. Resets all keying settings, allowing for adjustments anew. If it is necessary to correct adjustments it is possible to clear either all or a portion of the colors in the panel **UV Colors** (see 5.4) by manually adding or removing colors from the frame (see 5.1).



Select background colors. Allows selection of background colors of in the frame image on the panels **Input**. For this purpose it is necessary to press the left mouse button and to paint over the background in frame (Figure 15). More in details are in section 5.1.



Select actor colors. Indicates the actor colors (see 5.1).



Select corrected colors. Allows color correction (see 5.2).



Show/hide selected colors. Switches display of painted over colors (see 5.2).



Brush size (pixels). Allows selection of the brush size for painting over the image.



Brush size in color space (UV x Y pixels). The size of the area in the 3D color space **YUV** around the frame color pixel selected in the image. Each color painted over on the image is selected and its neighbors in this color area.

The following toolbar buttons are NOT duplicated on the menu **Chroma Key**.

Auto select background colors

Automatically chooses background colors. Any previous settings are reset.

Auto select actor colors

Automatically paints over an actor color. Any previous settings are reset.

Auto adjust keying parameters

Automatically adjusts parameters of the groups **Mask Filters** and **Alpha correction** (see 2.4).

Select colors... Opens dialog *Add colors* (Figure 18).

In the dialog *Add colors* (Figure 18) it is possible to add colors to either the range of actor color (**Actor's color**), the background colors (**Background's color**) or to make color correction (**Corrected color**). In the drop-down list it is possible to select the size of area in 3D color space around the color with coordinates **Y** (from 0 up to 255), **U** and **V** (from -128 up to +128). Buttons **Black** and **White** set values appropriate to black and white colors. Pressing on the button **Add** adds area. After change adjustments are made and again press button **Add**. Button **OK** closes dialog, and any changes to the key table is saved.

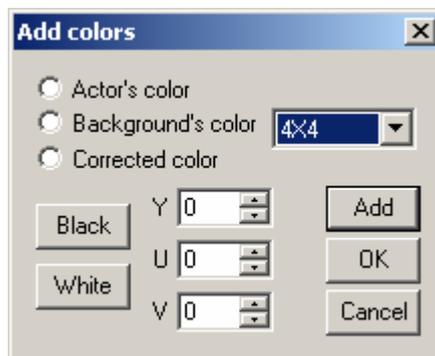


Figure 18. *Add colors* dialog

5.4 UV Colors and Colors Statistics

In the panel **UV Colors**, the section of color space with a constant brightness (plane of coordinates **UV**) is shown. On this plane the projection of the color indicated by the cursor on the frame image is shown. Exact value of all coordinates is displayed in the condition line (see 2.2). If the option **Statistics** is activated, the distribution of colors on the captured frame is displayed as gradations of grey color. The darker the color, the more frequently pixels with the color specified by the coordinates in the condition line occur. With the slider  it is possible to change contrast in the of statistics display.

Actor/background colors displays the background colors as dark blue, the actor colors as red, and corrected colors as green. If one of the brush buttons is pressed, it is possible to edit the appropriate colors by painting over or erasing areas on plane **UV** as the right mouse button is pressed. For example, to add the actor colors absent in the frame, as it is recommended in section 5.1, or to delete color correction to adjust it anew. The parameter **Brush size** sets the brush size for these purposes.

On the panels **3D Mask** and **3D Statistics** the parameters **Y**, **U** and **V** are coordinates of an internal point of the cut out parallelepiped. These values can also be changed by moving the grey points on the edge of the color cube. **Actor/background colors** on the panel **3D Mask** as well as in **UV Colors** operates display of colors and switcher **Mask** controls display of distribution of mask values by the gradations of grey color. On the panel **3D Statistics** the regulator changes contrast of statistics display.

5.5 Advanced Algorithm Settings

The button **Advanced actor/background area parameters...** in the dialog *KeyConfigPro* (Figure 14) opens the dialog *Advanced Actor/Background Area Parameters* (Figure 19).

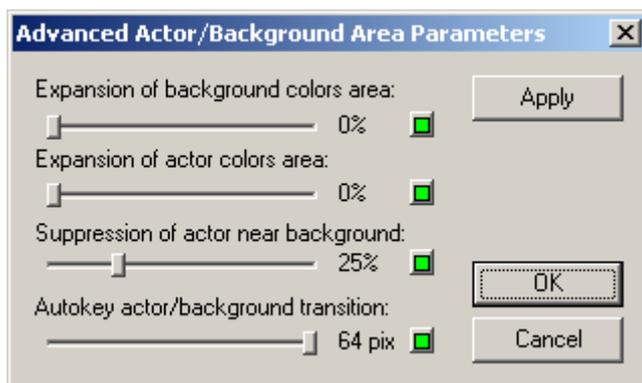


Figure 19. *Advanced Actor/Background Area Parameters* dialog

To regulate manually parameters in the dialog *Advanced Actor/Background Area Parameters* (Figure 19) it is necessary to understand the algorithm details and carefully analyze the input video colors. Therefore it is recommended to adjust them, after pressing the button for automatic settings . It is not required to set anew these parameters if the input noise level has not changed, for example, if for example, a video tape recorder is connected as an input instead of a live video camera.

The slide regulators **Expansion of background colors area** and **Expansion of actor colors area** set additional expansion of the background colors and actor colors areas, which are displayed in plane UV by dark blue, and dark red colors respectively.

Suppression of actor near background sets area of the actor next to the background in which designation of an actor color is ignored, i.e. even the painted over areas of the actor in these areas will be always transparent. At increase of a noise level value of this parameter should be increased accordingly.

Autokey actor/background transition sets width of the transition between the actor and a background to which the automatic setting of keying parameters in pixels on the captured image is applied.