UE VIDEOVERARBEITUNG 2017W

EXERCISE 2

GENERAL

The following filters have to be implemented for the first exercise:

1) **effect_add_text.m**
2) **effect_irising_in_out.m**
3) **effect_soft_focus.m**
4) **effect_fast_motion.m**

The filter functions have to be implemented in the above-mentioned files. All filters have a different amount of parameters, which control the properties of the filters. You can expand the number of parameters for every filter but you should be able to justify each new parameter. During the implementation of each filter, meaningful parameter values that result in authentic looking results have to be found.

All the files which are needed for implementing each filter (effect_*.m) are in the /src directory. By calling the function exercise2.m all implemented filters are applied on an image sequence.

Example 1: **exercise2('../images/', '../output/');**
applies all filters to the frames frameXXXX.png in the directory '../images' and stores the resulting images in the directory '../output'.

Example 2: **exercise2('../images/', '../output/', start_frame, end_frame);**
processes only frames 'start_frame' to 'end_frame'.

Example 3: **exercise2({'../images/','../images/'}, '../output/');**
reads all images from 2 input directories '../images1' and '../images2' (in this order) and applies the filters to all images.

Example 4: **help exercise2**
displays help text for each file in the command window (in this example for the file exercise2).

SUBMISSION

The deadline for exercise2 is **27.11.2017**.

The submission must include:

- Commented Matlab source files of all filters.
- Following fields have to be completed at the beginning of each filter:
    - Short description of the implementation.
    - Short summary of the physical background/reason of the effect.
      For example: What causes Sepia discoloration?
    - Meaningful parameter values.
- One picture of every filter that demonstrates the operation of the filter.

You will get points for

- Your implementation
- The description of your filters
- The mention of meaningful parameter values

All files have to be uploaded as a .zip file (UE_GROUPx_EXERCISEy.zip) on TUWEL. Only one submission is needed per group.

NOTE: Check your submission for completeness because points will only be given to the submitted files!

GENERAL INFORMATION

DATA CONVERSION

You can use the function convert_video_to_images to extract frames from a video of your choice and save them as .png files. Be warned that this process might lead to a large consumption of disk space if the movie is very long.

Furthermore, the function convert_images_to_video does the opposite and combines all images from a directory into a movie. This can be used to create the final movie after the filters were applied.

IMPLEMENTATION OF THE FILTERS

All exercises are handed out with a Matlab framework. In this exercise the framework consists of the file exercise2.m. The framework automatically takes care of reading, saving and displaying the images. To each filter in this exercise, the struct video will be passed as the first argument. It has the following structure:

video.original	Original image in RGB
video.filtered	Filtered image in RGB
video.original_frame_nr	Frame number of this frame in the input directory (is not modified by any buffer!)
video.frame_nr	Frame number of this frame (can change if frames are inserted/removed by a filter)

When implementing a filter the following has to be taken into account:

1) Each filter works on the field video.filtered and saves the result there again. In this way, all filters can work sequentially on the same image.
2) To provide access to previous frames a frame buffer is installed. Thus, two previous frames can be addressed. You can access the current frame over video.frame(1).filtered, the previous one over video.frame(2).filtered.

video.frame(1).filtered	current frame i
video.frame(2).filtered	frame i-1
video.frame(3).filtered	frame i-2

3) You can perform any conversion of the input information. However, EVERY filter MUST save its results in the RGB format. Thus, no distinction and multiple implementations for different image and color formats are needed and the filters can be executed in an arbitrary order.

Example:

```
function filter_test(video)
  img = video.frame(1).filtered;
  …
  video.frame(1).filtered = img;
end
```

In order to pass information from one filter to another, the struct video will be expanded in the course of this lecture. Temporary filters, which operate on multiple images, require knowledge about the status of the filtering (What has been done so far? What has to be done in this step?).

HINT 1:

You can insert any additional fields in the struct video if you need them for the proper working of the filters.

HINT 2:

Matlab manages the images in a transposed way, which means that the image point (x,y) corresponds to the value (y,x) in the image structure. Each image in video.filtered and video.original has the format [H x W x C], where H represents the image height, W the image width and C the color depth. For the RGB color space C = 3 (R/B/G).

Here are some examples showing how to access the color information of the images:

Example 1:

```
r_info = video.filtered(4,3,1);        % x = 3, y = 4, c = 1
r_info = 34                            % red color information at the position (3,4)
```

Example 2:

```
rgb_info = video.filtered(4,3,1:3)     % x = 3, y = 3, c = 1:3
rgb_info = [34 12 120]                 % RGB values at the position (3,4)
```

Example 3:

```
r_info = video.filtered(1:10,1:10,1)   % x = 1:10, y = 1:10, c = 1
r_info = 10 x 10 matrix                % red color information at the positions (x = 1:10, y
                                                                                  1:10)
```

HINT 3:

Try all the filters in an arbitrary order to verify correct functioning.

Useful MATLAB links:

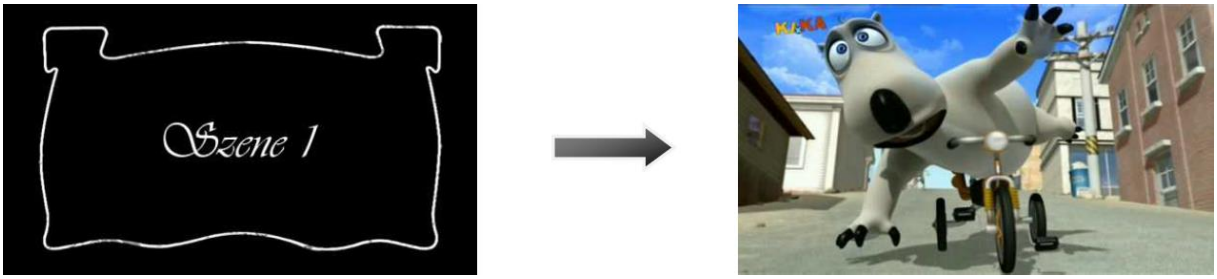
https://de.mathworks.com/help/matlab/ref/videoreader.html

https://de.mathworks.com/help/matlab/ref/videowriter.html

EFFECT 1: EFFECT_ADD_TEXT

GENERAL INFORMATION

As old movies did not support speech, showing text was a commonly used technique to overcome this gap. In this task, inserting text descriptions to the original sequence has to be realized.



IMPLEMENTATION

For this task, the following functions have to be implemented:

Function:	effect_add_text
Input:	<video> struct, <text> cell with the effect parameters
Output:	<video> struct with modified list of input files (video.input_files)
File:	effect_add_text.m

1) Read the filenames, positions and durations of the text effects.
2) Copy the filenames of the text frames to the desired positions in video.input_files
3) Take care that frames are shifted correctly and do not get lost.

The effect is called before the processing of the frames and inserts the appropriate images in the list video.input_files. The variable "text" contains an array with the filenames of the images, the temporal position (relative to the original order of the input frames) of the text frames and the duration in frames.

text{1..N}{1} = filename of the text image
text{1..N}{2} = number of the original input frame before which the text should be added
text{1..N}{3} = duration of the text scene

It is possible to define several positions where text frames should be added (1...N).

EXAMPLE

effect_add_text(video, {{'../text/scene_text1.png', 1,3},{'../text/scene_text2.png',3,3}, {'../text/scene_text3' ,png,30,3}};

This call adds the image 'scene_text1.png' three times before frame 1 in the list video.input_files.

Furthermore, it adds the image 'scene_text2.png' three times before frame 3 and the image 'scene_text3.png' three times before frame 30.

ATTENTION: The position of the text frames always refers to the original images in the list video.input_files. If the original frame with the number text{i}{1} is not found in the list, the effect does not gets applied at this point.

Original order: I1, I2, I3, I4, I5, I6

After calling the above-mentioned command, the sequence changes to the following one:

T1, T1, T1, I1, I2, I3, **T2, T2, T2**, I4, I5, I6

Ix is the i-th input image and Tx is the t-th text image. Since frame 30 is not present in the original list, the affect is not applied.

EFFECT 2: EFFECT_FAST_MOTION

GENERAL INFORMATION

By cutting away, some frames showing non-relevant and tedious actions were shortened in old movies. This effect is also used in modern movies and is called time-lapse.

IMPLEMENTATION

For this task, the following functions have to be implemented:

Function:	effect_fast_motion
Input:	<video> struct, <drop> cell with the effect parameters
Output:	<video> struct with modified list of input files (video.input_files)
File:	effect_fast_motion.m

1) Read the start frame and the old and new duration of the sequence.
2) Find the original images in the list video.input_files the effect should be applied to.
3) Identify the images of the sequence that should be deleted.
4) Delete the images from the list video.input_files

This effect takes a certain area of the video (e.g. frames 1 to 15) and reduces the number of frames by randomly dropping some of the frames. Similar to the 'text' structure in effect_add_text the structure 'drop' contains the start frame and the number of frames the effect should be applied to. Moreover, the amount of frames the scene should get shortened to gets specified:

drop{1..N}{1} = Start frame where the effect should be applied (refers to the initial number of frames in the input list video.input_files and does not consider inserted text frames by effect_add_text).
drop{1..N}{2} = Number of frames the effect should get applied to.
drop{1..N}{3} = Number of frames the scene should get shortened to.

EXAMPLE

A sequence consists of 6 original frames and 6 frames of two text sequences (2 sequences, each with 3 pictures).

T1, T1, T1, I1, I2, I3, **T2, T2, T2**, I4, I5, I6

Calling the effect with effect_fast_motion(video, {{1,3,2}}) applies the effect (starting at frame 1) to 3 original frames (frames 1-3) and reduces the number to two by randomly dropping one frame. In this example frame I2 gets rejected:

T1, T1, T1, I1, I3, **T2, T2, T2**, I4, I5, I6

USEFUL MATLAB COMMANDS

rand, sort, find

REFERENCES:

http://en.wikipedia.org/wiki/Time-lapse

EFFECT 3: EFFECT_IRISING_IN_OUT

GENERAL INFORMATION

To make the transition between scenes more exiting, the iris was closed at the end of a scene and then reopened. This effect should be replicated here.

IMPLEMENTATION

For this task, the following functions have to be implemented:

Function:	effect_irising_in_out
Input:	<video> struct, transition_size, min/max_size, dist_x/y, <fade> cell with the effect parameters
Output:	<video> struct with modified frame(1).filtered
File:	effect_irising_in_out.m

To implement this function the already existing function filter_iris should be used. Therefore, effect_irising_in_out uses the same parameters. In addition, a structure <fade> is passed indicating at which positions in the sequence a fade_in/fade_out occurs and how long it lasts:

> fades{1..N}{1} = The frame number where the fade starts. This effect works on all frames (also on the inserted text frames).
> fades{1..N}{2} = Duration of the fade_in/fade_out process. During this period the iris should be closed completely and then reopened to the default value.

1) Determine the start and end frames of the effect.
2) Determine appropriate values for the parameters transition_size, min_size, max_size, dist_x, dist_y. When no fading in or fading out occurs the filter_iris should get called with these default settings.
3) In addition, the iris should get closed and reopened at the desired points in the video. If the effect was selected with 10 images, the effect should close the iris in about half the time (5 frames) and reopen in the remaining five frames back to the default value. The iris must be closed completely in the middle of the duration. You can make the transition linearly but also use other function (e.g. sinus). Calculate the size of the iris for each frame and call the filter filter_iris with the obtained values.

USEFUL MATLAB COMMANDS:

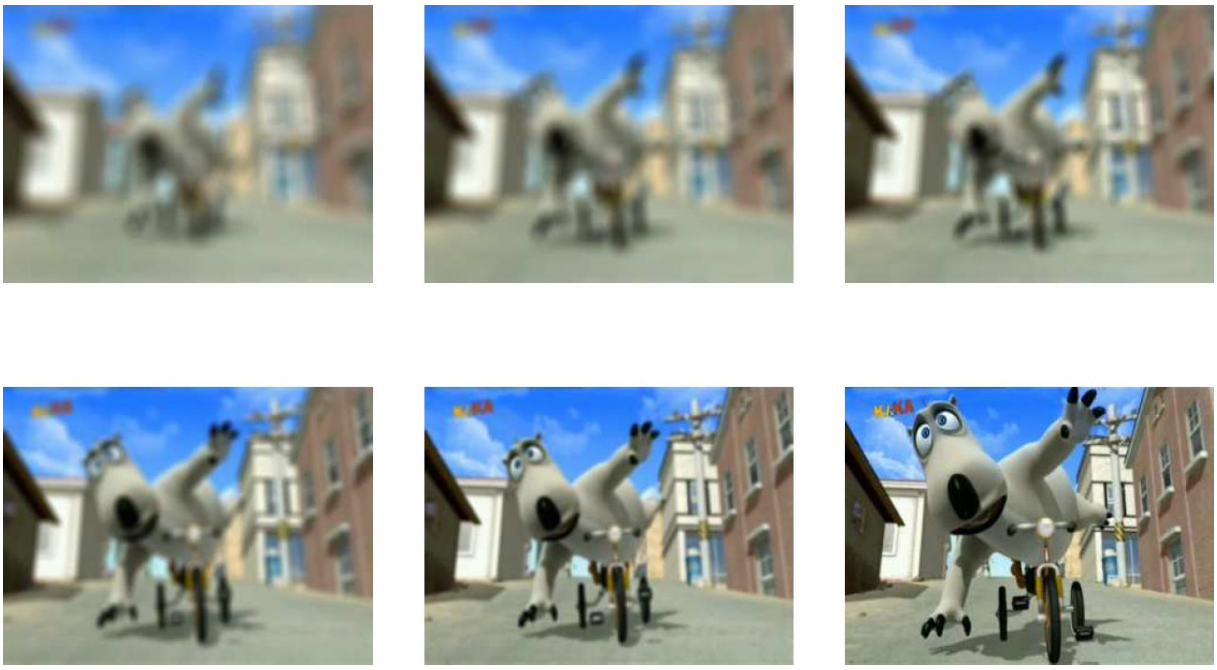
filter_iris

NOTE: The frame number showing the start of the effect refers to the video.frame_nr of each image also including text frames.

EFFECT 4: EFFECT_SOFT_FOCUS

GENERAL INFORMATION

This effect was used to draw attention to certain points in the movie (e.g. in romantic moments when hero and heroine are seeing each other for the first time in months the scene gets blurred for a moment).



IMPLEMENTATION

For this task, the following functions have to be implemented:

Function:	effect_soft_focus
Input:	<video> struct, blur factor, <focus> struct
Output:	<video> struct with modified frame(1).filtered
File:	effect_soft_focus.m

A value blur_factor is passed, which represents the maximum degree of blurriness. The transition between the fully blurred image (start frame) and the unblurred image (end frame) should be fluent. The struct <focus> indicates at which positions the blur starts and how long it takes:

fades{1..N}{1} = The frame number where the effect starts (biggest blur factor).
fades{1..N}{2} = Duration of the blurring.

1) Determine start and end frames of the effect
2) Determine the blurriness of the image based on the distance to the start frame.
3) Pass the calculated blur factor to the filter_unsharp function or use the MATLAB functions fspecial and imfilter to blur the image accordingly.

USEFUL MATLAB COMMANDS:

filter_unsharp, fspecial, imfilter