

Question 1: Image Extraction at Best Quality

Qn.1A, if you used the supplied replay software:

please save and submit your results using the filename:

'Q1A_ReplayDescribed_YOURINITIALS' or

Please specify (i) the investigation method used to a) examine the video sequence and b) extract and examine the frame, and (ii) all steps executed. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

Q1A_ReplayDescribed_ID09.jpg

Amped FIVE Report

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 32 bit

Exported Images

Chain 4

4. [Video Loader](#): *Loads a video from file. ([File](#))*
5. [Image Writer](#): *Writes the current image to a new file. ([File](#))*
7. [Super Resolution](#): *Merges all frames to improve the resolution of the image.*
8. [Optical Deblurring](#): *Corrects the blur of objects that are out of focus (big blur).*
9. [Contrast Brightness](#): *Adjusts the contrast and brightness values of the image.*
10. [Averaging Filter](#): *Smooth the image with an averaging filter.*

Chain 4

4. Video Loader

Loads a video from file.

Details:

The *Video Loader* tool renders an video file that can be encoded in a variety of standard formats to a sequence of bitmaps that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive
TEST/Q1/XVis_TestE_7mDistance_HighElevation/20140508/184505/NORMAL/[000001].drv-converted.avi

Path of the video to load.

- **Video Engine:** FFMS
Video decoder to use.
- **Original File:** Not used.
Original video file that has been converted from a proprietary DVR format.

5. Image Writer

Writes the current image to a new file.

Details:

The *Image Writer* tool encodes the current frame to the specified file with the chosen format.

Parameters:

- **File:** ../../../../Desktop/SFive
TEST/Q1/XVis_TestE_7mDistance_HighElevation/20140508/184505/NORMAL/[00000
1].drv-converted-150429085233.tif

Path of the image to save.

- **Format:** Tiff
Format used to encode the image file.
- **Quality:** 90
Quality of the image to save (the bigger is the better is).
- **Frame Position:** 0
Position of the saved frame in the input video.

7. Super Resolution

Merges all frames to improve the resolution of the image.

Details:

The *Super Resolution* filter applies a sub-pixel registration to all the frames of a video, then merges the motion corrected frames together, along with a deblurring filtering. If a *Selection* is set, then the selected area will be optimized.

Parameters:

- **Zoom:** 4
Zoom factor for the output image.
- **Iterations:** 10
Number of deblurring steps.
- **Selection:** 0 0 0 0

Region of the image to optimize.

References:

- Hiroyuki Takeda, Peyman Milanfar, Matan Protter, and Michael Elad. 2009. Super-resolution without explicit subpixel motion estimation. *Trans. Img. Proc.* 18, 9 (September 2009), 1958-1975. DOI=10.1109/TIP.2009.2023703
<http://dx.doi.org/10.1109/TIP.2009.2023703>

8. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 7
The size of the point spread function.
- **Noise:** 0.0079
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, *Two-Dimensional Signal and Image Processing*, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall, pp. 276-284, 1989.

9. Contrast Brightness

Adjusts the contrast and brightness values of the image.

Details:

Contrast Brightness maps the input image values to the output image values according to a linear transformation. The mapping involves two operations, multiplication and addition with a constant respectively controlled by the *Contrast* and *Brightness* parameters. Increasing (or reducing) the *Contrast* makes the difference between light and dark areas appears sharper (or smoother). Similarly, increasing (or decreasing) the *Brightness* makes the overall image appear lighter (or darker). These changes can improve the definition of excessively dark or light areas in the image, but will tend to saturate the image if taken too far.

Parameters:

- **Contrast:** 3
Extends the intensity difference among pixel (linear gain).
- **Brightness:** -4
Adds or subtracts an offset to image pixels (bias).
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

10. Averaging Filter

Smooth the image with an averaging filter.

Details:

The *Averaging Filter* performs a spatial linear filtering of the image. The pixel value of the output image is computed by averaging the values of the input image in the neighborhood of the corresponding input pixel.

Parameters:

- **Size:** 5
Size of the filter kernel in pixels.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 244-245, 1989.

Qn.1A, if you used another method:

Please save and submit your results using the filename: 'Q1A_OtherMethod_YOURINITIALS'

Please specify (i) the investigation method used to a) examine the video sequence and b) extract and examine the frame, (ii) all tools used, and (iii) all steps executed. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

Qn.1B, if you used the supplied replay software:

Please save and submit your results using the file name: '

Q1B_ReplayDescribed_ID09.jpg

Amped FIVE Report

Exported Images

Chain 3

3. Image Loader: *Loads an image from file. ([File](#))*
4. Averaging Filter: *Smooth the image with an averaging filter.*
5. Contrast Brightness: *Adjusts the contrast and brightness values of the image.*

Chain 3

3. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive TEST/Q1/B/001.png

The path of the file to load.

4. Averaging Filter

Smooth the image with an averaging filter.

Details:

The *Averaging Filter* performs a spatial linear filtering of the image. The pixel value of the output image is computed by averaging the values of the input image in the neighborhood of the corresponding input pixel.

Parameters:

- **Size:** 5
Size of the filter kernel in pixels.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 244-245, 1989.

5. Contrast Brightness

Adjusts the contrast and brightness values of the image.

Details:

Contrast Brightness maps the input image values to the output image values according to a linear transformation. The mapping involves two operations, multiplication and addition with a constant respectively controlled by the *Contrast* and *Brightness* parameters. Increasing (or reducing) the *Contrast* makes the difference between light and dark areas appear sharper (or smoother). Similarly, increasing (or decreasing) the *Brightness* makes the overall image appear lighter (or darker). These changes can improve the definition of excessively dark or light areas in the image, but will tend to saturate the image if taken too far.

Parameters:

- **Contrast:** 67
Extends the intensity difference among pixel (linear gain).
- **Brightness:** 72
Adds or subtracts an offset to image pixels (bias).
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

Please specify (i) the investigation method used to a) examine the video sequence and b) extract and examine the frame, and (ii) all steps executed. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

Use any space you need

Qn.1B, if you used another method:

Please save and submit your results using the filename 'Q1B_OtherMethod_YOURINITIALS'

Please specify (i) the investigation method used to a) examine the video sequence and b) extract and examine the frame, (ii) all tools used, and (iii) all steps executed. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

Qn.1C

Frame Size of source file recording used in Qn.1A				Frame Size of source file recording used in Qn.1B			
2880	x	1152	pixels	910	x	572	pixels

What are your conclusions about the raw, encoded quality of the provided video frame/sequence in Q1A and Q1B?

Question 2: Super-Resolution from supplied sequence of 249 .bmp files

Please select your best result, i.e.: a single best quality super-resolution image:
Please save and submit your results using filename:

“Q2A_SuperRes

1. How have you ingested the material into your enhancement system and super-resolution software tools?
Please detail all steps of any conversion performed including all software tools and settings used. The information you provide should have sufficient detail so that anyone could independently reproduce your results.
2. Please specify all software tools and all Enhancement Filters used (in order) and specific parameter settings; e.g. Super-Resolution Filter (Method? Zoom factor? Number of Iterations? Interpolation?.....)

Use any space you need

- 1.
 - 2.
 - 3.
 - 4.
 - 5.
- Etc

3. Did you select a "region of interest" for directing the super-resolution tool? If so please specify co-ordinates of the region (if used) in the format given by the tool.
4. Did you select any specific frames or image? If so, please provide details of range of frames or specific frames you used.
5. Please provide any other information that would be needed so that others would be able to repeat and reproduce your work.

Use any space you need

Qn.2B

Please select your best result, i.e.: a single best quality super-resolution image:
Please save and submit your results using filename:

“Q2B_SuperRes_ID09.jpg”

Amped FIVE Report:

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 32 bit

Exported Images

Chain 1

1. Video Loader: *Loads a video from file. ([File](#))*
2. Range Selector: *Selects frames of the video within an interval with an optional step.*
5. Local Stabilization: *Stabilizes a shaking video by keeping the current selection steady.*
6. Super Resolution: *Merges all frames to improve the resolution of the image.*
7. Rotate: *Rotates the image.*
13. Crop: *Crops a region of interest of the image.*
14. Contrast Brightness: *Adjusts the contrast and brightness values of the image.*
15. Super Resolution: *Merges all frames to improve the resolution of the image.*
16. Optical Deblurring: *Corrects the blur of objects that are out of focus (big blur).*

Chain 1

1. Video Loader

Loads a video from file.

Details:

The *Video Loader* tool renders an video file that can be encoded in a variety of standard formats to a sequence of bitmaps that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive
TEST/Q2/TestP_7mDistance_MidElevation/TestP_7mDistance_MidElevation.dav-converted.avi
Path of the video to load.
- **Video Engine:** FFMS
Video decoder to use.
- **Original File:** Not used.
Original video file that has been converted from a proprietary DVR format.

2. Range Selector

Selects frames of the video within an interval with an optional step.

Details:

The *Range Selector* tool outputs a video of specific frames that are part of the input video.

Parameters:

- **First Frame:** 1000
First frame of the selection of interest.
- **Last Frame:** 1100
Last frame of the selection of interest.
- **Step:** 1
Take only one frame every Step frames.

5. Local Stabilization

Stabilizes a shaking video by keeping the current selection steady.

Details:

The *Local Stabilization* tool horizontally and/or vertically shifts the different frames of a video in order to correct instability. The offset to be applied is calculated by finding the maximum of the cross-correlation function between each frame and a template, which is obtained by the reference area copied from the reference frame.

Parameters:

- **Selection:** Static Tracking
Reference Selection(s)
0: 0 0 0 0
13: 0 0 0 0
28: 0 0 0 0

43: 0 0 0 0

61: 0 0 0 0

74: 0 0 0 0

79: 0 0 0 0

Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

6. Super Resolution

Merges all frames to improve the resolution of the image.

Details:

The *Super Resolution* filter applies a sub-pixel registration to all the frames of a video, then merges the motion corrected frames together, along with a deblurring filtering. If a *Selection* is set, then the selected area will be optimized.

Parameters:

- **Zoom:** 6
Zoom factor for the output image.
- **Iterations:** 10
Number of deblurring steps.
- **Selection:** 0 0 0 0
Region of the image to optimize.

References:

- Hiroyuki Takeda, Peyman Milanfar, Matan Protter, and Michael Elad. 2009. Super-resolution without explicit subpixel motion estimation. *Trans. Img. Proc.* 18, 9 (September 2009), 1958-1975. DOI=10.1109/TIP.2009.2023703
<http://dx.doi.org/10.1109/TIP.2009.2023703>

7. Rotate

Rotates the image.

Details:

The *Rotate* filter rotates the image by the given angle. If the rotation angle is not multiple of 90 degrees, the selected interpolation algorithm is used, otherwise the original pixel values are only transposed.

Parameters:

- **Angle:** -180
Rotation angle.

- **Resize Image to Fit:** true
If unchecked, the image remains of the original size, although part of the actual data could render outside of the visible area.
- **Interpolation:** Bicubic
Interpolation algorithm.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 253-255, 1989.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 320-322, 1989.
- H.S. Hou and H.C. Andrews, Cubic spline for image interpolation and digital filtering, in IEEE Transactions on Acoustic, Speech, and Signal Processing, vol. 26, pp. 508-517, 1978.

13. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)
0: 721 521 427 624
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

14. Contrast Brightness

Adjusts the contrast and brightness values of the image.

Details:

Contrast Brightness maps the input image values to the output image values according to a linear transformation. The mapping involves two operations, multiplication and addition with a constant respectively controlled by the *Contrast* and *Brightness* parameters. Increasing (or reducing) the *Contrast* makes the difference between light and dark areas appears sharper (or smoother). Similarly, increasing (or decreasing) the *Brightness* makes the overall image appear lighter (or darker). These changes can improve the definition of excessively dark or light areas in the image, but will tend to saturate the image if taken too far.

Parameters:

- **Contrast:** 15
Extends the intensity difference among pixel (linear gain).
- **Brightness:** -24
Adds or subtracts an offset to image pixels (bias).
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

15. Super Resolution

Merges all frames to improve the resolution of the image.

Details:

The *Super Resolution* filter applies a sub-pixel registration to all the frames of a video, then merges the motion corrected frames together, along with a deblurring filtering. If a *Selection* is set, then the selected area will be optimized.

Parameters:

- **Zoom:** 6
Zoom factor for the output image.
- **Iterations:** 10
Number of deblurring steps.
- **Selection:** 0 0 0 0
Region of the image to optimize.

References:

- Hiroyuki Takeda, Peyman Milanfar, Matan Protter, and Michael Elad. 2009. Super-resolution without explicit subpixel motion estimation. *Trans. Img. Proc.* 18, 9 (September 2009), 1958-1975. DOI=10.1109/TIP.2009.2023703
<http://dx.doi.org/10.1109/TIP.2009.2023703>

16. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 3
The size of the point spread function.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

1. How have you ingested the material into your enhancement system and super-resolution software tools?

Please detail all steps of any conversion performed including all software tools and settings used. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

2. Which of the 5 number plates have you concentrated your efforts on (1=closest number plate, ..., 5=most distant) and how did you decide on selecting this number plate?

Selected no. plate: 1, 2, 3, 4, or 5

Decision reached how:

3. Please specify all software tools and all enhancement filters used (in order) and specific parameter settings; e.g. Super-Resolution Filter (Method? Zoom factor? Number of Iterations? Interpolation?.....)

4.

- 1.
- 2.
- 3.
- 4.

5.
Etc

5. Did you select a “region of interest” for directing the super-resolution tool? If so please specify co-ordinates of the region (if used) in the format given by the tool.
6. Did you select any specific frames or image? If so, please provide details of range of frames or specific frames you used.

Use any space you need

7. Please provide any other information that would be needed so that others would be able to repeat and reproduce your work.

Use any space you need

Qn2B. (continued): optional:

As indicated on the Collaborative Exercise webpage you may choose to submit multiple results. If this is the case then please specify how you obtained your results by replicating the previous 6 points for each Procedure/toolset used and/or each possible license plate you focussed on.

For example:

Please save and submit your results using filename:

'Q2B_SuperRes_Procedure1_PlateAll_YOURINITIALS' to indicate the best enhancement result you obtained for all plates using the Procedure1 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

and/or

Please save and submit your results using filename:

File name: 'Q2B_SuperRes_Procedure2_Plate1_YOURINITIALS' to indicate the best enhancement result you obtained for Plate 1 using the Procedure2 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

and/or

Please save and submit your results using filename:

File name: 'Q2B_SuperRes_Procedure2_Plate2_YOURINITIALS' to indicate the best enhancement result you obtained for Plate 2 using the Procedure2 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

Qn.2C (optional)

Please select your best result, i.e.: a single best quality super-resolution image:
please save and submit your results using filename: "Q2C_SuperRes_YOURINITIALS"

1. How have you ingested the material into your enhancement system and super-resolution software tools?

Please detail all steps of any conversion performed including all software tools and settings used. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

Use any space you need

2. Which of the 5 number plates have you concentrated your efforts on (1=closest number plate, ..., 5=most distant) and how did you decide on selecting this number plate?

Selected no. plate: 1, 2, 3, 4, or 5

Decision reached how:

3. Please specify all software tools and all enhancement filters used (in order) and specific parameter settings; e.g. Super-Resolution Filter (Method? Zoom factor? Number of Iterations? Interpolation?.....)

Use any space you need

- 1.
 - 2.
 - 3.
 - 4.
 - 5.
- Etc

4. Did you select a "region of interest" for directing the super-resolution tool? If so please specify co-ordinates of the region (if used) in the format given by the tool.

Use any space you need

5. Did you select any specific frames or image? If so, please provide details of range of frames or specific frames you used.

Use any space you need

6. Please provide any other information that would be needed so that others would be able to repeat and reproduce your work.

Use any space you need

Qn2C. (continued): optional:

As indicated on the Collaborative Exercise webpage you may choose to submit multiple results. If this is the case then please specify how you obtained your results by replicating the previous 6 points for each Procedure/toolset used and/or each possible license plate you focussed on.

For example:

Please save and submit your results using filename:

'Q2C_SuperRes_Procedure1_PlateAll_YOURINITIALS' to indicate the best enhancement result you obtained for all plates using the Procedure1 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

and/or

Please save and submit your results using filename:

File name: 'Q2C_SuperRes_Procedure2_Plate1_YOURINITIALS' to indicate the best enhancement result you obtained for Plate 1 using the Procedure2 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

and/or

Please save and submit your results using filename:

File name: 'Q2C_SuperRes_Procedure2_Plate2_YOURINITIALS' to indicate the best enhancement result you obtained for Plate 2 using the Procedure2 you will describe using a cut-paste repetition of the 6 previous subquestions above, etc.

etc.

Question 3: Focal deblur test

Please specify (i) all software tools or processing steps, (ii) all enhancement filters used (in order) and (iii) all specific parameter settings. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

125 cm chart:

Please save and submit your results using filename: 'Q3_125cm_YOURINITIALS' or '**Q3_125cm_LineNUMBER ID09**'

KIVO

Amped FIVE Report

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 64 bit

Project File:

Exported Images

Chain 1

1. [Image Loader](#): *Loads an image from file. ([File](#))*
2. [Crop](#): *Crops a region of interest of the image.*
3. [Super Resolution](#): *Merges all frames to improve the resolution of the image.*
11. [Smart Resize](#): *Resizes the image with a smart zoom algorithm.*
12. [Laplacian Sharpening](#): *Sharpens the image using a Laplacian filter algorithm.*
13. [Levels](#): *Adjusts intensity and color levels.*
4. [Motion Deblurring](#): *Corrects the blur caused by moving objects.*
5. [Contrast Brightness](#): *Adjusts the contrast and brightness values of the image.*
6. [Optical Deblurring](#): *Corrects the blur of objects that are out of focus (big blur).*
7. [Contrast Stretch](#): *Improves the image contrast by expanding the range of intensity values.*
8. [Motion Smoothing](#): *Reduces the noise integrating current and previous frames and avoiding halos on moving objects.*
9. [Optical Deblurring](#): *Corrects the blur of objects that are out of focus (big blur).*
10. [Motion Deblurring](#): *Corrects the blur caused by moving objects.*

Summary:

Chain 1

1. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** SFive TEST/Q3/Random_Focus_150cm_from_lens.JPG
The path of the file to load.

2. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)
0: 1167 410 466 924
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

3. Super Resolution

Merges all frames to improve the resolution of the image.

Details:

The *Super Resolution* filter applies a sub-pixel registration to all the frames of a video, then merges the motion corrected frames together, along with a deblurring filtering. If a *Selection* is set, then the selected area will be optimized.

Parameters:

- **Zoom:** 4
Zoom factor for the output image.
- **Iterations:** 10
Number of deblurring steps.
- **Selection:** 0 0 0 0
Region of the image to optimize.

References:

- Hiroyuki Takeda, Peyman Milanfar, Matan Protter, and Michael Elad. 2009. Super-resolution without explicit subpixel motion estimation. *Trans. Img. Proc.* 18, 9 (September 2009), 1958-1975. DOI=10.1109/TIP.2009.2023703
<http://dx.doi.org/10.1109/TIP.2009.2023703>

11. Smart Resize

Resizes the image with a smart zoom algorithm.

Details:

Smart Resize interpolates the input image by generating an output image of the desired size with an iterative two-dimensional implementation of the Warped Distance algorithm.

Parameters:

- **Size:** 3702, 7366
Size of output image.
- **Steps:** 1
The number of times the filter is applied.
- **Strength:** 1
Sharpness of borders and details of the interpolated image.

References:

- Anil. K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall, pp. 253-255, 1989.
- Anil. K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall, pp. 320-322, 1989.
- G. Ramponi, Warped distance for space-variant linear image interpolation, in *IEEE Transactions on Image Processing*, vol. 8, pp. 629-639, May 1999.

12. Laplacian Sharpening

Sharpens the image using a Laplacian filter algorithm.

Details:

The *Laplacian Sharpening* filter convolves the image with the 3x3, negative, 45 degrees rotation-invariant Laplacian kernel and then adds the resulting high-passed image onto the original image. More specifically, the amount of high-passed information added to original image is proportional to the *Strength* of sharpening. The result of sharpening

operator is to increase the contrast between each pixel and its neighbors. The Laplacian-based unsharp masking is sensible to noise due to the nature of the Laplacian operator.

Parameters:

- **Strength:** 0.1900
Strength of the sharpening effect; larger values provide increasing amounts of sharpening.
- **Mode:** Colors
Type of adjustment to be done.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 249-250, 1989.

13. Levels

Adjusts intensity and color levels.

Details:

The *Levels* filter maps the values of the input image to the values of output image according to a piece-wise linear transformation controlled by the values of *Highlights*, *Midtones* and *Shadows*. The *Midtones* slider changes the intensity values of the middle range of intensity levels without significantly changing the highlights and shadows in the image. The *Highlights* and *Shadows* sliders set the black point and the white point of the image. Each channel of the input image is configured using the sliders of the corresponding parameter: *Value*, *Red*, *Green* or *Blue*. For each parameter, the histogram of the tonal range of the input image is displayed. If the input image is in grayscale, changing the setting of *Red*, *Green* and *Blue* parameters has no effect on the output image.

Parameters:

- **Value:** 223, 189, 24
Highlights, Midtones and Shadows settings used to map the pixel values of the grayscale converted image.

- **Red:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the red channel of image.
- **Green:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the blue channel of image.
- **Blue:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the green channel of image.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

4. Motion Deblurring

Corrects the blur caused by moving objects.

Details:

*Motion Deblurring reduces the blurring effect caused by objects moving too fast during the image acquisition process. The algorithm is based on a Wiener filtering, having a line, long *Size* pixels with an angle of *Angle* degrees, as point spread function (PSF).*

Parameters:

- **Size:** 45
Length of the blur, expressed in pixels.
- **Angle:** 180
Angle of the blur direction, expressed in degrees with respect to the horizontal.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image
- **Mode:** Linear
Selects if using a classical linear PSF or two isolated points to correct replica issues
- **Thickness:** 2

Thickness of the blur, expressed in pixels. This allows to consider also an optical deblurring component.

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989

5. Contrast Brightness

Adjusts the contrast and brightness values of the image.

Details:

Contrast Brightness maps the input image values to the output image values according to a linear transformation. The mapping involves two operations, multiplication and addition with a constant respectively controlled by the *Contrast* and *Brightness* parameters. Increasing (or reducing) the *Contrast* makes the difference between light and dark areas appears sharper (or smoother). Similarly, increasing (or decreasing) the *Brightness* makes the overall image appear lighter (or darker). These changes can improve the definition of excessively dark or light areas in the image, but will tend to saturate the image if taken too far.

Parameters:

- **Contrast:** 0
Extends the intensity difference among pixel (linear gain).
- **Brightness:** -42
Adds or subtracts an offset to image pixels (bias).
- **Selection:** Whole Image

Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

6. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 3

The size of the point spread function.

- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

7. Contrast Stretch

Improves the image contrast by expanding the range of intensity values.

Details:

The *Contrast Stretch* filter adjusts the image values expanding the pixels values across the whole available range.

Two stretching mode are available:

- *Intensity:* the stretch is applied to the overall image luminance by processing the image in the YCrCb color space;
- *Colors:* the stretch is independently performed on the three RGB channels.

For the grayscale images there is no difference in using the *Intensity* or the *Colors* mode.

If the range of the input image values already covers the whole tonal range (0-255), the filter will have no effect, unless you set the parameter *Sensibility* to a value bigger than zero. The contrast will be stretched to the point where the percentage of *Sensibility* pixel has been reached, both for the maximum and minimum values.

Parameters:

- **Mode:** Colors
Type of adjustment to perform.
- **Sensibility:** 3.8000
The percentage of pixel to exclude in the computation of the tonal range.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, p. 235, 1989.

8. Motion Smoothing

Reduces the noise integrating current and previous frames and avoiding halos on moving objects.

Details:

The *Motion Smoothing* tool reduces the noise in a video by processing each image along with the previous and the next frame. Each pixel of the output image is calculated from the neighboring pixels in the same frame and from the values of the pixel in the same position in the previous and next frames. Since the moving objects are recognized by the filter, they won't be blurred as it happens with simpler temporal filters, such as the temporal smoothing.

Parameters:

- **Still Smooth:** 0.5000
Smoothing strength from the current frame.
- **Still Details:** 16
Details preservation from the current frame.
- **Motion Smooth:** 0.0700
- *Smoothing contribution from the neighboring frames.*
- **Motion Details:** 15

Details contribution from the neighboring frames.

References:

- G. Ramponi, S. Marsi and S. Carrato, Image processing using rational functions, in Nonlinear Model-Based Image/Video Processing and Analysis, Kotropoulous and I. Pitas, Eds. Joh Wiley & Sons, 2001.

9. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 2
The size of the point spread function.

- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

10. Motion Deblurring

Corrects the blur caused by moving objects.

Details:

Motion Deblurring reduces the blurring effect caused by objects moving too fast during the image acquisition process. The algorithm is based on a Wiener filtering, having a line, long *Size* pixels with an angle of *Angle* degrees, as point spread function (PSF).

Parameters:

- **Size:** 103
Length of the blur, expressed in pixels.
- **Angle:** 73
Angle of the blur direction, expressed in degrees with respect to the horizontal.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric

Reduce ringing artifacts near the boundaries of the image

- **Mode:** Linear
Selects if using a classical linear PSF or two isolated points to correct replica issues
- **Thickness:** 1
Thickness of the blur, expressed in pixels. This allows to consider also an optical deblurring component.

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

75 cm, 4th line:

Please save and submit your results using filename: 'Q3_75cm_Line4_YOURINITIALS'

'Q3_75cm_Line4_ID09.jpg'

Amped FIVE Report

Q ? ? S

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 64 bit

Project File:

Exported Images

Chain 1

1. [Image Loader](#): *Loads an image from file. ([File](#))*
14. [Crop](#): *Crops a region of interest of the image.*
15. [Optical Deblurring](#): *Corrects the blur of objects that are out of focus (big blur).*
16. [Levels](#): *Adjusts intensity and color levels.*
17. [Optical Deblurring](#): *Corrects the blur of objects that are out of focus (big blur).*

Summary:

Chain 1

1. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive TEST/Q3/Random_Focus_150cm_from_lens.JPG

The path of the file to load.

14. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)
0: 432 1102 560 112

Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

15. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 15
The size of the point spread function.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

16. Levels

Adjusts intensity and color levels.

Details:

The *Levels* filter maps the values of the input image to the values of output image according to a piece-wise linear transformation controlled by the values of *Highlights*, *Midtones* and *Shadows*. The *Midtones* slider changes the intensity values of the middle range of intensity levels without significantly changing the highlights and shadows in the image. The *Highlights* and *Shadows* sliders set the black point and the white point of the image. Each channel of the input image is configured using the sliders of the corresponding parameter: *Value*, *Red*, *Green* or *Blue*. For each parameter, the histogram of the tonal range of the input image is displayed. If the input image is in grayscale, changing the setting of *Red*, *Green* and *Blue* parameters has no effect on the output image.

Parameters:

- **Value:** 235, 119, 4
Highlights, Midtones and Shadows settings used to map the pixel values of the grayscale converted image.
- **Red:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the red channel of image.
- **Green:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the blue channel of image.
- **Blue:** 255, 127, 0
Highlights, Midtones and Shadows settings used to map the pixel values of the green channel of image.
- **Selection:** Whole Image
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 234-241, 1989.

17. Optical Deblurring

Corrects the blur of objects that are out of focus (big blur).

Details:

Optical Deblurring reduces the blurring effect due to incorrect focus settings during the image acquisition process. The algorithm is based on a Wiener filtering, having a circle of diameter *Size* as point spread function (PSF).

In order to filter out the noise it is possible to set the *Noise* parameter, which represents the estimated noise-to-signal power ratio of the image.

Parameters:

- **Size:** 2
The size of the point spread function.
- **Noise:** 0.5012
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

75 cm, 5th line:

Please save and submit your results using filename: Q3_75cm_Line5_YOURINITIALS'

Use any space you need

any other results: optional:

Please save and submit your results using filenames:
'Q3_DISTANCEcm_LineNUMBER_YOURINITIALS'

Question 4: Motion deblur test

Qn.4A:

Please specify (i) all software tools or processing steps, (ii) all enhancement filters used (in order) and (iii) all specific parameter settings. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

If you wish to provide results for different regions of interest in the image, please specify their coordinates and/or indicate the region in a small thumbnail, and use the filenames: "Q4A_RegionNUMBER_YOURINITIALS".

Region NUMBER: coordinates and/or thumbnail:

Q4A_RegionNUMBER ID09.jpg

Amped FIVE Report

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 64 bit

Exported Images

Chain 26

- 26. [Image Loader](#): *Loads an image from file. ([File](#))*
- 27. [Crop](#): *Crops a region of interest of the image.*
- 31. [Super Resolution](#): *Merges all frames to improve the resolution of the image.*
- 32. [Motion Deblurring](#): *Corrects the blur caused by moving objects.*

Summary:

Chain 26

26. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive TEST/Q4/Qn4A.png

27. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)
0: 415 1492 426 72

Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

31. Super Resolution

Merges all frames to improve the resolution of the image.

Details:

The *Super Resolution* filter applies a sub-pixel registration to all the frames of a video, then merges the motion corrected frames together, along with a deblurring filtering. If a *Selection* is set, then the selected area will be optimized.

Parameters:

- **Zoom:** 4
Zoom factor for the output image.
- **Iterations:** 10
Number of deblurring steps.
- **Selection:** 0 0 0 0
Region of the image to optimize.

References:

- Hiroyuki Takeda, Peyman Milanfar, Matan Protter, and Michael Elad. 2009. Super-resolution without explicit subpixel motion estimation. *Trans. Img. Proc.* 18, 9 (September 2009), 1958-1975. DOI=10.1109/TIP.2009.2023703
<http://dx.doi.org/10.1109/TIP.2009.2023703>

32. Motion Deblurring

Corrects the blur caused by moving objects.

Details:

Motion Deblurring reduces the blurring effect caused by objects moving too fast during the image acquisition process. The algorithm is based on a Wiener filtering, having a line, long *Size* pixels with an angle of *Angle* degrees, as point spread function (PSF).

Parameters:

- **Size:** 140
Length of the blur, expressed in pixels.
- **Angle:** 4
Angle of the blur direction, expressed in degrees with respect to the horizontal.

- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image
- **Mode:** Linear
Selects if using a classical linear PSF or two isolated points to correct replica issues
- **Thickness:** 1
Thickness of the blur, expressed in pixels. This allows to consider also an optical deblurring component.

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
 - Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.
-

Platforms 1 to 7 only

Q4A_RegionNUMBER_ID09_A.jpg

Amped FIVE Report

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 64 bit

Exported Images

Chain 26

- 26. [Image Loader](#): *Loads an image from file. ([File](#))*
- 51. [Motion Deblurring](#): *Corrects the blur caused by moving objects.*
- 52. [Crop](#): *Crops a region of interest of the image.*

Chain 26

26. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** ../../../../Desktop/SFive TEST/Q4/Qn4A.png

The path of the file to load.

51. Motion Deblurring

Corrects the blur caused by moving objects.

Details:

Motion Deblurring reduces the blurring effect caused by objects moving too fast during the image acquisition process. The algorithm is based on a Wiener filtering, having a line, long *Size* pixels with an angle of *Angle* degrees, as point spread function (PSF).

Parameters:

- **Size:** 33
Length of the blur, expressed in pixels.
- **Angle:** 11
Angle of the blur direction, expressed in degrees with respect to the horizontal.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image
- **Mode:** Linear
Selects if using a classical linear PSF or two isolated points to correct replica issues
- **Thickness:** 1
Thickness of the blur, expressed in pixels. This allows to consider also an optical deblurring component.

References:

- J.S. Lim, Two-Dimensional Signal and Image Processing, Englewood Cliffs, Prentice Hall, NY, p. 548, equations 9.44 -- 9.46, 1990.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 276-284, 1989.

52. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)

0: 114 824 170 109

Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

Q4A_RegionNUMBER_ID09_ B.jpg

Amped FIVE Report

Amped FIVE version info:

Build date: 20141029

Revision: 6579

Platform: Microsoft Windows, 64 bit

Exported Images

Chain 26

- 26. [Image Loader](#): *Loads an image from file. ([File](#))*
- 55. [Crop](#): *Crops a region of interest of the image.*
- 56. [Resize](#): *Resizes the image.*
- 57. [Motion Deblurring](#): *Corrects the blur caused by moving objects.*

Summary:

Chain 26

26. Image Loader

Loads an image from file.

Details:

The *Image Loader* tool renders an image file that can be encoded in a variety of formats to a bitmap that can be displayed and processed.

Parameters:

- **File:** *../../../../Desktop/SFive TEST/Q4/Qn4A.png*
The path of the file to load

55. Crop

Crops a region of interest of the image.

Details:

The *Crop* tool produces an output image which is only the selected region of the input image.

Parameters:

- **Selection:** Static Region
Reference Selection(s)
0: 1644 1411 349 170
Selection where the filter is applied. It may be the whole image, a static region, or a region containing a tracked object of interest.

56. Resize

Resizes the image.

Details:

The *Resize* tool interpolates the input image by generating an output image of the desired size.

The available interpolation algorithms are:

- *Nearest:* simply copies the value of the closest pixel in the position to be interpolated;
- *Bilinear:* uses a bilinear interpolation to resample pixel data;
- *Bicubic:* uses a bicubic interpolation to resample pixel data.
- *Area* resamples using pixel area relation.
- *Lanczos* uses a Lanczos interpolation to resample pixel data.

Parameters:

- **Size:** 1396, 680
Size of output image.
- **Interpolation:** Bicubic
Interpolation algorithm.

References:

- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 253-255, 1989.
- Anil. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, pp. 320-322, 1989.
- H.S. Hou and H.C. Andrews, Cubic spline for image interpolation and digital filtering, in IEEE Transactions on Acoustic, Speech, and Signal Processing, vol. 26, pp. 508-517, 1978.

57. Motion Deblurring

Corrects the blur caused by moving objects.

Details:

Motion Deblurring reduces the blurring effect caused by objects moving too fast during the image acquisition process. The algorithm is based on a Wiener filtering, having a line, long *Size* pixels with an angle of *Angle* degrees, as point spread function (PSF).

Parameters:

- **Size:** 130
Length of the blur, expressed in pixels.
- **Angle:** 0
Angle of the blur direction, expressed in degrees with respect to the horizontal.
- **Noise:** 0.0100
Estimate of the noise-to-signal power ratio.
- **Boundary conditions:** Symmetric
Reduce ringing artifacts near the boundaries of the image
- **Mode:** Linear
Selects if using a classical linear PSF or two isolated points to correct replica issues
- **Thickness:** 1
Thickness of the blur, expressed in pixels. This allows to consider also an optical deblurring component.