

Question 1: Image Extraction at Best Quality

Qn.1A, if you used another method:

Result saved as: Q1A_OtherMethod_ID01.bmp

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.

STEPS TAKEN:

- 1. Opened drv-file [000001].drv with provided Player. Observed duration, start time and end time of video.**
- 2. Created snapshot of first frame using the provided Player. Observed that this snapshot not only captures image but also the player itself. Furthermore the snapshot format is jpg. This could cause additional compression artefacts. Therefore, another approach is taken (see next steps).**
- 3. Opened dvr-file [000001].drv in Hex-editor (Hex Workshop). Observed that H.264 format is used. Observed that header of first frame of file starts at byte-position 0x1F60. Observed that first frame is a key-frame. Observed that first '00 00 01 65'-block starts at byte-position 0x202A.**
- 4. Found that header of first frame contained UNIX-timestamp '535E8515' = 2014-04-28 16:43:01. This confirms that first frame in the file is requested frame.**
- 5. Opened dvr-file in Defraser. Once again first frame found from byte-position 0x202A. First frame ends at byte-position 0x7F87. Two different exports performed: (i) Selected bytes from 0x202A up to 0x7F87 and saved them as bmp-file, (ii) Exported first 'SequenceParameterSet' in Defraser and its children as H264-file.**
- 6. Exported bmp-file opened in IrfanView. Observed that resolution is 720x288. Image 'looks' OKE.**
- 7. As a check, opened exported H.264-file in NFI-player. Observed that resolution is 720x288. Movie 'looks' OKE. Same resolution as found in step 6.**

Qn.1B, if you used another method:

Result saved as: Q1B_OtherMethod_ID01.jpg

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.

STEPS TAKEN

1. Opened par-file with provided Player. Observed start time (28-04-2014 16:42:50) and end time (28-04-2014 16:43:51) of video. Conclude that questioned timestamp (16:43:30) is not first or last frame of movie.
2. Opened par-file in Hex-editor (Hex Workshop). Observed that jpg-format is used. Observed that timestamp is provided with each frame.
3. Searched for all frames with timestamp 16:43:30. In total six frames are found.
 - 0x461E04 Time: 16:43:30..MSec: 145..Locale: GMT..UTCOffset: 0
 - 0x4668A7 Time: 16:43:30..MSec: 305..Locale: GMT..UTCOffset: 0
 - 0x46B322 Time: 16:43:30..MSec: 465..Locale: GMT..UTCOffset: 0
 - 0x46FD71 Time: 16:43:30..MSec: 625..Locale: GMT..UTCOffset: 0
 - 0x474810 Time: 16:43:30..MSec: 825..Locale: GMT..UTCOffset: 0
 - 0x47926B Time: 16:43:30..MSec: 985..Locale: GMT..UTCOffset: 0
4. First frame of 16:43:40 is asked for. Therefore jpg starting at byte-position 0x461DA9 is taken because it has the lowest MSec. This jpg ends at byte-position 0x466707. This part is selected and saved as jpg-file.
5. Opened exported jpg-file in IrfanView. Observed that resolution is 720x288. Image 'looks' OKE.

Qn.1C

Frame Size of source file recording used in Qn.1A				Frame Size of source file recording used in Qn.1B			
720	x	288	pixels	720	x	288	pixels

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

The raw, recorded quality is 720x288. The provided player doubles the amount of lines.

In [000001].drv it is found that the parameters PicturewidthInMacroBlocksMinus1 = 44 and PictureHeightInMapUnitsMinus1 = 17. Converting this into pixels implies:

Pixel Width = (44+1)*16 = 720

Pixel Height = (17+1)*16 = 288

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

Qn.2A

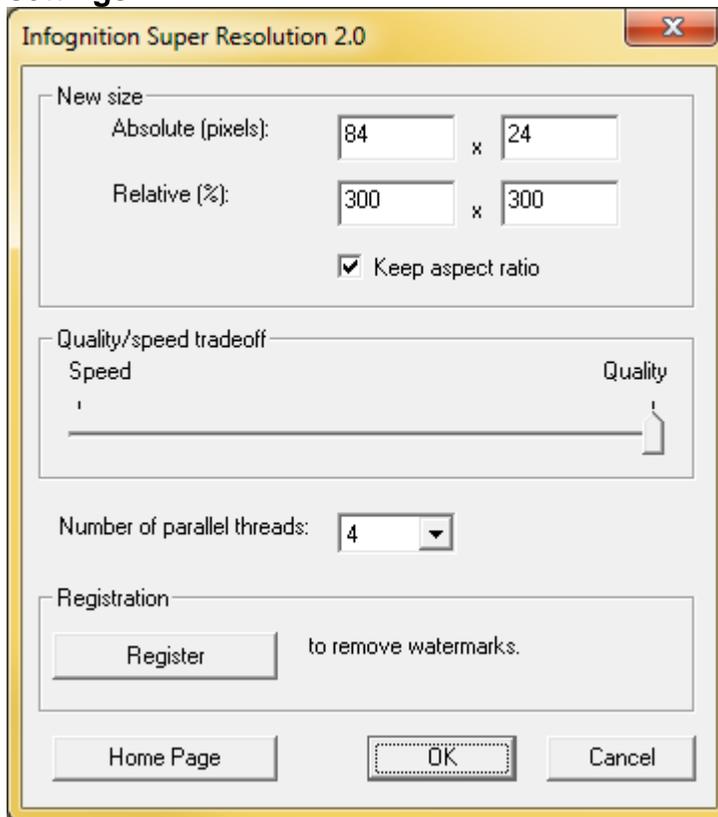
Result saved as: Q2A_SuperRes_ID01.bmp

The following software was used: VirtualDub version 1.9.11 and the plug-in “Infognition Super Resolution 2.0”

(http://www.infognition.com/super_resolution_vdff/). We used the free version of this plug-in which adds a watermark to the result. This watermark is visible as a grey diagonal line starting at the upper left corner of the result.

STEPS TAKEN:

- All 249 bmp-files are loaded into VirtualDub
- A cropping is performed (X1 offset=6, X2 offset=14, Y1 offset = 14, Y2 offset=18). This cropping contained mainly the license plate, because the rest of the image did not provide any information about the movement of the license plate.
- The “Infognition Super Resolution 2.0” filter is applied with the following settings:



- The “Infognition Super Resolution 2.0” filter does not provide a single image but a super-resolution movie. For the best interpretation of the license plate, the complete movie is used and not a single frame because some letters are more clearly visible in one frame while others in another frame. Submitted is frame 237 of the created super-resolution movie.

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

No selection was performed. All images were used.

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

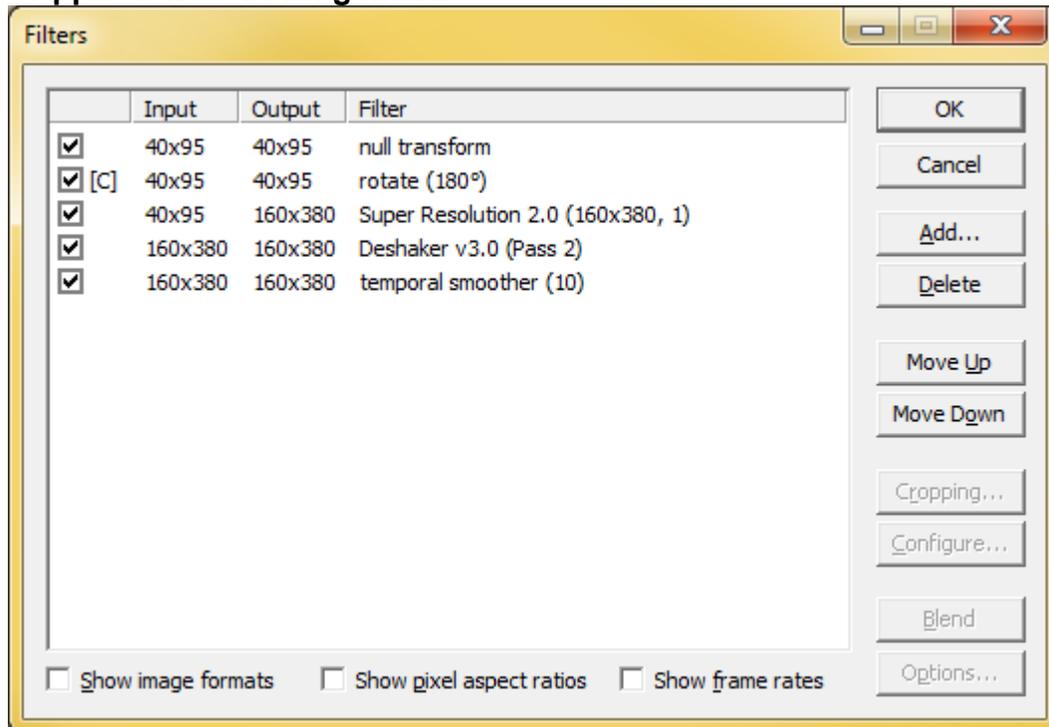
For this investigation, four different approaches have been tried. The one described here is chosen because it gave the best results and was most user friendly.

Qn.2B

Result saved as: Q2B_SuperRes_ID01.avi

The approach taken in this exercise is the same for all number plates. This approach is as follows:

- * Opened dav-file in provided player. Converted dav-file into avi-file using the button in the player. Closed provided player.
- * Checked in a Hex-editor that no recompression has occurred during the conversion from dav to avi. This is not the case.
- * Opened created avi-file in VirtualDub 1.9.11.
- * Applied the following filters



- * Saved resulting movie as Q2B_SuperRes_ID01.avi

Some remarks with respect to the applied filters:

First filter: To crop part of the image that contains all five number plates.

Second filter: The rotation of 180 degrees was initially not applied but during the investigation it was noticed that the images were rotated.

Third filter: Applied a 400% magnification with the “Infognition Super Resolution 2.0” filter. Since the free version of this filter was used, a grey diagonal line is added to the result as a watermark. The result of this step is a super-resolution movie.

Fourth filter: Significant movement is still present in the movie making the readability of the license plates more difficult. This movement is partly countered by the stabilization plug-in Deshaker.

Fifth filter: some additional temporal smoothing to suppress fast temporal fluctuations.

The submitted result is a movie and not a single frame, because submitting a single frame is considered a reduction in quality because information is lost about the remaining fluctuations.

1. 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?

No specific license plate was selected although probably license plate 1 was mostly used because it was most easily readable.

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?.....)

See description above.

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.

See description above.

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

No selection was performed. All images were used.

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

No additional information.

Qn.2C (optional)

Not performed.

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:

Result saved as: Q3_125cm_ID01.png

A crop has been made from the original picture which only contained the ‘125cm’ sheet of paper. The exact crop position is not of importance. To deblur the cropped image the following software is used: SmartDeblur v1.27 (<https://github.com/Y-Vladimir/SmartDeblur/downloads>)

Settings:

**Defect type = Out of focus Blur
Radius = 22.7
Smooth = 31%
Correction Strength = -23%
Edge Feather = 22%**

Although a frame has been submitted according to the above settings, the best result is visible by constantly tuning the parameters. In this way an easier interpretable result is obtained. Our findings are that the following letters are printed on “125cm”:

**125cm
K I V O
P N D J
Y X Q F**

This is not clearly visible from a single frame as requested.

The remaining lines were not interpretable and are therefore not mentioned.

75 cm, 4th line:

Result saved as: Q3_75cm_line4_ID01.png

A crop has been made from the original picture which only contained the ‘75cm’ sheet of paper. The exact crop position is not of importance. To deblur the cropped image the following software is used: SmartDeblur v1.27 (<https://github.com/Y-Vladimir/SmartDeblur/downloads>)

It is observed that motion blur is playing a bigger role than defocus blur. Therefore, this image has been improved by deconvolution using a motion kernel.

Settings:

**Defect type = Motion Blur
Length = 8.5
Angle = -71 degrees
Smooth = 60%**

Although a frame has been submitted according to the above settings, the best result is visible by constantly tuning the parameters. In this way an easier interpretable result is obtained. Our findings are that the following letters are printed on the 4th line of "75cm":

E A ? ?

The last two letters are not uniquely interpretable. Our guess would be that the third letter is an H or a B. The fourth letter is probably an S but we are not sure.

75 cm, 5th line:

No result submitted.

any other results: optional:

No result submitted.

Remark: For this investigation, an alternative approach in Matlab has been tried. The results are of similar quality and therefore the results obtained with SmartDeblur v1.27 are provided. However, more investigation into the Matlab program would probably result in a better result.

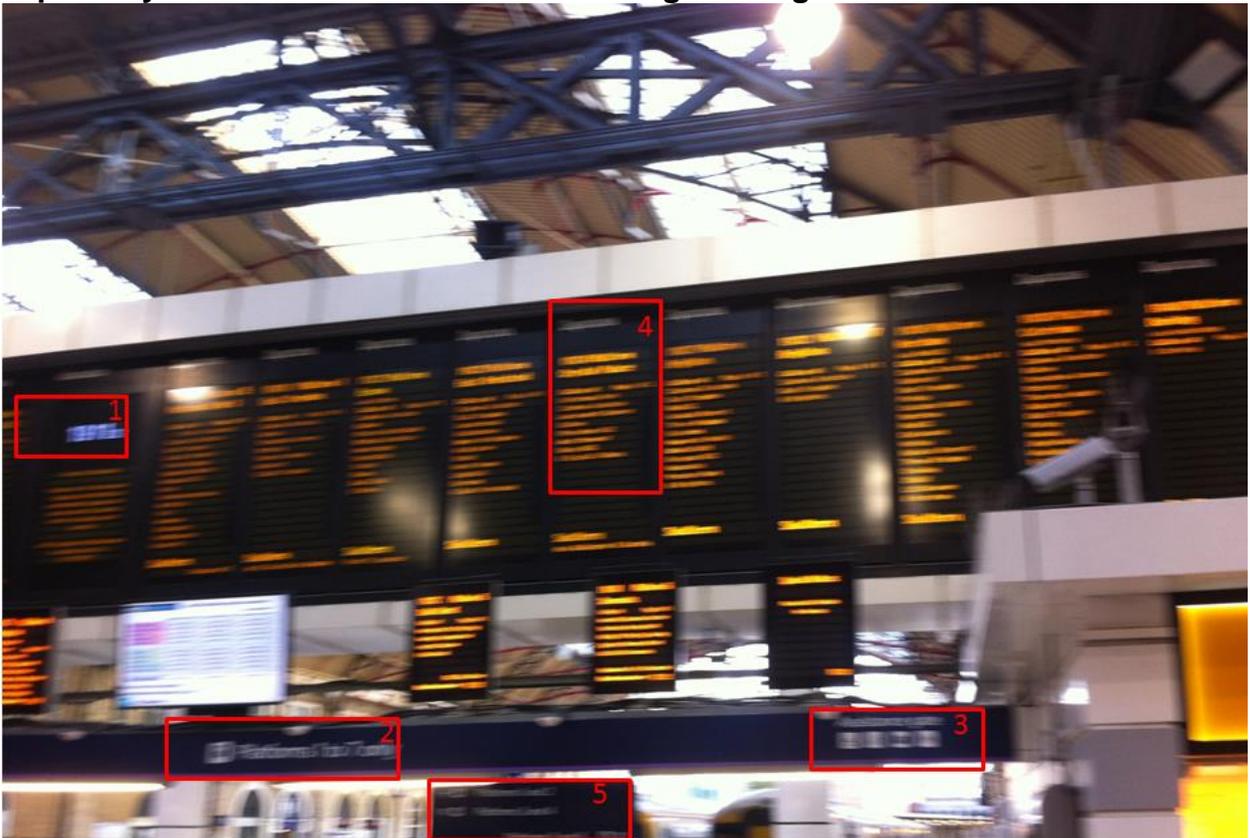
Question 4: Motion deblur test

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".

During the investigation it was observed that the movement blur was not uniform over the photo. Therefore 5 separate regions were selected and processed separately. An overview of the 5 selected regions is given below.



Method:

Matlab has been used to counter the effect of motion blur as much as possible by deconvolution with a motion kernel (function `fspecial('motion', length, angle)`). The user could interactively modify the motion kernel and immediately see the new result until the visually most optimal result was obtained. When the user was satisfied, the program exports the resulting image in combination with the original selection into a png-file. The following five results are provided:

Qn4A_Region1_ID01.png

Qn4A_Region2_ID01.png

Qn4A_Region3_ID01.png

Qn4A_Region4_ID01.png
Qn4A_Region5_ID01.png

The parameters which could be tuned by the user are the length of the motion (in pixels), the direction of the motion (in degrees) and a signal-to-noise ratio.

The following parameters were found:

	Length	Angle	SNR
Region 1:	36.0	5.40	280
Region 2:	30.5	3.80	210
Region 3:	32.5	6.00	165
Region 4:	31.0	-1.20	80
Region 5:	31.5	2.20	75

The following text is readable

Region 1: 19:11:32

Region 2: Platforms 1 to 7 only

Region 3: Assistance gate

Region 4: Departures
19:24 Platform
Crystal Palace

Region 5: Platforms 1 and 2
Platforms 3 and 4
Platforms 5 and 6

Qn.4B:

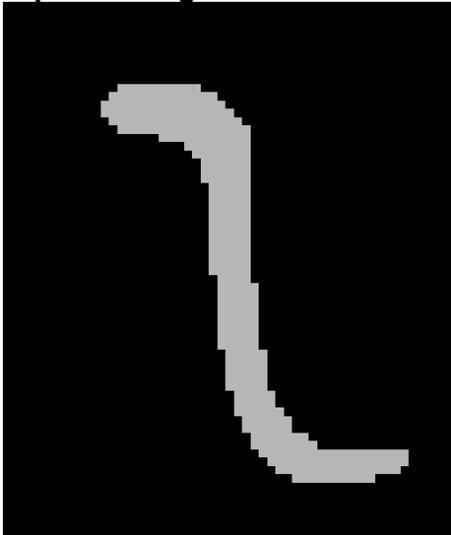
Please specify (i) all software tools or processing steps, (ii) all enhancement filters used (in order) and (iii) all specific parameter settings. The information you provide should have sufficient detail so that anyone could independently reproduce your results.

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".

It was observed that the motion present in Qn4B.png could not be approximated by a linear motion. Furthermore, it was observed that the motion blur changes over the image. Therefore a kernel that properly represents the applied motion is estimated from the photo.



In the picture the red rectangle depicts a region which is used to estimate the motion. It is assumed that the white line in this region is representative for the motion. Therefore by thresholding this region a binary array is obtained representing the motion kernel.



The motion kernel is then used to deconvolve (via wiener deconvolution) the green rectangle of the image. The original green selection and the deconvolved

version are submitted as Qn4B_Region_ID01.png (see also picture below). No other regions in the image were improved.

