CMN_binViewer manual

1. Introduction

CMN_binViewer came into existence during the second part of August 2014, as a result of a dire need of new viewing software for CAMS and Skypatrol data. As the Croatian Meteor Network grew in its demands, it became apparent that the existing solutions were not satisfactory.

In this short guide the usage of CMN_binViewer is described, accompanied with images showing the usage in details.

During the development great concern has been given to the ease of use, and it is recommended that the users **get acquainted with keyboard shortcuts**, described in **chapter 4**. With the knowledge of keyboard shortcuts and a bit of practice, the software is quick and easy to use.

2. Recommended Computer Configuration

The following configuration is recommended for the full functionality of the software. Less powerful machines can be used, but hangs and freezes can occur during the more demanding tasks such as GIF animation making and video preview.

Processor (CPU): Dual core with 2 GHz or more

Memory: 1 GB RAM or more

Storage: 1 GB of free storage

Operating System: Microsoft Windows XP with SP3 or newer (also fully tested on Windows 7)

Display resolution: 1366 x 768 or more

Image 1 CMN_binViewer icon

3. Quick start

3.1. Opening the data folder

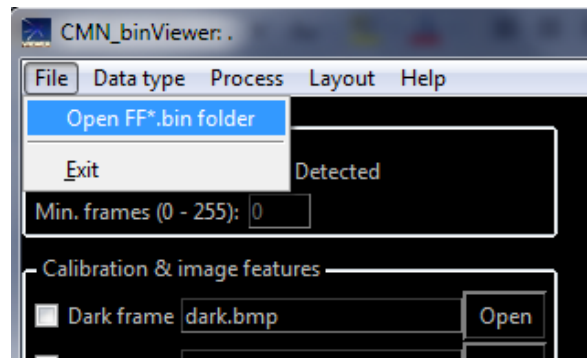To open the desired folder which contains image data, click **File → Open FF*.bin folder**

Image 2 Opening the image data folder

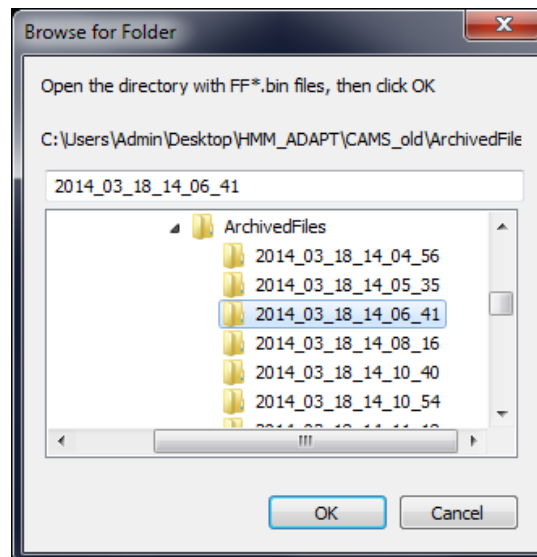Navigate to the desired folder using the folder dialog.

Image 3 Selecting the folder via folder dialog

3.2. Selecting data type

Two data types are available: CAMS and Skypatrol. The default option is **Auto**, which will automatically detect the data type of images the software is presented with. The specific data type can be forced by selection from the Data type menu.
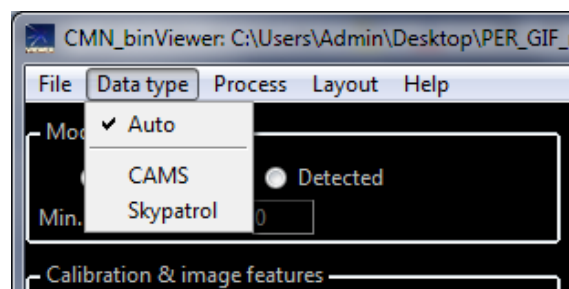

Image 4 Selecting data type

3.3.   Selecting layout

Depending on the resolution of the computer screen, two layouts are used: **vertical** and **horizontal**.
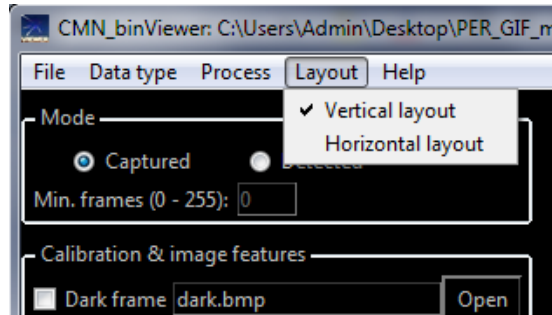

Image 5 Selecting the layout

Vertical layout is best used with higher resolution screens, as it requires at **least 875 pixels in height**.
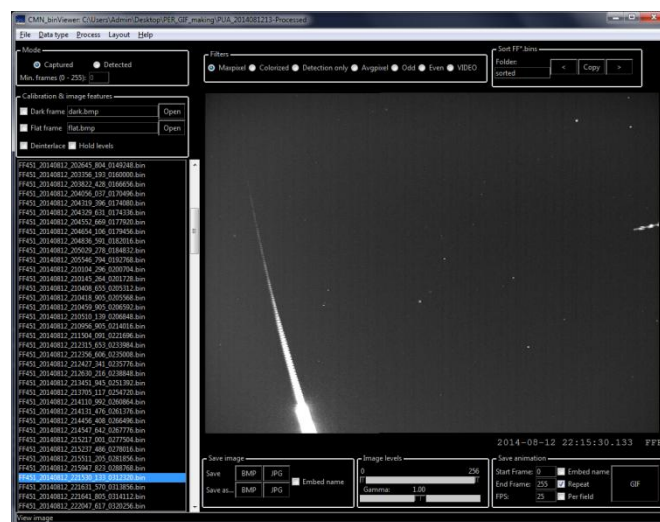

Image 6 Vertical layout

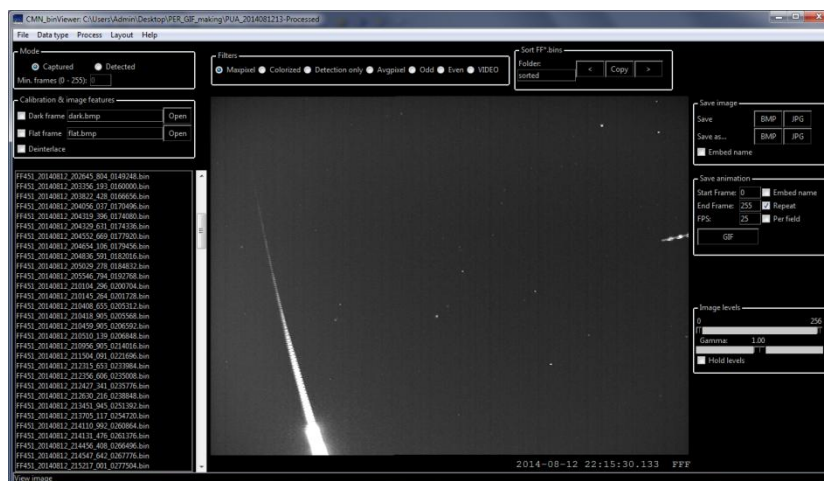For smaller laptop screens, with at least **1366x768 pixels resolution**, horizontal layout is recommended.

Image 7 Horizontal layout

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4. Keyboard shortcuts (key bindings)

To fully utilize to power of the software, the user must get acquainted with its keyboard shortcuts. Every keyboard shortcut is conveniently placed so the usage is as simple as possible.

4.1.   Changing images

Key	Description
Arrow down ↓	move down by one image
Arrow up ↑	move up by one image
Home	jump to the first image in the list
End	jump to the last image in the list

4.2.   Changing mode

Key	Description
Page Up	Captured mode
Page Down	Detected mode

4.3.   Changing filters and image options

Key	Description
Arrow Right →	move right by one filter
Arrow Left ←	move left by one filter
F1	Maxpixel image
F2	Colorized filter
F3	Detection only filter
F4	Average pixel image
F5	Odd field
F6	Even field / Odd field
F9	Play video
Delete	Toggle deinterlace
Insert	Toggle hold levels

4.4.   Sorting files

Key	Description
Enter	copy FF*.bin to sorted folder

5. Filters

To grasp the velocity and other various features of a meteor without having to see the actual video, special filters are applied on an image to display meteor characteristics as intuitive as possible. This chapter describes available filters and their proper usage.

The following filters are available: Maxpixel, Colorized, Detection only, Average pixel, Odd field, Even field and VIDEO filter.

Image 8 Filters in the GUI

Filters can be changed by left and right arrow keys, all except VIDEO filter. The reasons for that behavior are explained in VIDEO filter chapter. After reaching the last image filter, Even field, pressing the right arrow key it will activate the Maxpixel image filter. The same goes other way around, the left arrow key will activate Even field filter after Maxpixel image, but not VIDEO filter.

All filters are mapped to F-keys at the top of the keyboard. Detailed keyboard shortcuts are given in chapter 4.

5.1.   Maxpixel image

Maxpixel image filter displays the image composed of pixels which had the highest value during the recording period of 256 frames. On **Maxpixel** image every recorded meteor should be seen, and thus it is set as the first and the default filter.

Image 9 Example of an image viewed with Maxpixel filter

5.2. Colorized filter

To get the general idea about the meteor's velocity, without looking at the video, Colorized filter is used. It colors intermittent fields with cyan and red color. This is done by deinterlacing the image by odd field duplication. The resulting image is put into red image channel, and deinterlaced image by even field duplication is put into green and blue channels. When all channels are viewed simultaneously, the image shows the desired effect.

Fast meteors have nicely separated cyan-red detection points, while slow meteors often have detections very close to each other, thus odd field image and even field image are almost indistinguishable from each other. This results in an almost colorless white meteor on the final colorized image.
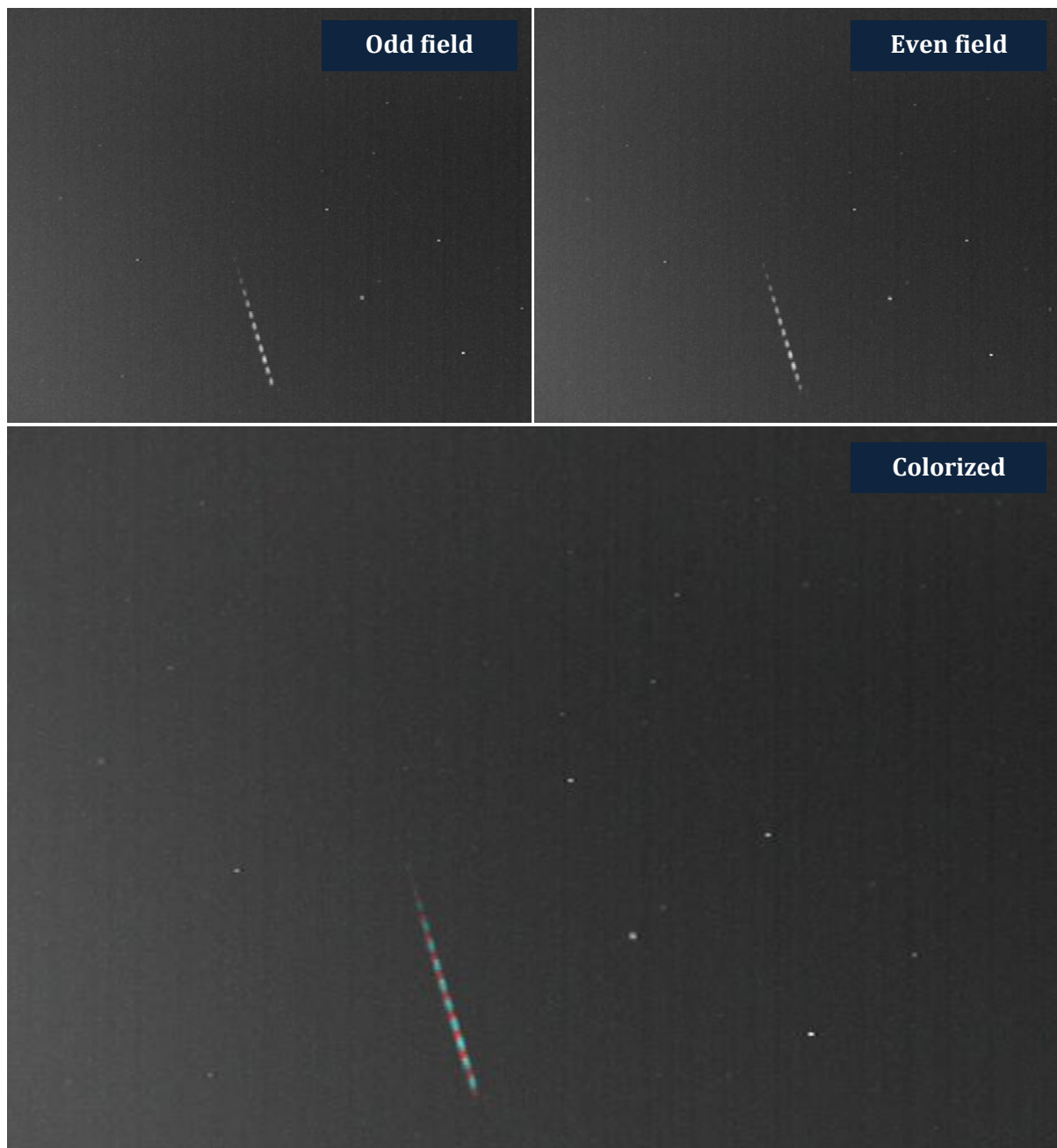

Image 10 Odd field (top left), even field (top right) and combined colorized image (bottom) depicting a fast meteor

5.3. Detection only filter

In Captured mode, Detection only filter subtracts the Average pixel image from the Maxpixel image, which results in an image which shows only the detection, without background. The resulting image is usually darker than the Maxpixel. This filter is used when the background is very bright (e.g. during the full Moon) to better see faint meteors. In Detected mode, the image is constructed from individual frames of a detection, so only that particular detection is visible (in case when there are several detections on a single image).

Image 11 Example of an image viewed with Detection only filter

5.4. Average pixel image

The Average pixel image (Avgpixel in the GUI) depicts the average value of all pixels during the recording period of 256 frames. It shows background features like background sky brightness, CCD sensor imperfections (hot pixels), stars, the Moon, objects obscuring the field of view, etc. It is used to easily see the background conditions when the meteor was recorded.
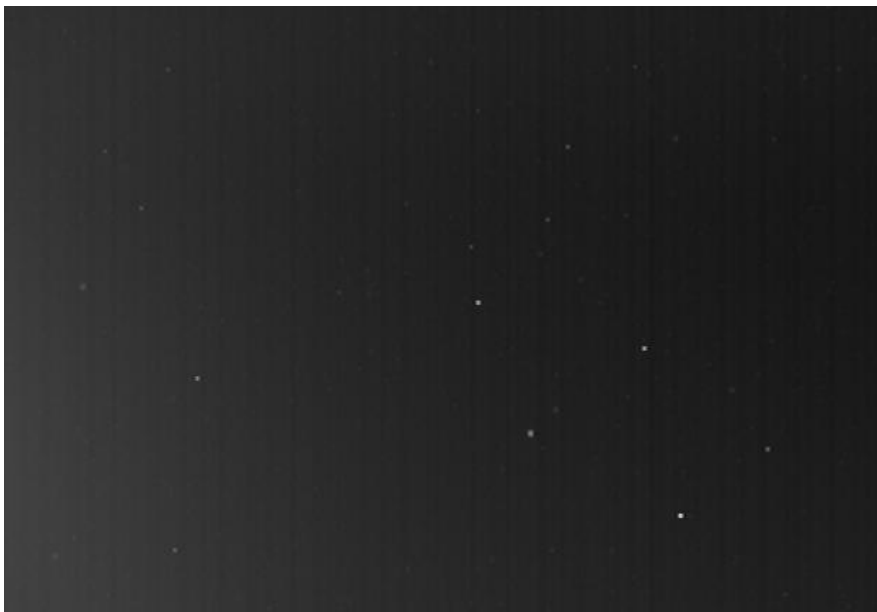

Image 12 Example of an image viewed with Average image filter

5.5.   Odd field image

Odd field depicts the deinterlaced Maxpixel image by odd row duplication. The method consists of copying odd image rows (from top to bottom) to even rows. This filter is often used to see individual detections of a faster fireball to reveal the true nature of the fireball. With brighter events, phenomena such as wakes, trains and trails can be visible between the frames.

5.1 Example of an image viewed with Odd field filter

5.6.   Even field image

Even field image depicts the deinterlaced Maxpixel image by even row duplication. See previous chapter for detailed explanation.

5.2 Example of an image viewed with Even field filter

5.7.   VIDEO

While not exactly being a filter, it is practical to count it as one. It is used for viewing the video of a certain file or a detection. It is also the only filter that is reached only by a certain key stroke (**F9**), and not by arrow keys. The reason for that is that it is not usually practical to play a video when going through a lot of images. Pressing the left arrow key will switch to Even field filter and pressing the right arrow key will switch to Maxpixel filter.

Image modifiers (deinterlacing, levels, dark frame, flat frame) are **not applied during video preview** as they require a lot of processor time to apply on each frame of the video.

During video preview the current frame number will be shown at the end of the timestamp (and change rapidly according to FPS entry). When the viewer is showing a static image, the frame number will simply read "FFF".
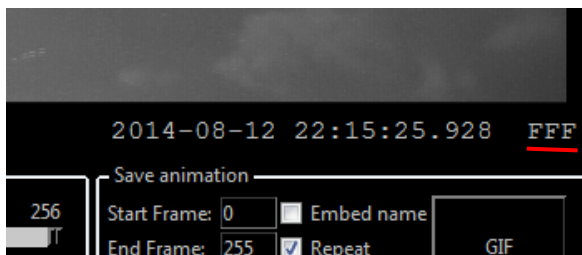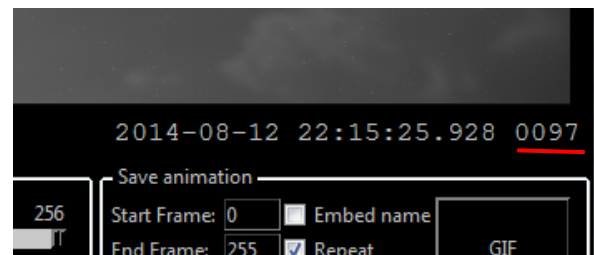

Image 13 Timestamp during image preview

Image 14 Timestamp during video preview

6. Calibration & image features

CMN_binViewer offers a possibility to apply two calibration images: **dark frame** and **flat frame**. It can **deinterlace** the image by blending the odd and even fields. Also, it can apply **levels** adjustment. These options are used to enhance the final image.

In several filters and the Detection mode some of these features are disabled, as they would interfere with normal operation. When available, all options can be combined to produce a joint effect.

6.1.   Dark frame subtraction

A **dark frame** is an image captured with the sensor in the dark, essentially just an image of noise in an image sensor. To apply a dark frame on an image, click the Open button and choose the desired dark frame image. Tick the Dark frame option and the dark frame will be subtracted from the image.
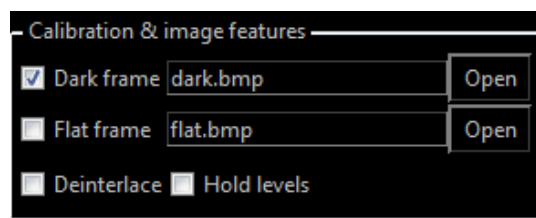

Image 15 Applying dark frame

6.2.   Making master dark frame

To generate one master dark frame from multiple dark frames, built-in functionality to do so can be used. Keep in mind that individual dark frames must be taken in complete darkness, without any light sources. This is usually done during the night by covering the camera with multiple layers of thick cloth, or putting a nontransparent object that can wrap around the camera. Pay attention to the possible reflections from the outside and the inside when taking dark frames.

1. Copy all dark frames into a single folder, then choose **Process → Make master dark frame**.
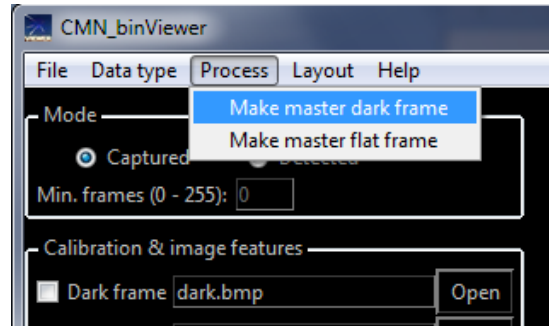
Image 16 Making master dark frame

2. Choose the folder where the individual dark frames are stored. Keep in mind that only dark frames must be in that folder. Any stray light or flat frame will ruin the final master dark frame image.
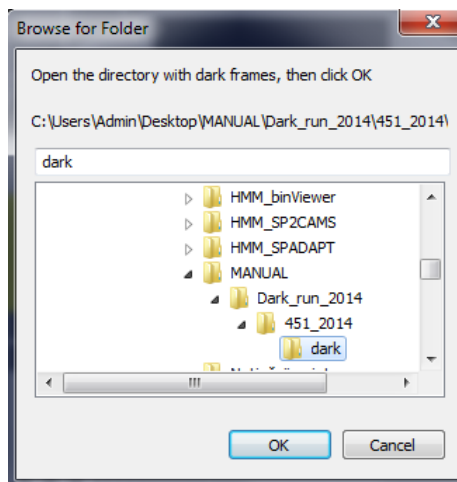

Image 17 Selecting the folder with dark frames

3. A Save dialog will appear asking where to save the master dark frame. Navigate to the desired location and click Save.

Generating the master dark frame can take from a few seconds to half a minute, depending on the image size and number. During that time the program will be unresponsive until the process is done. A pop-up window will appear with the notification that the process is finished.

6.3.   Flat-field correction

Flat fielding refers to the process of compensating for different gains and dark currents in a sensor. To apply a flat frame on an image, click the Open button and choose the desired flat frame. Tick the Flat frame option and the flat frame will be applied to the image.
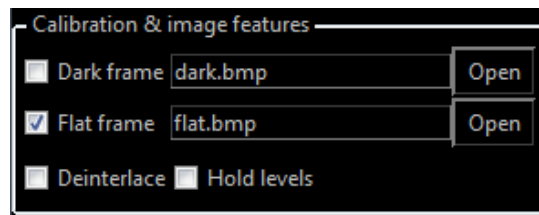

Image 18 Applying flat frame

6.4.   Making master flat frame

To generate one master flat frame from multiple flat frames, built-in functionality to do so can be used. Individual flat frames must be carefully taken, as it is very difficult to achieve a perfect result. There are numerous methods of taking flat frames, ranging from taking them during the twilight or dawn, pointing the camera to a white LCD screen, making a special light box, etc. Internet is full of advice how to take a proper flat frame and it is recommended consulting several websites or books before recording a set of flat frames.

1. Copy all taken images into a single folder, then choose **Process → Make master flat frame**.
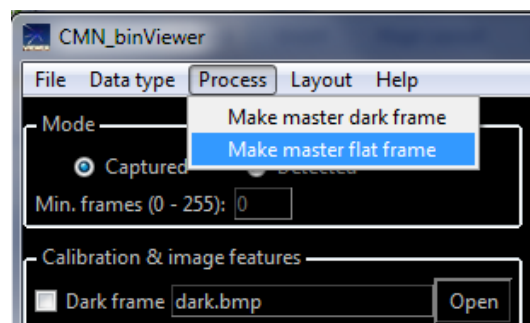

Image 19 Making master flat frame

2. Choose the folder where the individual flat frames are stored. Keep in mind that only flat frames must be in that folder. Any stray light or dark frame will ruin the final image.
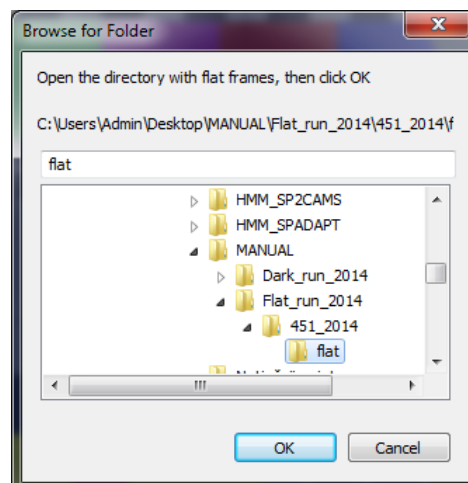

Image 20 Selecting the folder with flat frames

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3. A Save dialog will appear asking where to save the master flat frame. Navigate to the desired location and click Save.

4. An optional dark frame can be applied to all flat frames before they are stacked together. If it isn't available, choosing a dark frame can be skipped simply by pressing Cancel on the file dialog.
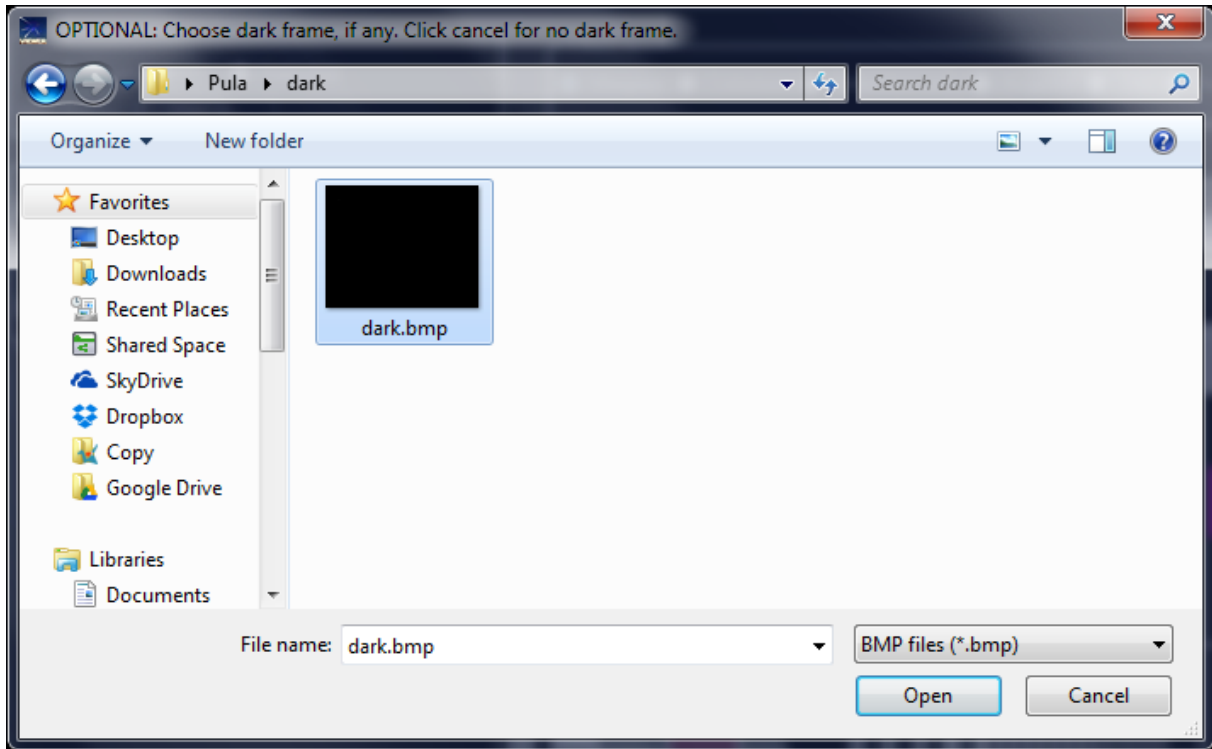

Image 21 Choosing the optional dark frame

Generating master flat frame can take from a few seconds to half a minute, depending on the image size and number. During that time the program will be unresponsive until the process is done. A pop-up window will appear with the notification that the process is finished.

6.5.   Deinterlacing

Deinterlacing can be applied by checking the Deinterlace check box. The primary use for deinterlacing is to better see individual dots of detection, as the interlaced image often shows a blurry meteor. Note the dark banding present on the interlaced image and clear points of detection on the deinterlaced image.
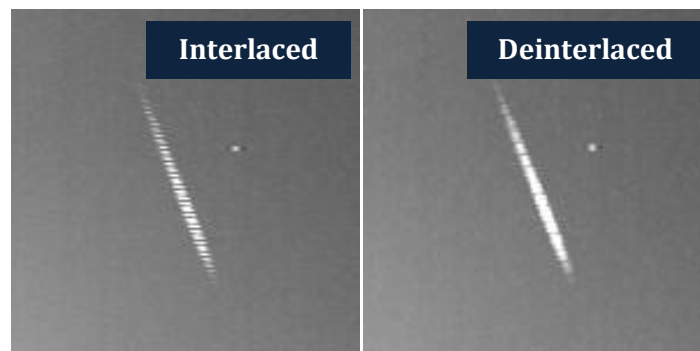

Image 22 Comparison between an interlaced meteor (left) and its deinterlaced counterpart (right)

6.6.　　　Levels adjustment

Arguably one of the most useful features of the viewer is levels adjustment. It allows changing the tonal range of an image by adjusting intensity levels of image shadows, midtones, and highlights.
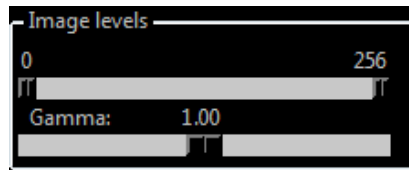

Image 23 Levels adjustment

The upper two sliders map the black point and white point of an input image to the darkest and the fully saturated point of an output image. The darkest point is at level 0, where the pixels are black, and the fully saturated point is at level 255, where the pixels are white. Moving the left slider maps the pixel value to level 0 and moving the right slider maps the pixel value to level 255. The remaining levels are redistributed between levels 0 and 255. This redistribution increases the tonal range of the image, in effect increasing the overall contrast of the image.

The Gamma slider adjusts the gamma in the image. It moves the midtone (level 128) and changes the intensity values of the middle range of gray tones without dramatically altering the highlights and shadows.

The usefulness of this option becomes clear when it is difficult to see a certain meteor because of its background. To preserve the given adjustment on every consecutive image and filter, locate and check the **Hold levels** button.
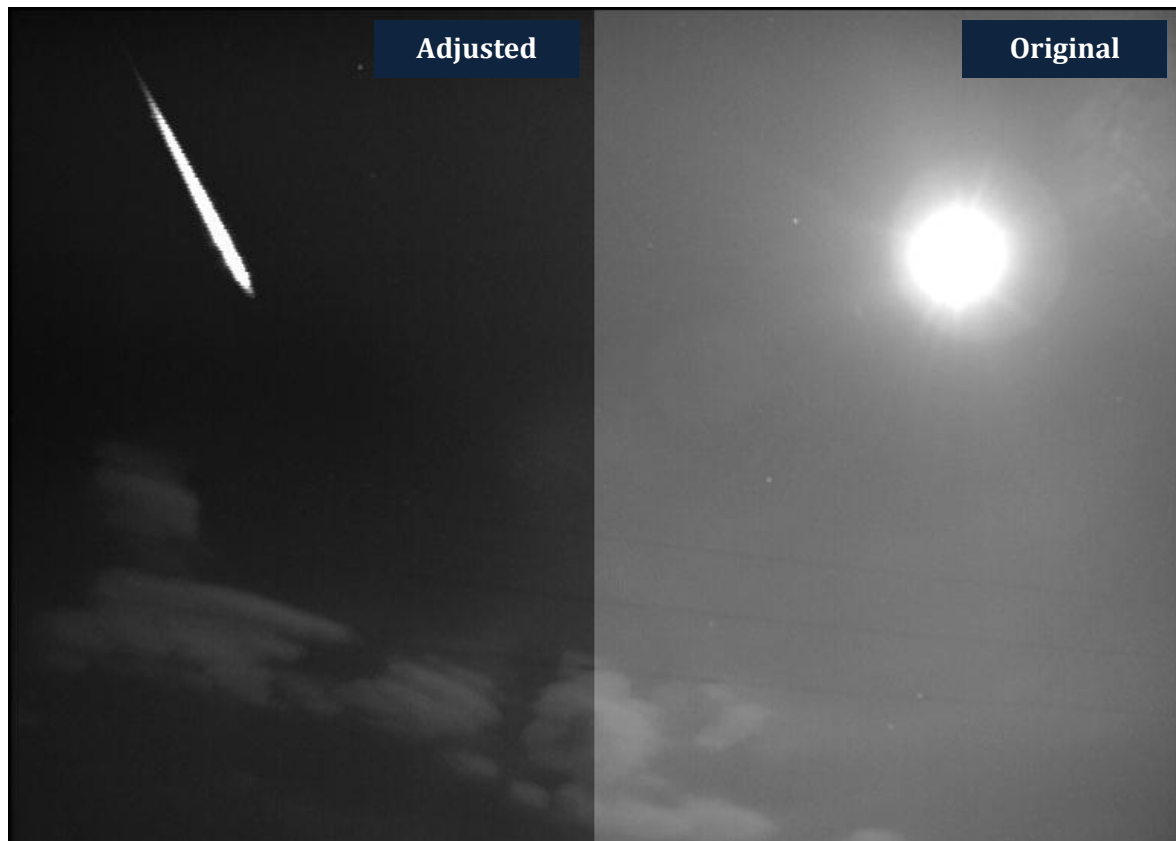

Image 24 Comparison between the level adjusted part (left) and the original part (right) of an image

7. Modes

There are two distinct modes: **Captured** and **Detected**.

Image 25 Modes

7.1.   Captured mode

In Captured mode every image in a certain folder is shown in the file list box, whether it has a detection (i.e. meteor) or not. It is useful for going through all images from a certain night. In this mode all filters are available for use.

VIDEO filter will show a movie from the first to the last frame (0 – 255 for CAMS). To narrow the temporal range, a new range can be specified in the Start Frame and the End Frame entries.

When a GIF animation is generated in this mode, it will also produce an animation 255 frames long. To make an animation only of the detection, Detected mode is used.
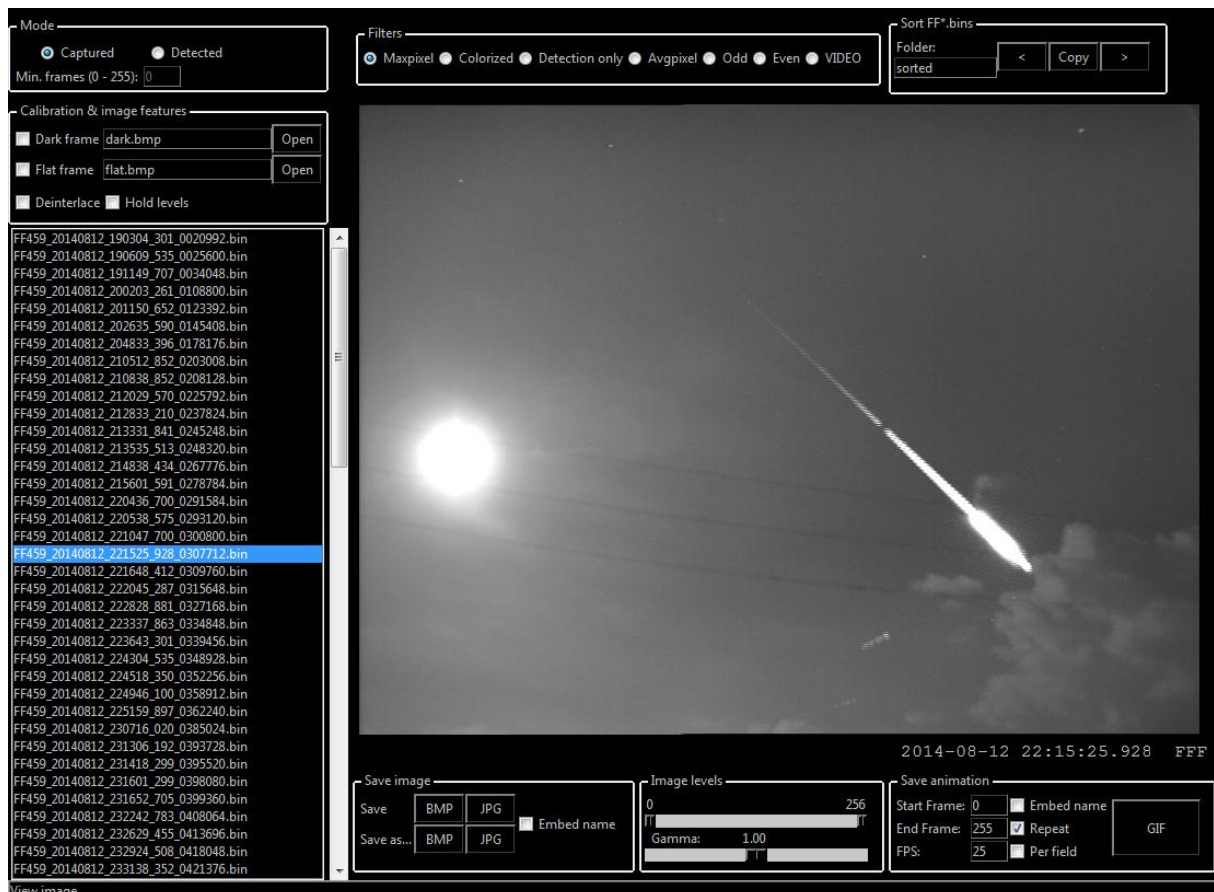

Image 26 A bright fireball viewed in Captured mode

7.2. Detected mode

In the Detected mode only images with detections are shown. All filters are disabled except Detection only filter which shows the specific event. Keep in mind that **FTPdetectinfo file** needs to be present in the folder to use this mode.

VIDEO filter is also available in this mode, but it will show a movie only from the start to the end of a certain event. This can be used to quickly go through all recorded meteors and see their video clips.

Also please note that the **image generation time is longer for events with 30 frames or more**, as every individual frame needs to be read and stacked to a final image. This can be problematic during a quick view of detections, as **long (and more attractive) events can be easily skipped**. It is strongly advised to use Detected mode only for a specific purpose of seeing a movie clip of a meteor with VIDEO filter or making an image/GIF file.

The entries in the file list box are now somewhat different, as they consist of a file name and the first and the last frame of the detection.

In this mode the entry widget "Min. frames" is activated. The number of minimum frames of duration can be specified. This means that every event that has less than N number of frames will not be shown in the file list box. This is useful for filtering out very short events (10 frames or shorter) as they are usually not very visually attractive.
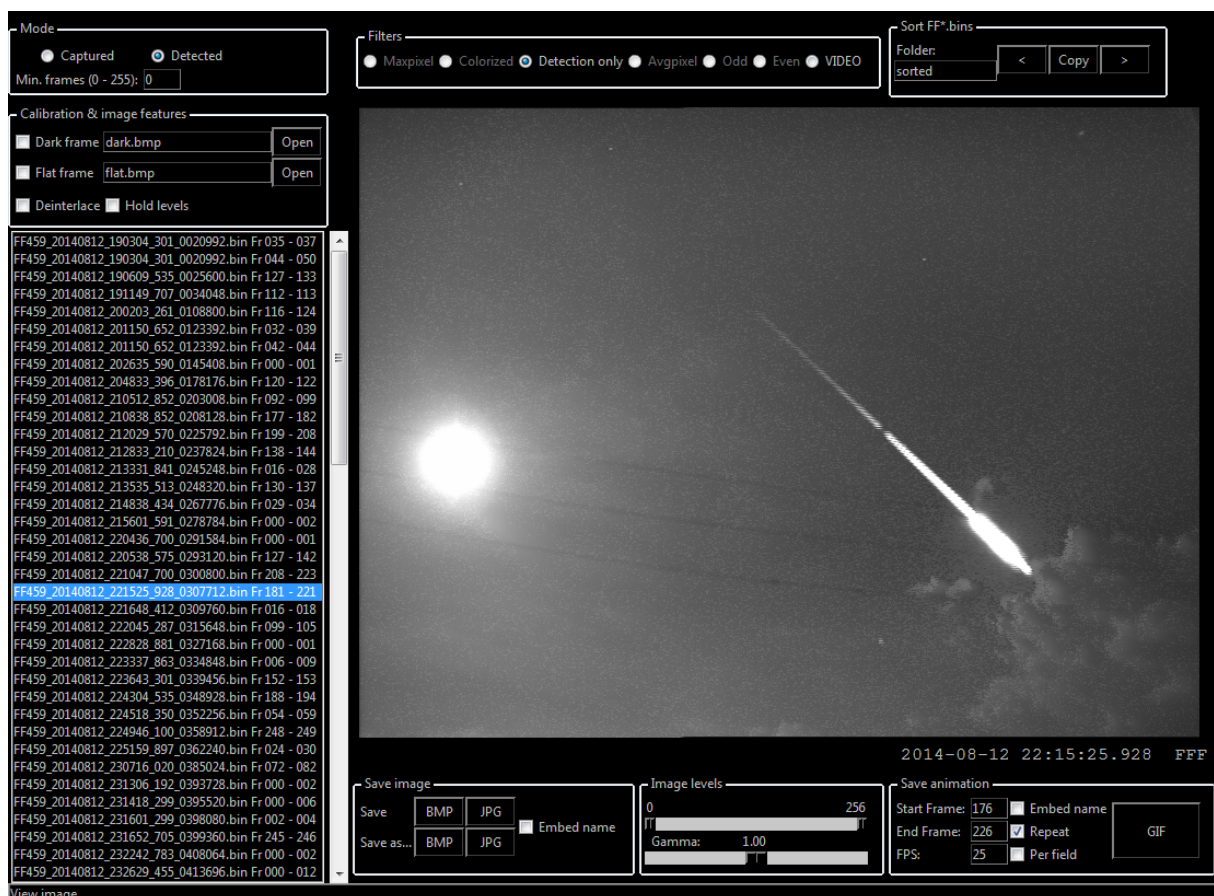

Image 27 A bright fireball viewed in Detected mode

8. Saving a GIF animation

It is often useful to have a short animation of a certain meteor that can be easily viewed across many platforms. The GIF format has been chosen because of the small final size of an animation, and the compatibility with many current web browsers. This provides easy sharing and viewing the animations.
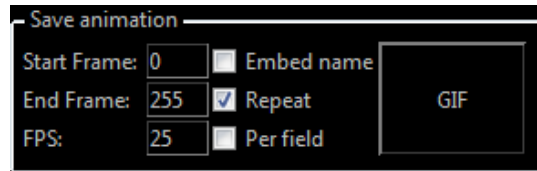

Image 28 Save animation

The creation of a GIF animation is a very CPU (computer processor) intensive process and it requires a lot of RAM memory for longer animations, especially when "Per field" option is enabled. The maximum amount of RAM this process can consume is up to 512MB, as every individual frame needs to be loaded into the memory before saving. If the PC is not powerful enough to handle this, hangs and freezes can occur. Every filter applied to the image on the screen, as well as other image options, will be also applied to the animation.

Depending on the desired final animation, the following parameters can be changed: Start Frame, End Frame, FPS, Embed name, Repeat and Per field.

Start Frame defines the first frame to be shown in the animation. Combined with End Frame it defines the temporal range of an animation. The minimum value that can be set is 0 and it must be smaller than the End Frame value. This entry is also used to regulate the VIDEO filter.

End Frame defines the last frame to be shown in the animation. Combined with Start Frame it defines the temporal range of an animation. The maximum value that can be set is 255 and it must be larger than the Start Frame value. This entry is also used to regulate the VIDEO filter.

FPS (Frames Per Second) is the frequency (rate) at which the animation is shown. The default value for NTSC cameras is 30 FPS and for PAL cameras 25 FPS. To slow down the final animation, smaller values can be used. At 15 FPS with NTSC data, the final animation will run at half speed than normal. The range of values that can be set is from 0 to 255. This entry is also used to regulate the VIDEO filter.

Embed name option offers a possibility to permanently include the name of the file inside the animation.

Image 29 Name of the file and the current frame embedded in the upper left part of an animation

Repeat option can be checked to loop the animation infinitely number of times. Otherwise the animation will run only once and stop with the last frame.

Per field option provides the possibility to split every frame into separate fields, and store the animation with twice the amount of individual frames. When using this option, the animation will run at half speed than normal and will be twice the size. This method enables doubling the temporal resolution with losing a half of vertical resolution.

9. Saving an image

To save an image of a current view on the screen, Save image option can be used. BMP and JPG formats are supported. By pressing a button in the **Save** row, the image will be saved alongside the original data. If a button is pressed in the **Save as** row, a dialog will open to ask where to save the file.

Image 30 Save image

Embed name option offers a possibility to permanently include the name of the file inside the image.

Every filter applied to the image on the screen, as well as other image options (deinterlacing, levels, etc.) will be also applied to the saved image.

10. Sorting image files

Often it is very convenient to copy a certain image file to a different folder, especially if the image contains a fireball or other interesting events.

Image 31 Sorting image files

By pressing the **Copy** button, the current image will be copied to a defined folder which will be created inside the opened folder. The same effect is accomplished by pressing the **Enter** key on the keyboard. Arrow buttons are used for navigating between the images and have the same purpose as the up and down arrow key on the keyboard.

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