Fripon – Feedback on FreeTure software

Jim Rowe, 30th December 2016

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Appendix:

1. What is the purpose of FreeTure?

The ***primary*** purpose of FreeTure is to provide meteor capture software for the private institutional Fripon network, with no restrictions on licencing or availability and no use of proprietary algorithms.

The ***secondary*** purpose of FreeTure is to encourage public participation in the Fripon and Vigie-Ciel projects, and it appears that the purpose of this includes:

- Recruitment of searchers to help with meteorite recovery, whose objectives are aligned with those of Fripon,
- Extension and infill of the camera network, which will make it less susceptible to weather events and more likely to detect daytime bolides, and
- Crowdsourcing of further development of FreeTure.

It would be perfectly legitimate for FreeTure to serve only the primary purpose, and FreeTure is probably already adequate for this purpose. If it is to serve the secondary purpose, it will need to be attractive to amateur video meteor. These are individuals who:

- will happily spend €1.000 to €2.000 on equipment,
- want to see and understand what their own camera system is capturing,
- want to collaborate with other observers to calculate orbits and ground tracks, and
- are motivated by science and interest rather than by commerce.

2. To be chosen by amateurs, what features does FreeTure need?

2.1 What do European observers use already?

Hundreds of amateur meteor observers in Europe make up at least ten national or regional observer networks (including BOAM, CEMeNt, HMN, IMO VMN, IMTN, PFN, Serbia Network, SVMN, UKMON, and Nemetode). These networks share data and are loosely coordinated through the "European viDeo MeteOr Network Database" (EDMOND), associated with the Comenius University of Bratislava in Slovakia[1]. There are also non-affiliated all-sky networks such as CAMS Benelux and the Danish Stjerneskud network.

Most European observers use sensitive analogue CCTV cameras (such as the Watec 902H) and most use fields of view of sixty or seventy degrees, resulting in very good capture of faint meteors but poor

[1] http://www.daa.fmph.uniba.sk/edmond

capture of fireball events. Some observers have two to six cameras, and could add a Fripon-compliant camera if it offered additional utility.

EDMOND-affiliated networks use the SonotaCo UFOCapture software suite, while the two all-sky networks mentioned above each use different software. UFOCapture is therefore the "gold standard" against which FreeTure will be judged by most European observers.

2.2 FreeTure compared with the SonotaCo UFOCapture Suite

The UFOCapture suite is made up of three parts, which are quite idiosyncratic – logically the functions of part 2 should be combined in part 1, the "capture" program. The three-part software suite and its comparison with FreeTure is:

Program	***UFOCapture Suite functionality***	***FreeTure Functionality***
1. UFOCapture / FreeTure	Identifies a meteor event in real time, captures video frames, writes BMP, JPG, XML and AVI files for every capture. Allows a user to watch the video feed in real time, look at a composite BMP image of every capture and the play back of AVI files.	Identifies a meteor event in real time, captures video frames, writes BMP, JPG, XML and FITS files for every capture. Should write AVI files but this function does not work in the Windows version. Does calibration of the captured image to a starfield database.
2. UFOAnalyzer	Allows calibration of the captured images to align with a starfield database. Identifies the start and finish points of each meteor. Writes a summary CSV and XML file for meteors captured within a specified time period. Has some duplication of UFOCapture's functionality, i.e. allows viewing of a composite BMP image of every capture and the play back of AVI files.	No equivalent
3. UFOOrbit	Using the CSV files produced by multiple stations, calculates orbits and ground tracks.	No equivalent available to public.

3. Suggested additional functionality

3.1 Overview

It is perhaps worth members of the FreeTure team installing and running UFOCapture/Analyzer/Orbit to become familiar with the functionality that it has, and what functionality meteor astronomers will expect.

Additional functionality which would make FreeTure acceptable to amateurs is:

(a) Display of realtime video so the user can see what the camera is seeing in real time.
(b) A graphical user interface so the user can enter and alter all information in the CONFIG file. Both (a) and (b) above are illustrated in Section 3.2, below.
(c) Production of an AVI file showing each capture (this feature does not work in the Windows version of FreeTure)
(d) Demonstration to the user that the camera is calibrated to the starfield – for an example, see Figure 3 and Figure 4 below and Section 3.3. This gives the user confidence that the camera is doing useful, accurate work.
(e) Being able to list all captures in a user-defined period and to "delete" uninteresting captures (which may just make them invisible to the user rather than actually deleting them).
(f) Being able to produce the XML and CSV files for all captures in a specified period as UFOAnalyzer does, allowing sharing of data between observers and use of UFOOrbit by collaborating groups[2].
(g) Use of a hierarchical folder structure for captures, like UFOCapture – the current folder structure for FreeTure captures is unwieldy.
(h) Calculation of calibration-related data in the config file rather than requiring user entry – for example, the "degrees per pixel" entry which is impossible for users to calculate as it depends upon the unknown calibration.

Existing functionality in FreeTure which perhaps needs to be explained to, or made accessible to users, includes:

(i) Display of the FITS files, including embedded data, and the ability to play them as a sequence like a video. This could be useful because the raw unprocessed frames captured by FreeTure may be very dark and so an AVI built from processed frames may be more interesting and informative.
(j) Display of frame number, exposure time and frame rate during operation - this is useful in the existing program and should be retained in the graphical user interface.

[2] A similar user request was made in November 2015 – see https://github.com/fripon/freeture/issues/6

3.2 Graphical User Interface

A graphical user interface showing real-time AVI capture and allowing user input of all configuration information is important. Two examples of this are shown below.

The first is from SonotaCo's UFOCapture:

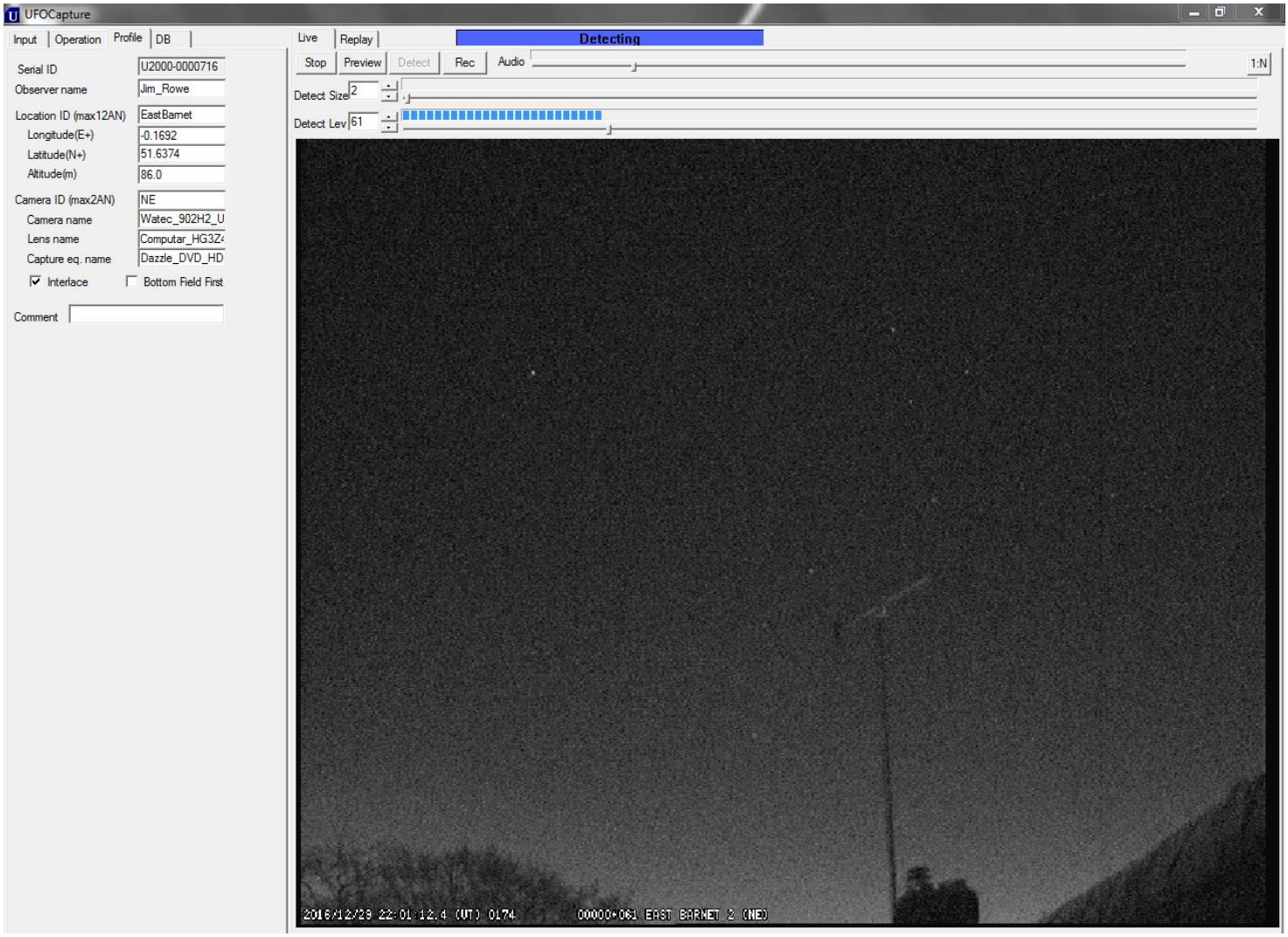

Figure 1: The UFOCapture input and display screen, with user input at the left and realtime camera video playing in the main window.

The second is from the Croatian Meteor Network[3], who have produced viewing software to be used with CAMS or Skypatrol capture software. On its website, CMN says that "the goal of CMN_binViewer software is to provide an all-around capability for easy data viewing, sorting, saving individual frames and images, making an animation, applying dark and flat frames and correcting image levels for CAMS and Skypatrol standard data."

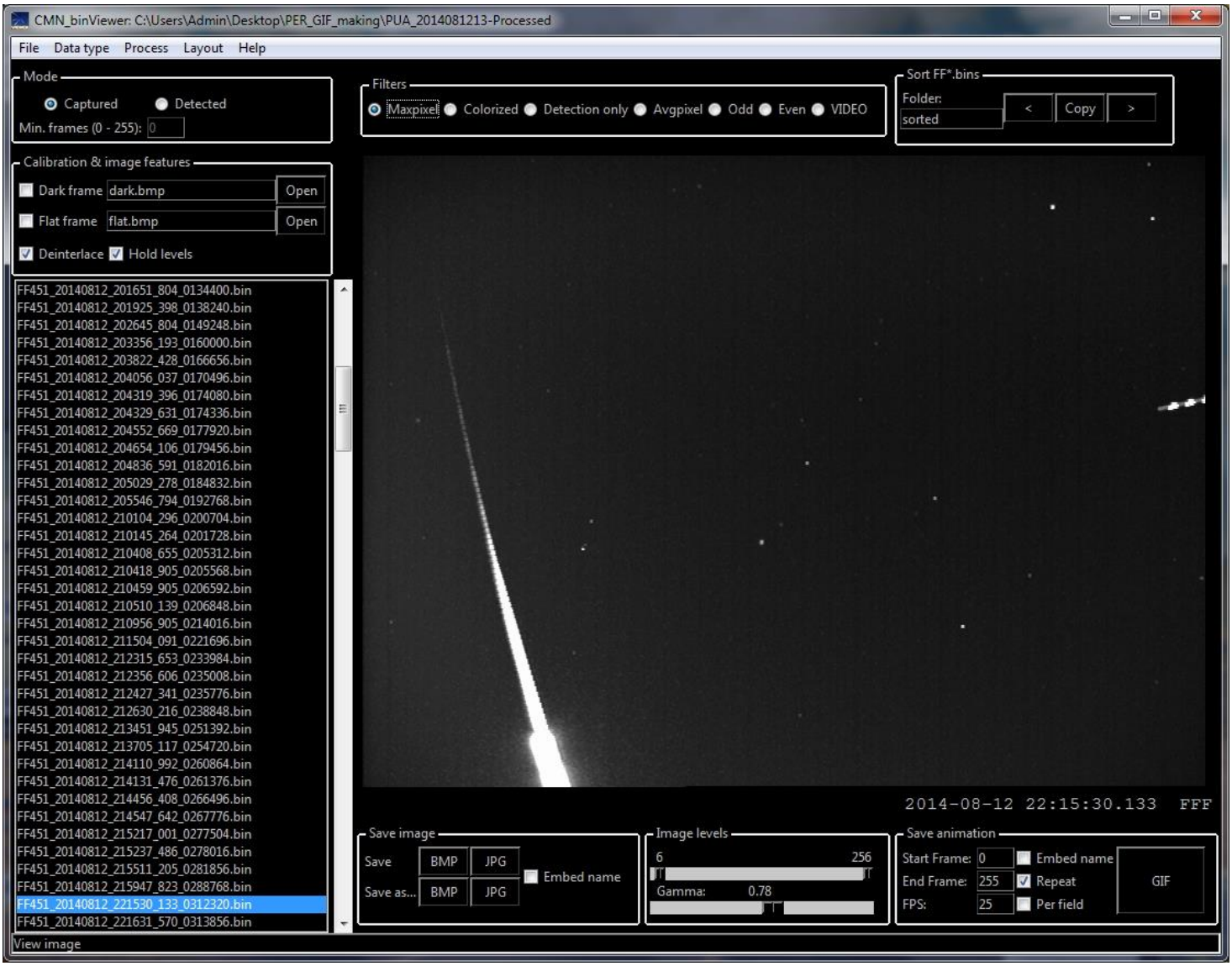

Figure 2:CMN's binViewer program, © CMN.

[3] http://cmn.rgn.hr/index.html

3.3 Calibration

Accurate calibration of the camera to the starfield is very important, and it is assumed that this is already done with care in FreeTure or it would not be able to function usefully. However, this process is not transparent to the user, and it is not clear what methodology is used. Unprocessed captures from a Fripon camera at 30 fps show few or no stars, and some useful bolide captures may include large amounts of cloud which obscure many stars.

For FreeTure to be accepted by amateur astronomers the calibration of the camera cannot just be a "black box", it will need to be documented and demonstrated. Two examples of this from other software systems are shown below. The first is from UFOAnalyzer:

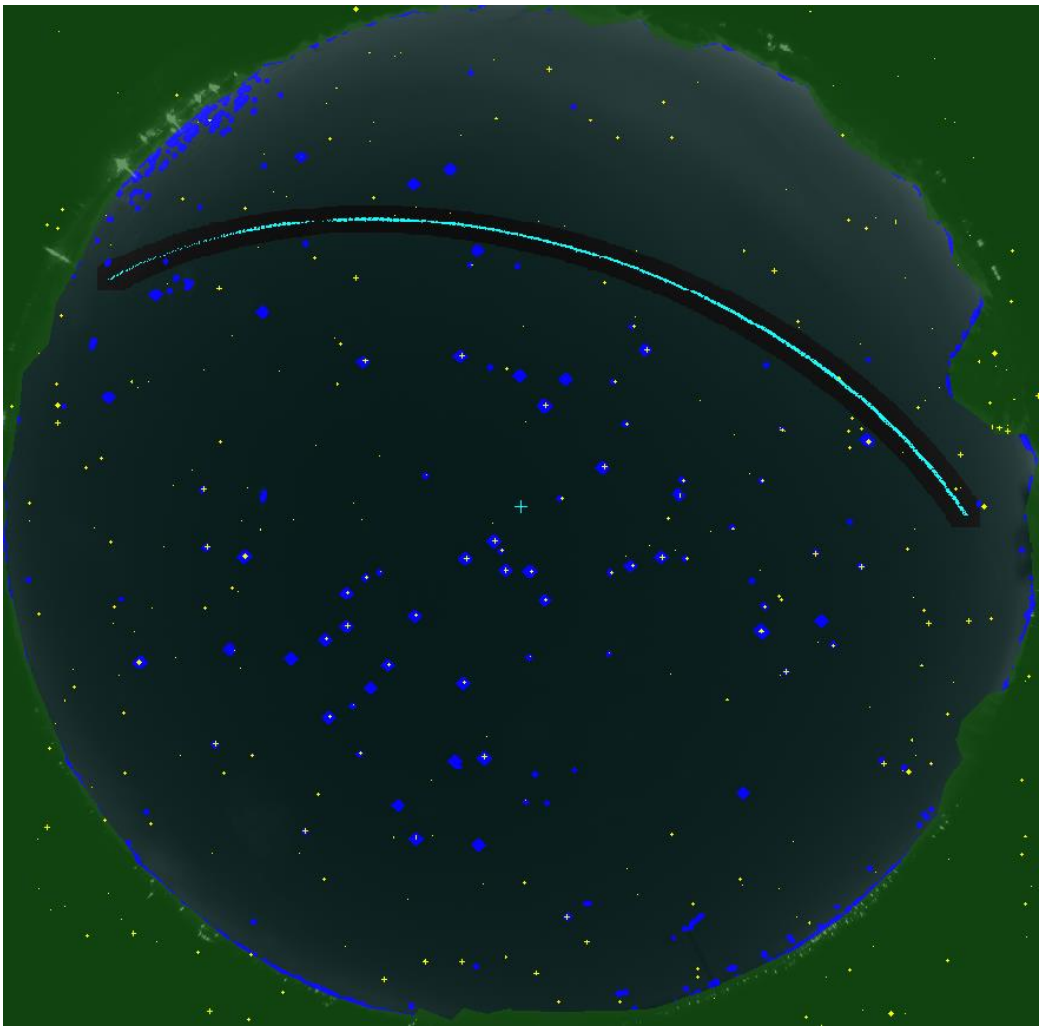

Figure 3- Demonstration of camera calibration in UFOAnalyzer. Blue dots are observed stars, yellow dots are predicted star positions.

The second is from proprietary software produced by Alcor System[4] of Lyon:

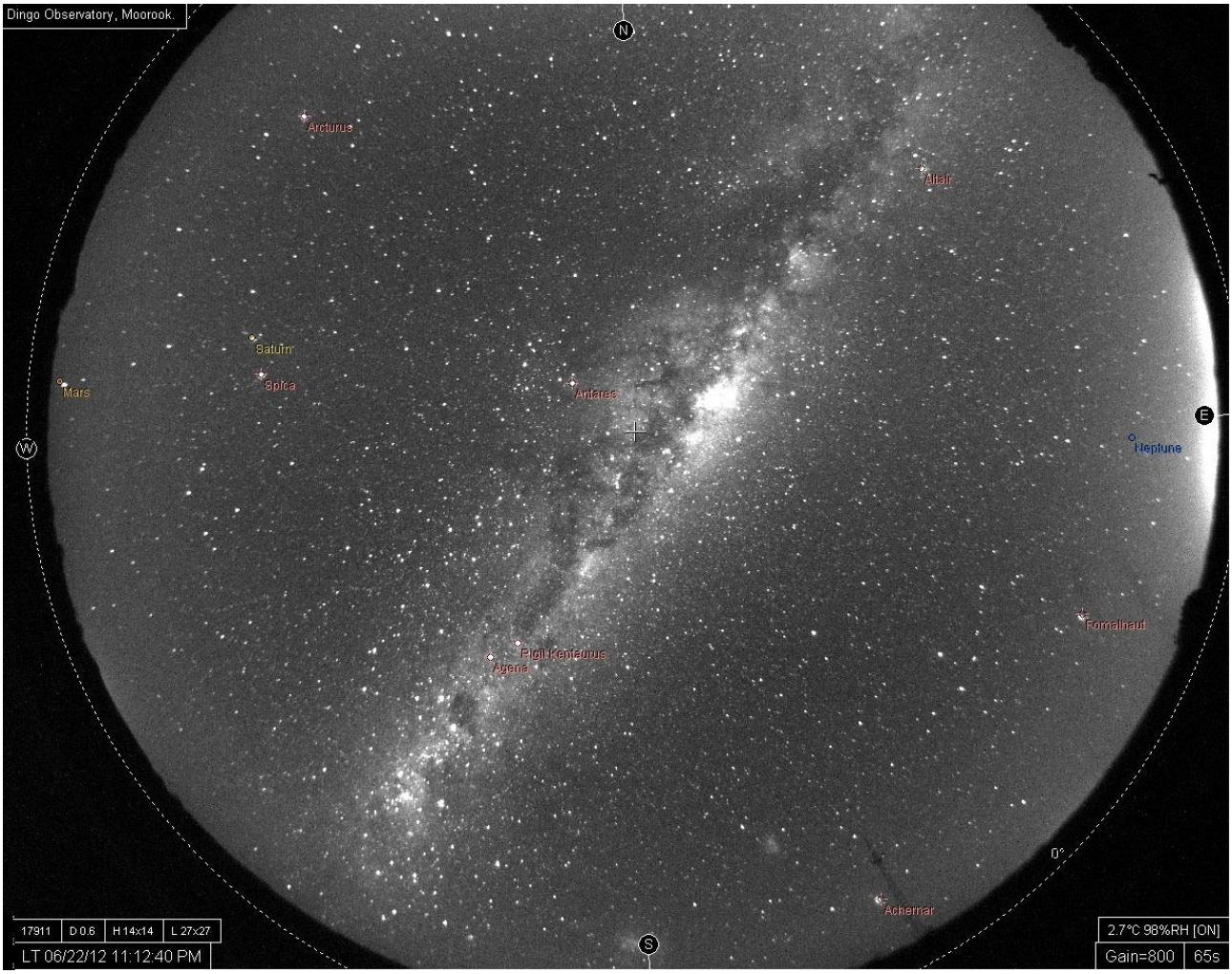

Figure 4. A thirty-second exposure was used to generate a calibration image, in which key stars were then identified and labelled. Image © Alcor System.

3.4 Installation of FreeTure

Windows installation of FreeTure is simple, but in needs to be documented that Basler Pylon version 3 needs to be installed, not version 4 or 5. Alternatively, FreeTure needs to be modified to work with Pylon version 5.

Debian installation is extremely difficult because the installation of dependencies is not managed by the FreeTure package and the list of dependencies on the FreeTure wiki is not complete. It is not clear where to get three or four of the necessary packages are, as they are not in standard repositories. I

[4] http://www.alcor-system.com/new/index.html

spent more than 40 hours on it and had a lot of user support from the Fripon team and still could not make FreeTure work with Debian. Automation seems essential.

During installation of either Linux or Windows versions, it is probably also worth prompting users to install an NTP package (such as Meinberg) because many amateur observers are not aware of the need for their computer clock to always be accurate.

3.5 Windows and/or Debian?

Most amateur observers will buy a cheap second-hand Windows PC computer costing about €100 to €150 to run their meteor camera. There is no need to buy a Windows licence because the computer will already have Windows 7, 8 or 10 installed. It is very difficult to get multiple cameras working with a single PC using UFOCapture, so an existing meteor observer with three cameras will already be running three dedicated Windows PCs. Each PC represents 10% to 20% of the total camera system cost.

It will therefore be very important to continue producing a Windows version of FreeTure and to keep it up-to-date. Every time there is a new Debian build of FreeTure, it would be good if a Windows build could be produced soon afterwards.

4. Other Tools for Outreach

FreeTure could be very useful part of the Fripon outreach campaign, alongside the project's excellent Facebook, social media and traditional media campaigns.

Another possibility is to produce a mobile phone app as has been done by the Australian "Fireballs in the Sky" network[5], or to commission a French, Fripon-branded version of this app. The Fireballs in the Sky app allows users to report their own meteor sightings by pointing it to the beginning and end of the meteor trail that they have just seen, picking from a list of fireball shapes to choose the one that matches the observation they just made and reporting any sonic boom. This app played a part in recovery of a 1.15 kg meteorite in Western Australia on 31 October 2016[6], as it had been adopted by a local astronomy club.

[5] http://fireballsinthesky.com.au/download-app/
[6] http://fireballsinthesky.com.au/2016/11/dfn-did-it-again/

5. Summary

FreeTure seems to have good functionality, but does not reward its users with information that they can see, understand or share. It will therefore not be adopted by amateur astronomers unless improved.

Key points for improvement are:

(a) Meteor triangulation necessarily involves collaboration, and most collaborative networks in Europe use UFOCapture with information being feed to the EDMOND database, which is then freely available for study. Unless FreeTure can produce the same information for collaboration within existing networks and with the Edmond database, it will not be widely adopted.
(b) A Graphical User Interface is a necessary part of any vision-based, camera-based application and is also needed to ensure that proper camera configuration is easy to do. A standard form of the interface already seems to have emerged.
(c) Calibration must be transparent and demonstrable as users will not accept a “black box”; and
(d) Installation needs radical improvement in the Linux version. Other software may also need to be installed as part of the package to make the camera system truly useful, such as NTP software.

Appendix - Example of UFOAnalyzer output files

Attached are the CSV and XML files produced by the “East Barnet 2” camera in London which lists the meteors captured in the first fifteen days of December 2016.

The content of each column is explained in various SonotaCo and publications and is largely self-evident. The meteor stream identification in column 2 is provisional and of little importance.