

General Installation and Operating Instructions

DMNS All-sky Camera

Chris Peterson, September 6, 2002

1.0 Installation

1.1 Hardware Requirements

350MHz CPU (Pentium, Pentium II, Pentium III, AMD)

One free PCI slot

1GB Hard drive

64MB RAM

Network card

Windows 98 or Windows NT/2000/XP with a DOS boot diskette or dual boot configuration

We did encounter one very new, fast computer at the Museum that did not work. For this application, you are probably best off with a slightly older machine. The 350MHz minimum clock speed is critical. Slower machines will not be able to capture video at the maximum rate of 30 frames/sec, and you will miss some meteors and incompletely record others.

It is important for this machine to participate on your school's network. It is difficult to keep the data on an isolated computer backed up, and you will need daily Internet access to upload your log files to the Museum. Network access also allows you to utilize tools designed to keep your computer's clock accurately set.

Many computers have power management features that are designed to put them into a sleep state after a period of inactivity. When running programs in DOS mode the power management system cannot tell if anything is active. You must disable power management, or your Metrec session may be terminated prematurely. Generally this involves accessing the machine's BIOS, usually by typing Del or F1 shortly after powering on or resetting. Navigate through the menus until you find power management, and make sure it is off.

1.2 Software Requirements

The Metrec V3.6 software runs under DOS only. On Windows 98 machines, you can enter DOS from the Start button by shutting down Windows and selecting **Restart in MS-DOS mode**. You can run Metrec on Windows NT/2000/XP machines, but it takes a little more preparation. The hard disk must be formatted using FAT32, not NTFS. You will need to be able to boot the machine into DOS. This can be accomplished by configuring the machine with a second operating system, either DOS or Windows 98 and using the NT boot manager to select which system you want at startup time. You can also prepare a DOS boot diskette on a Windows 98 machine and boot from this diskette when you want to run Metrec. Setting up these special boot options can be a bit tricky- if you need to run Metrec on an NT based machine, you may want to discuss your options with your resident computer guru (assuming you have one; perhaps one of your students).

1.3 Hardware Installation

Make sure your computer is unplugged. Remove its cover and insert the Matrox frame grabber into any free PCI slot. The card is sensitive to static electricity damage, so be sure you, the computer, and the card are all at the same electrical potential. Work on a static free surface, touch the computer, then touch the metal edge of the card. Now insert the card and screw down the edge bezel. Close up the computer and turn it on. Windows will start and probably detect new hardware has been added. You do not need to install any drivers, so just select **Cancel** if you are prompted to search for any. Some machines may not detect the new card, and Windows will start without asking for anything. This is probably okay, so don't worry yet. Now is also a good time to connect your camera to the BNC jack on the back of the Matrox card. At this point, it is best to have the camera indoors and next to the computer. It does not need to be in the all-sky configuration yet, i.e. you can just use the camera body

and lens without the mirror and mounting. Make sure the camera is plugged in to its power supply, and that the red LED next to the lens is on.

1.4 Software Installation

It is easiest to install Metrec from within Windows. Using Explorer, open the root of your C drive (from My Computer, double click your C drive to open it in a window). Insert your install CD and open it in a window just like you did your C drive. Drag the folder called Metrec from the CD Explorer window into the C drive Explorer Window. This will copy the entire folder to your hard drive. When the operation is complete, you should be left with a folder called Metrec in the root of your C drive. Open this folder, select all the contents, and right click. From the resultant context menu select Properties, and in the dialog box make sure Read-only is unchecked. You may need to click this box a couple of times until it is completely clear. Select OK to close the dialog.

When you ask DOS to execute a program, it looks for that program in the current directory. If it does not find the program there, it searches a list of directories identified in a special variable called **PATH**. In order to run the Metrec programs, you need to make sure that their location is specified in the **PATH** environment variable. In the root of your C drive, you should have a file called **Autoexec.bat**. If you don't, you need to create it using Notepad or some other text editor. Open this file, and add a new line at the end:

```
set path=%path%;c:\metrec
```

This appends the location of the Metrec programs to the existing path value. Save the file, and restart your computer.

1.5 Testing the Basic Setup

Everything should be ready to operate now. Test your system by exiting Windows to DOS. You will see a rather unfriendly black screen reminding you of your computer from ten or fifteen years ago. It will probably display a prompt like **C:\Windows>**. Change to the Metrec folder by typing **cd\metrec**. Your prompt should now be **C:\Metrec>**. Type **g** to start the grab program running. After a couple of seconds, a window will open up displaying the real-time image from the camera.

You can hit the key several times to make the window larger on your screen. Note the menu at the bottom of the screen. Experiment with these keys to control the image brightness and contrast, and the number of frames averaged together. Use lower case letters to increase values, and upper case letters to reduce them.

If you don't see an image on the screen, make sure the camera has power and is correctly connected to the Matrox card. You may need to open the computer and make sure the card is seated properly (be sure the power is off when you do this).

1.6 Configuring Metrec

If you are interested in the technical details of operating Metrec, view the **readme.txt** file in the Metrec folder. It is not necessary to understand all these details, or to change the configuration file in order to use the program.

The three programs you will be using are **metrec.exe**, which is the actual meteor grabbing application, **postproc.exe**, which is the post processor that you will use for looking at the data you collect, and **grab.exe**, which displays a live image from the camera and can be used to save individual frames. Small scripts called *batch files* are already set up to invoke these programs, **night** (and **nightat**), **pp**, and **g** respectively. All of the required configuration values are contained in a single file called **allsky.cfg**, which is read automatically when you invoke the **night** command. There are only a few values in this configuration file that you may want to modify:

FrameSize: you need to measure the field of view of your all-sky camera along the Y-axis and enter the value here. This is used to calculate the angular velocity of meteors. If you aren't clipping the image of the mirror at the top or bottom, the default value of 130 degrees is probably fairly close. There is an excellent opportunity for a class project in applied trigonometry here, by moving a

vertical pole of known length to a distance from the mirror where it is just possible to see its top and calculating the resultant field of view.

RecognitionEndTime: enter the time you want the program to stop running in the morning. The default is 6 00 00, for 6:00:00 am. You will want to adjust this occasionally to account for sunrise at different times of the year. There is little reason to leave the program running much past sunrise.

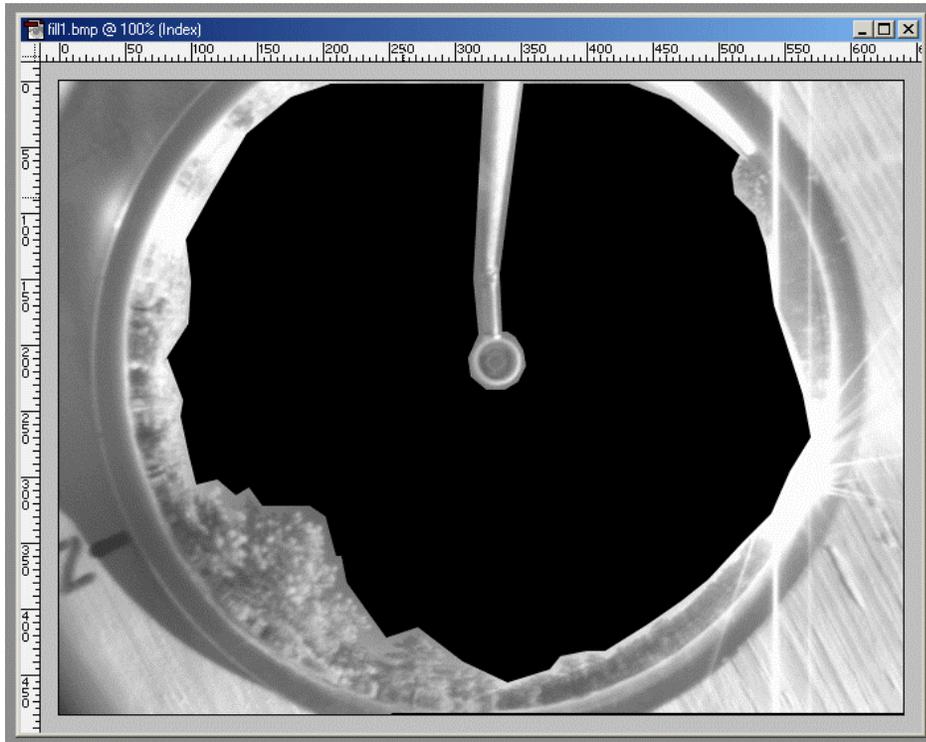
RecognitionRestartTime: enter the time you want the program to restart in the evening. The default is 20 00 00, for 8:00:00 pm. You will want to adjust this occasionally to account for sunset at different times of the year.

UseInputMask: you may need to define a mask to block out parts of the image you do not want considered for meteor evaluation. A light behind a tree, or something that reflects headlights, will trigger false alarms. You can easily construct a mask using a graphics editing program. Here is the procedure using Photoshop 6:

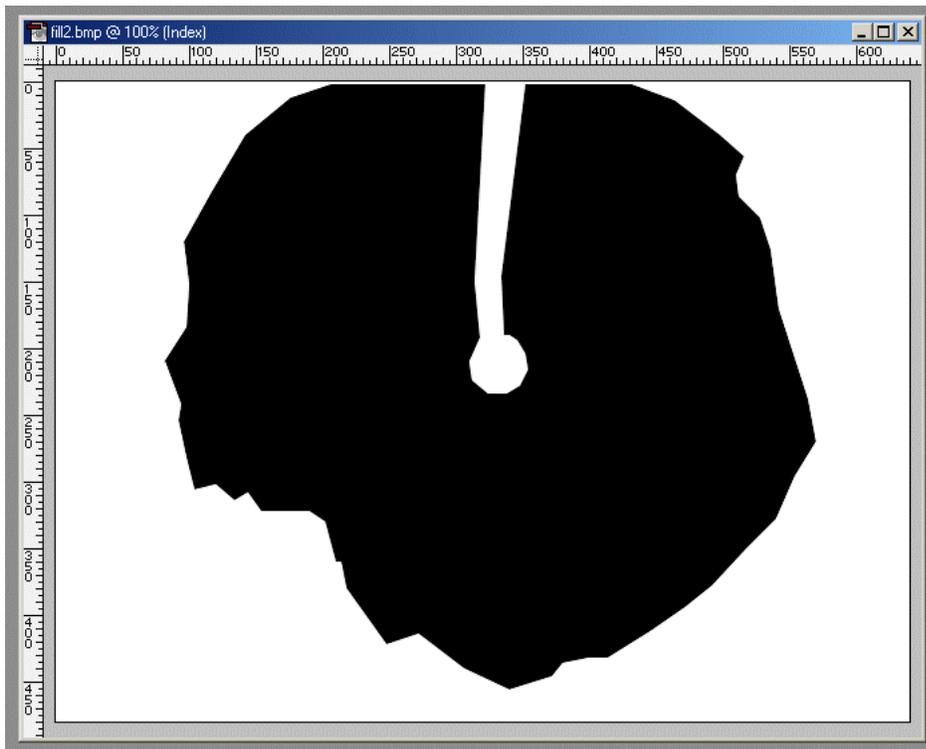
- 1) Begin by grabbing a single image from the camera. Execute the **g** command and press . This will save the image on the screen in the Metrec folder, in the file **temp.bmp**.
- 2) Restart Windows and open Photoshop. Open **temp.bmp** for editing in Photoshop.
- 3) Convert the image to grayscale (**Image | Mode | Grayscale**).
- 4) Use the Polygonal Lasso tool to draw around the areas of the image you want to use for meteor detection.



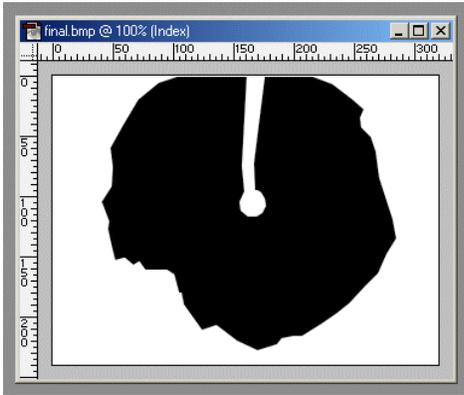
5) Fill the selected area with black (**Edit** | **Fill**).



5) Invert your selection (**Select** | **Inverse**) and fill it with white (**Edit** | **Fill**).



6) Resize the image to 320 by 240 pixels (**Image | Resize**).



7) Change the image to a one-bit bitmap (**Image | Mode | Bitmap**).

8) Save the image as **mask.bmp** (**File | Save As**). Exit Photoshop.

Place this mask file you have generated in the Metrec folder, and make sure that **allsky.cfg** contains these lines:

```
UseInputMask = yes
InputMask = mask.bmp.
```

1.7 Camera Installation

The computer hardware and software are working, and you have built your all-sky camera. The next step is to install the camera in its final location and route the power and signal wires to your computer. It is important to verify that all of the camera fittings are tight and that the camera assembly itself is securely attached to your mounting surface. If anything can move, it will change the calibration of your camera and reduce the accuracy of future measurements.

1.7.1 Focus

Good focus is critical. The camera is imaging what are essentially point sources. If it is even slightly out of focus, these point images will have their light distributed over more pixels, and camera noise will become dominant. It is important to focus the camera at night, using a bright object in the sky as a target. Although it is possible to do this with one person at the camera and another at the computer, the simplest approach is to use a TV monitor right at the camera. Jupiter is an excellent object on which to focus. Make absolutely certain that the iris is wide open. If you have the lens stopped down at all, you will increase the depth of field and make it difficult to tell when the camera is in focus (i.e. it will look to be in focus over a wide range, and when you finally open the iris to image meteors, you probably won't be at optimum focus). Position yourself so that you are not blocking the object you are using for focus, and adjust the focus ring until you get the smallest, brightest image. That's all there is to it. Remember that the sky is a lot farther away than the camera and its support stalk. Expect to see the camera (and the power light if your camera has one) slightly out of focus. If the image of the camera is sharp, you do not have the sky properly focused.

If you use the camera during the day, you will need to stop the lens down, i.e. reduce its aperture. This is quite easy to do, but you must be very careful to avoid accidentally changing the focus. If you have projects requiring daytime use of the camera, consider replacing the lens with one that can adjust the iris automatically as the light level changes.

1.7.2 The Mirror

You may want to clean the mirror and treat it with Rain-X. The directions provided on the bottle are fine. Be careful when cleaning the mirror not to scratch it.

2.0 Operation

Now that everything is set up and operating correctly, you are ready to begin nightly operation of the camera.

2.1 Setting the Time

Although we have tools that try to correlate data between cameras with slightly different times, the quality of the data depends heavily on the accuracy of the clock in your computer. **Please ensure every day that the clock is accurate**. If your school's network has a time server on it, verify that it actually has a good time source before using the time packets it sends out. A good time source is either a piece of hardware on the time server, such as a GPS or WWVB receiver, or a program that uses an Internet time service. You can test if your network provides time synchronization services by deliberately setting your clock incorrectly, and then watching for it to adjust itself. If this happens, check it against WWV or a GPS for accuracy. Perform this test from Windows; DOS does not have networking support and will not recognize any correction information sent out from a server.

If your network does not provide a time service, you may want to consider adding a utility to your local computer to perform this function. A couple of good choices are Tardis, available at www.kaska.demon.co.uk and AtomTime, available at www.atomtime.com. In order for these applications to work, your machine must have Internet access, either directly through a modem or via a gateway on your network. These utilities can also be installed on a server on your network, and configured to synchronize all the workstations. A well designed network will already be doing this, however.

Because these time correction services only work when Windows is operating, you should stop Metrec in the morning and allow Windows to restart. The machine should be on, with Windows running, during the day. Try not to restart DOS until late in the day.

2.2 Starting Metrec

The time you actually start the program running will depend upon your individual circumstances. Try to start as late as possible. Running the program when it is still light tends to generate many false events. This is not a real problem, but will increase the time you spend sorting through the data for real events. There is a parameter in **allsky.cfg** that controls how the data folder is named. If you start Metrec with **DateCorrection = yes**, it will create folders with the previous day's date if the start time is between midnight and noon, otherwise it will use the current day's date. If you sometimes start the program after midnight, this is useful (otherwise you could end up with two days of data in a single folder). However, if you have this option set you should not start a normal evening's collection before noon of that day or the data will end up in the previous day's folder.

To start Metrec, shut down Windows and restart in DOS mode. If necessary, change into the Metrec folder by typing **cd\metrec**. Your prompt will be **C:\Metrec>**. To start immediately, type **night** and watch for a few moments to verify that the program starts and that the **No recognition** warning goes away. Check the frame rate display on the left side of the screen. If it isn't fluctuating between 29 and 30 frames/second, your computer is not fast enough. You will not be able to generate high quality data. You may also command the program to start later. Do this by typing **nightat 21:00** to start at 9pm (or use any time shortly after sunset.) You may leave things as you see, or hit to start a screen saver built into Metrec. You may also wish to simply turn off the power to the monitor. If you do not use the Metrec screen saver or turn off the monitor, the screen may eventually have a permanent image of the Metrec display burned into it.

2.3 Stopping Metrec

Stop the program by hitting . If you do this before the automatic shutdown time set in the configuration file, you will be asked to confirm the shutdown. Otherwise, the program will simply exit.

2.4 Viewing and Filtering Your Data

So where is the data you collected? When you start Metrec, it automatically creates a new folder inside the **Data** folder. The name of the folder created will be based on the date you start: YYYYMMDD, e.g. **20020125** for January 25, 2002. All the data collected in that session (much of which will be after midnight, and therefore on the next calendar date) will be placed in this new folder. To examine your data, you must first navigate to the folder. Enter **cd\metrec\data\20020125** (with whatever date you want). There will be files with three extensions in this folder: **.BMP** files are combined meteor images, **.BND** files are the individual meteor frames, and there will be a single **METREC.LOG** file summarizing all events. The bitmap and band files will be named according to the time of the event, e.g. 023454.bmp for 2:34:54 am. Note that the bitmap files can be viewed from Windows using any graphics editor or viewer, and will show the full meteor track (all the individual frames combined).

To review the data collected, invoke the post processor by typing **pp**. You can quickly cycle through events by using  and . Type **m** to animate each event. You may have difficulty seeing anything. Make sure the monitor brightness is high. You should be able to see a little rectangular band get painted during the animation. This is the location that a possible meteor was recorded. Study it for any sign of a moving spot. If you believe that you see a meteor, type **k** to keep the event. If nothing is there, type **d** to delete the event. If you see something interesting that you want to keep, but which is not a meteor, type **o** to move it to a miscellaneous directory.

You will see many false events. The most common will be caused by aircraft. These usually appear as stationary blinking lights. You will often catch a series of these over a minute or more as the aircraft moves across the sky and is repeatedly mistaken for a meteor. Normally, you should delete these events.

As you go through all the events, deleting, moving, or keeping, you are really only marking them for future action. If you change your mind, use the arrow keys to move back and select a different choice. Images will be marked with a cross if you have selected them for deletion, and a single line if you have selected them for moving. Take your time going through the images, make your choices, and use the arrow keys to review those choices. When you are satisfied, type . The program will summarize the actions it is going to take, and ask for your confirmation. If you type **y**, the deletions and moves will be performed. Type  to leave the post processor.

You are done with DOS until the evening, when you start Metrec running again. Restart Windows by typing **exit**.

2.5 Defragment Your Disk

You will probably notice that after you collect several days of data, or after a session with many meteors (or false events), that the post processor operation gets very slow. It may take a second or longer to move from one event to another. This is caused by the way the video gets written to the disk. The program is not very clever about this, and creates a condition known as *file fragmentation*. You can fix this from within Windows by opening My Computer and right-clicking on the C drive. Select **Properties**, and in the dialog box select the **Tools** tab. Now select the **Defragment** button and allow the operation to proceed. This may take as long as an hour. My experience is that I have to perform this operation every few days when using Metrec nightly.

2.6 Submitting Your Data

From Windows, open Explorer and navigate to the folder with the data you need to submit (e.g. **C:\Metrec\Data\20020125**). Use the right mouse button to drag **Metrec.log** onto your desktop, and select **Copy** from the menu. Now rename this copy on your desktop to match the name of the folder you dragged it from. In this case, you would rename it **20020125.log**. In the case of data collected by the Clodbait camera starting on January 25, 2002, I would rename **Metrec.log** as **20020125.log**.

Next, access the ftp site currently used for uploading data to the Museum. Open Internet Explorer (or you may use a dedicated ftp client if you prefer) and in the address bar enter **ftp://ftp.allsky.dmns.org**. If you use an ftp program, connect to **ftp.allsky.dmns.org**. Log in using the user name and password your school was provided with. Drag the renamed log file from your desktop into Internet Explorer or the ftp folder. It should successfully copy in a few seconds. The museum now has the data and it will be added to the master database.

2.7 Protecting the Source Data

You are only submitting your daily text log files to the Museum, not the images you obtain. If anyone analyzing the data detects something interesting, they may need the video data that was collected. You are responsible for making sure that this data is safe and available for as long as you are participating in the project. You should consider moving or copying the data (everything in the **C:\Metrec\Data** folder) off of the local machine and onto a network server where it will (hopefully!) be backed up regularly. About every month you will also need to back it up yourself onto a CD.

3.0 Accessing the Data

Of course, all of your locally collected data is readily available to you for analysis. However, much interesting analysis involves working with data from multiple cameras. Also, schools that do not yet have operational cameras will want to access the collected data. We are arranging for a special Internet site hosted by the Museum where the global database will be available to all project members. This will be updated daily and available for download. Also available will be a set of tools for analyzing the data. Project participants are encouraged to write their own analysis tools and submit them to the Museum for use by all members. In the meantime, anyone wishing to work with the database can email me directly (clp@alumni.caltech.edu) and I will send the latest database or make it available for download.

The database is in Microsoft Access format. It can be manipulated with Access, or with a variety of other tools such as Excel, Visual Basic, or C. The current analysis tools are written in Visual Basic, and their source code is available through the Museum to any project members wishing to modify the tools or use them as starting points for new ones. There are some excellent programming opportunities in this area for your more advanced students.