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Witold Polesiuk
The Paderewski School Complex no. 1 in Wałbrzych

DISCOVERING THE MOONS OF JUPITER.

The pictures were taken during observations on 24.06.2005, around 9.30 pm.
The observations were made with the use of an „Apollo” telescope, over thirty
years old, made in the former East Germany, whose focal length is 90 cm and
the diameter of the lens 6 cm, and with a Philips webcam.

The sky was so bright that practically only Jupiter itself was visible.
An AVI film was prepared with the use of the K3CCD program, about 30 sec.
long, comprising around 200 frames. The camera’s parameters were set
manually (the „auto” mode was off):
frame rate - 15 per second, gain and exposure set appropriately.
In each frame the bright sky is visible, as well as the disc of Jupiter.

A sample AVI file can be downloaded from the Internet:
<http://www.cft.edu.pl/~lech/HOU/Materials/jowisz.avi> (90 MB)

The file was processed as described below, with the help of the program IRIS.
The program is available for free at:
<http://www.astrosurf.org/buil/us/iris/iris.htm>

Processing the film with the pictures of Jupiter taken with a webcam

1. Create a new directory on your disk, e.g. „Jupiter”. IRIS needs quite a lot of
space on the disk to analyse the film – roughly 10 times as much as the raw
film itself – in the case of jowisz.avi half a GB will not be enough!

2. In the „File” menu select „Settings” and set the path to the „Jupiter” directory in the „Working path” field.
3. In the „File” menu select „AVI conversion” and in the field „AVI file” give the name of the AVI file with the pictures of Jupiter. (The AVI file can, but doesn't have to be in the „Jupiter” directory). Select „Color” and in the „Red band output file name” field give the name under which the program will automatically save working copies, e.g. „r”. In the lower fields, analogically „g” and „b”. Click on „Display” to see the selected film. In the „AVI conversion” window click „Convert” all the time and the program will automatically analyse the individual frames into RGB components, saving individual pictures in the „Jupiter” directory. The process lasts around 1 minute.
4. In the main window, select the area with Jupiter using the left mouse button. From the toolbar, select the „command” icon:  and a dialogue window will be displayed.
5. In the dialogue window type the „compute_trichro1” command and accept it by pressing the enter key. The syntax of the command will be displayed: in the „master” field type one of the colours, preferably „g”, then „r”, „g”, „b” as in point 3; in the „size” field type „512”; in „select nb” a number slightly smaller than the number of frames in the film; in the „total nb” the number of frames in the film. (This one has probably 199). The command will look as follows: „compute_trichro1 g r g b 512 190 199”.
6. Accept the command by pressing enter and the program will do the calculations automatically. Individual colours are analysed, then the shape of Jupiter is centred, and finally, the individual pictures are added. On my computer this process lasted a little over 10 minutes.
7. The final picture should be saved on the hard disk with the command „savebmp” – as a bitmap, „savejpg” – as a jpg, or simply „save” as a fits file. It should be remembered, however, that fits files can be opened only with a special program, such as IRIS.
8. We have the final pictures, so it is high time we found the Jupiter's Moons in it. In the „threshold” window select „auto” and the Moons should be clearly visible. You can also open „View” and select „Logarithm” and then in the „threshold” window select „auto” or set the scale manually.
9. Still in the „threshold” window and the „Logarithm” scale, you can switch to a black-and-white picture. If we set the sliders so that black represents the number of counts slightly smaller than maximum, then the structure of

Jupiter's atmosphere will be visible in the picture. Of course, the Moons are not visible at this scale.



Jupiter and its Moons. The black border around the picture is caused by adding several frames that are shifted in relation to one another.

10. In the „View” menu select „Slice” and drag the mouse across Jupiter and the Moons. A graph will be displayed, showing the number of counts in pixels in the selected area. It can be seen that the Moons are not very bright.
11. IRIS creates plenty of working files in the „Jupiter” directory. After the work is finished, it is recommended to move the film and pictures to a different directory and clear the unnecessary files from the „Jupiter” directory.
12. In case of problems during the work with IRIS you can refer to the Help file in the program.
13. Is it possible to identify the visible moons? The observations were performed in Wałbrzych (Poland) on 24.06.2005 at approximately 9:30 pm. “Sky and Telescope” has a very useful “Jupiter Moon Simulator” at

<http://skyandtelescope.com/observing/objects/planets/javascript/jupiter.html>

Hint: orientation of Jupiter and moons (up – down, left – right) depends on the optical system and on the orientation of the webcam with respect to the telescope.

Edited by A. Majczyna and M. Nalezyty

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