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Infrared Studies of Jupiter Using Image Subtraction

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Abstract

1. Images of Jupiter were taken with a set of bandpass filters in the near infrared region of the spectrum from 600 nm to 1000 nm. Subtle changes in detail are best recorded by compiling a colour image using three infrared bands or by digitally subtracting one image from another.

2. Introduction

The aim of the poster paper is to demonstrate the effectiveness of image subtraction to enhance the visibility of fine Jovian atmospheric detail from 600 nm to 1000 nm. The procedure is supplemented by compiling a colour image based on three infrared bands. The data is readily obtainable by amateur astronomers using commercial equipment.

3. The Equipment

The telescope is a 246mm f/10 apochromatic refractor. The instrument is mounted equatorially in a 3.3 metre fibreglass observatory situated in the authors backyard. All above mentioned items have been made by the author.
The camera is an ASI224MC camera made by the ZWO company. It has an IMX224 sensor with 1.2 megapixels each 3.75 µm square.
A set of band pass filters made by Andover Corporation is used to image Jupiter. The set is comprised of six filters with a centre bandwidth of 600, 700, 800, 900, 950 and 1000 nm respectively. Each filter has a FWHM bandwidth of 40nm. In addition, a methane absorption filter centred on 889nm with a FWHM bandwidth of 8 nm is used.

4. Processing.

After a set of data is acquired using all filters up to 1000 nm, the images are processed in an identical manner using the software packages Autostakkert and RegiStax6. Subtle differences are difficult to highlight without a more direct means of comparison.

5. Enhancement

Two methods of enhancement are used.

5.1 Composite Colour image.

Three images of descending wavelengths are assigned to red, green and blue channels and are used to create a false colour image of the planet. The resultant colour image emphasizes the brightness of a feature at that wavelength. Figure 1 is an example of allocating images taken with the 800x40, 700x40 and 600x40 nm filters allocated to red, green and blue channels.

5.2 Image Subtraction.

The second method uses numerical subtraction of two images taken with different bandpass filters to directly highlight the differences. The images to be subtracted must be taken at very close to the same time. To make this so one image must be de-rotated. For example, if an image taken with a 600x40 nm filter is to be subtracted from one taken with an 800x40 nm filter it is necessary to acquire a 600 nm image, an 800 nm image and a 600 nm image in that order. The two 600 nm images are then combined using the Winjupos software and time of the resultant image is very close to that of the 800 nm image. The combined 600 nm image is then subtracted from the 800 nm image using Matlab. Figure 2 shows the results of the procedure.

6. Results.

Enhanced images as a result of image subtraction show an increase in subtle detail not otherwise obvious. A sample is shown in Figure 3.

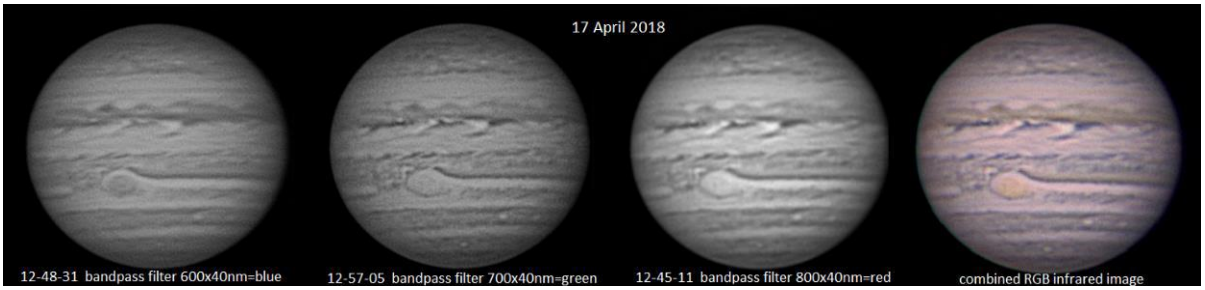

Figure 1.

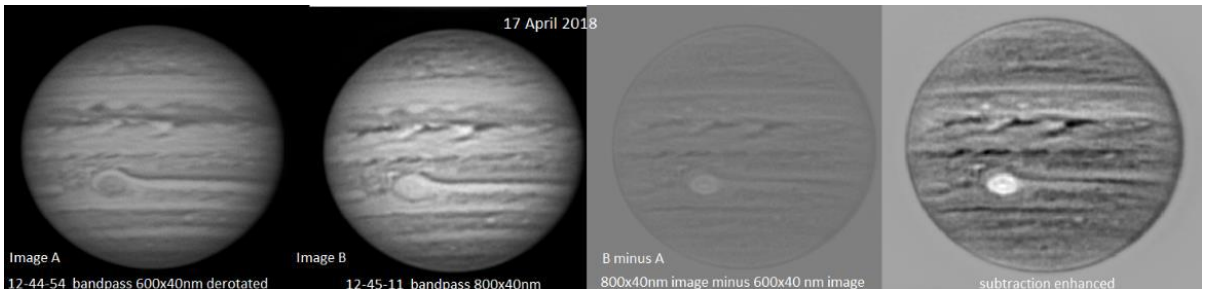

Figure 2.

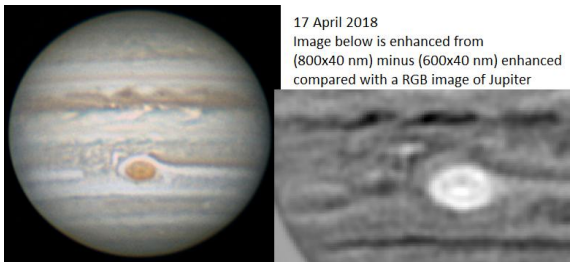

Figure 3.

7. Summary and Conclusions

There are just as many subtle changes in detail in the infrared region of the spectrum as there are in the visible region. The detail may be enhanced by processing a "colour" image using infrared bandpass filters or by directly subtracting one image from another.

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