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DeTeCt3.1.: A software tool to detect impacts of small objects in video observations of Jupiter obtained by amateur astronomers

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Abstract

Small objects (10-20 m in diameter) impacting Jupiter produce luminous superbolides that can be observed from the Earth with small size telescopes. Five of these impacts have been observed by amateur astronomers since July 2010. Recent analyses of these impacts try to infer the impact rate in Jupiter of such small objects towards a better characterization of the global impact rate in the giant planet [1-3]. Amateur astronomers observe Jupiter using fast video cameras that record thousands of frames during a few minutes which combine into a single image that generally results in a high-resolution image. Flashes are brief, faint and often lost by image reconstruction software. We present upgrades in the software DeTeCt initially developed by amateur astronomer Marc Delcroix and our current project to maximize the chances of detecting more of these impacts in Jupiter.

1. Introduction

The first fireball impact in Jupiter was observed by Anthony Wesley from Australia and Christopher Go from the Philippines in July of 2010 [1]. Further impacts are detailed in references [2-3]. These impacts were detected by the individual observers through the visual examen of their video observations. In most cases an individual observer reported the impact and other observers reviewed the data they have acquired during the same night finding the flash in their video observations. Sometimes these impact detections occurred days after the impact because of the faint nature of the impact and the long duration of the videos. It is recognized by many of the observers the difficulties to efficiently find the weak flashes on long night-time observing runs. Some observers storage Terabytes of past video observations of Jupiter equivalent to dozens of days of observing time and their analysis could potentially result in new detections of past impacts. Thus, a software tool able to automatically analyze video observations of Jupiter and find potential impacts could detect new impacts if its use is promoted within a number of observers large enough.

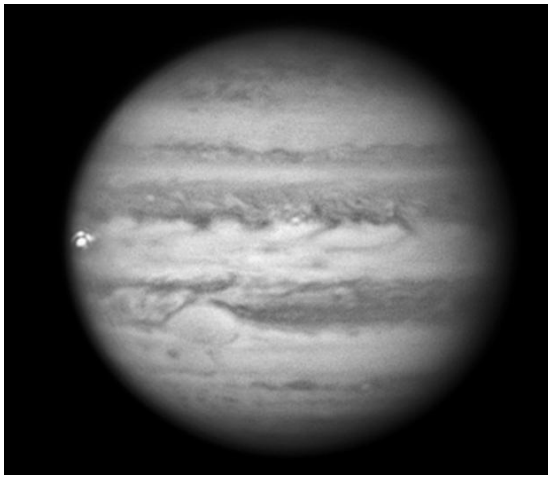

Figure 1: Image of the most intense Jupiter flash event recorded by George Hall in September 10, 2013. Background image from stacking all frames in the video sequence. The bright flash corresponds only to stacking the frames where the impact was visible in the video. Note the diffraction patterns around the punctual light source associated to the bright flash.

2. DeTeCt

DeTeCt is an open source Linux/Windows application developed by M. Delcroix that allows to search for impacts in Jupiter videos. The software has been regularly used by dozens of observers

examining data equivalent to about 76 days of observations distributed unevenly over the last few years. Over the last year we have developed and released a new version of the software: DeTeCt3.1. with some technical improvements and a graphical user interface that makes its use much easier. The software is fully documented and available at:

http://pvol2.ehu.eus/psws/jovian_impacts/

DeTeCt3.1. was developed as part of the Europlanet-2020 RI Planetary and Space Weather Services (PSWS) and is integrated into the PVOL web service (also developed through Europlanet-2020 funds).

The detection algorithm is based on differential photometry on coregistered images of the video sequence. Additionally the software produces detection images for each video that can be quickly inspected by the observer (see figure 2).

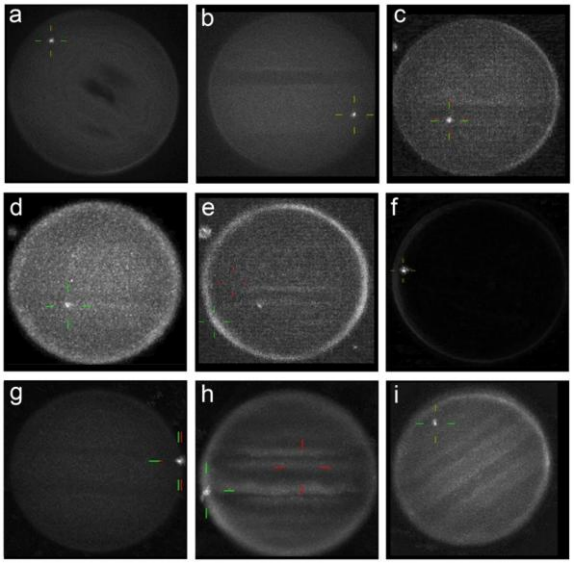

Figure 2: Collection of detection images produced by DeTeCt3.1 over past impacts in Jupiter. Although some weak flashes are missed by the software and false positives are still produced by the software the examen of these images unambiguously result in detections.

Our goal with this project is to maximize the number of users that examine their video observations of Jupiter. Large impacts (objects larger than 20 m) could also be observed in Saturn and we encourage the use of the software in video observations of both planets.

Statistics on the use of the software are prepared by one of us (M.D.) and can be accessed at:

http://www.astrosurf.com/planetessaf/doc/project_detect.shtml

3. Amateur-profesional collaboration

The latest impact events in Jupiter occurred in March 2016 and May 2017 [3]. The large number of Jupiter observations linked to the Juno mission and its call to amateur observers to participate in the mission through regular monitoring of the planet will contribute to obtain more observing time of the planet. The fact that Jupiter oppositions have moved from North hemisphere winter in the last few years to Spring in the last few Jupiter opposition will result in better chances of finding new impacts in the planet. A wide use of DeTeCt should help to identify these impact events characterizing better the flux of impacts in Jupiter.

Acknowledgements

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