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DeTeCt 3.0: A software tool to detect impacts of small objects in video observations of Jupiter obtained by amateur astronomers

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Abstract

Impacts of small size objects (10-20 m in diameter) with Jupiter atmosphere result in luminous superbolides that can be observed from the Earth with small size telescopes. Impacts of this kind have been observed four times by amateur astronomers since July 2010. The probability of observing one of these events is very small. 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 major upgrades in a software tool 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]. A second superbolide in Jupiter's atmosphere was observed from Japan in August of 2010 by three amateur astronomers (Masayuki Tachikawa, Kazuo Aoki and Masayuki Ichimaru) with telescope apertures in one case as small as 15 cm. A third fireball was observed in September of 2012 by Dan Petersen from Racine, Wisconsin visually observing Jupiter with a small telescope and resulting in an alert that reached to George Hall from Dallas, Texas who happened to have a video observation of the planet with the impact [2]. The last object that was detected to impact Jupiter was discovered by Gerrit Kernbauer and John McKeon observing the planet on March 16, 2016. All of these detections were produced by the visual examen of the video signal, sometimes as it was being recorded by in many other cases days after the video recording happened. Some of these events are so faint that they would be difficult to find visually and many amateur astronomers storage Terabytes of past video observations of Jupiter equivalent to dozens of days of observing time.

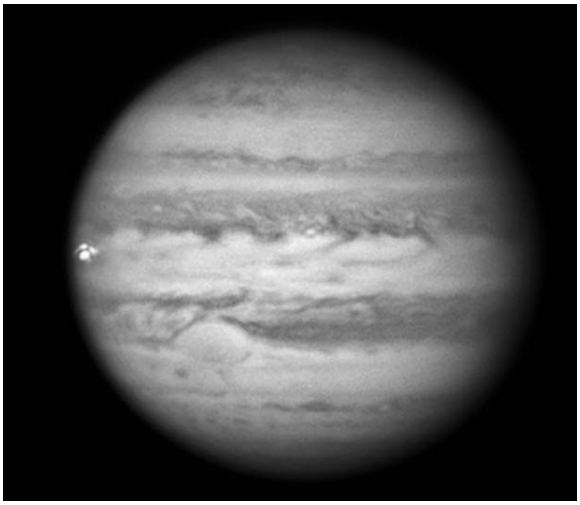

Figure 1: Image of the most intense Jupiter flash event recorded by George Hall in September 10, 2013. Background image from stacking all frames in the video sequence. The bright flash corresponds only to stacking the frames where the impact was visible in the video. Note the diffraction patterns around 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 first versions of this software was developed and written

by Luis Calderon from Spain as part of his Master in Space Science and Technology. An improved version was done by Marc Delcroix from France and has since then been regularly used by dozens of observers examining data equivalent to about 76 days of observations distributed unevenly over the last few years. The software runs from the line command and produces log files that can be used to examine the statistics of non detections when comparing with the fortuitous detections of impacts. It also produces detection images (see Figure 2). The detection algorithm is based on differential photometry on coregistered images of the video sequence. The software and its statistics can be accessed at:

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

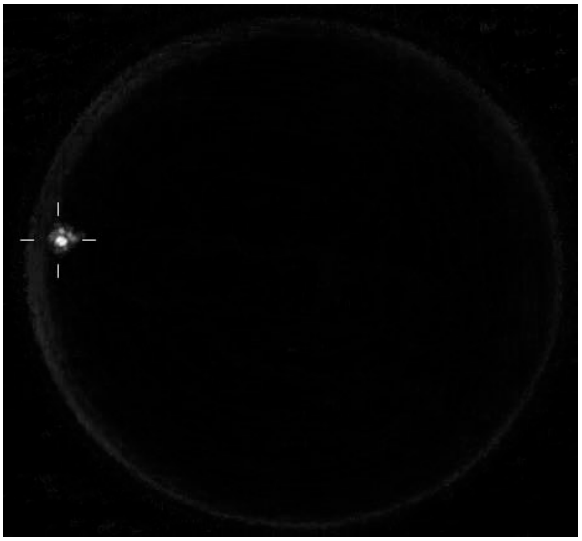

Figure 2: Detection image produced by DeTeCt3.0. Each video examined by the software produces an output in a text file and a detection image where the user can verify the existence and position of a possible impact. Example from the impact detected by George Hall.

DeTeCt3.0 is an open software for Windows that further develops DeTeCt and incorporates a Graphical User Interface, visualization options, improvements in the detection algorithm and outputs and further simplifications in the use of the software. 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.

The new version of the software 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). DeTeCt3.0 is available at:

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

Both webpages will be coordinated so that statistics of impacts and information will appear in both websites.

3. Amateur-profesional collaboration

This work constitutes a novel research area where the large amount of data required to detect impacts in the planet is supplied by amateur astronomers and the analysis is done by software also produced by a collaboration between amateur and professionals. We expect that the largest frequency 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 and the fact that Jupiter oppositions are moving from North hemisphere winter in the last few years to Spring in the current and next Jupiter opposition will result in better chances of finding new impacts in the planet.

Acknowledgements

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References

[1] Hueso et al.: First Earth-based detection of a Superbolide on Jupiter, The Astrophysical Journal Letters, Vol. 721, L129-L133, 2010.

[2] Hueso et al. Impact flux on Jupiter: From superbolides to large-scale collisions. A&A, 560, A55, (2013).