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DeTeCt3.1: Jupiter impacts detection software + updated documentation and webpage

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Dissemination level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Service)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (excluding the Commission Services)	

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Abstract: DeTeCt3.1 is a software tool designed to analyze amateur video observations of the planets Jupiter and Saturn to find short flashes of light caused by impacts of small size objects. Up to 5 events of this kind have been detected in the past without the use of software tools. However, a software tool freely available to the community of amateur astronomers can maximize the chances of finding more of these collisions in current and old data archived by the observers. DeTeCt 3.1. runs on Windows with an easy to use graphic interface. It incorporates several improvements over the previous version of the software making it easier to use, more universal with respect to image formats, and more efficient. The software is available publicly at <http://pvol2.ehu.eus/psws>. The webpage also contains documentation about the software and how to use it and the documented source code together with scientific information about these impacts for the general public.

1. Introduction

Impacts of small objects of 10-20 m with Jupiter release enough energy to be detectable in astronomical observations of the planet using small telescopes. 5 of these impacts have been detected by up to 11 amateur astronomers while they were observing the planet with video cameras. Most of these observers didn't see immediately the brief flash of light produced by the impact, but later on when hearing news about the flash being detected by one of them who was looking at the screen checking visually the video. In most cases the impact is so brief and weak that finding it by eye can become difficult. Software tools able to analyze video observations to find short flashes have been designed in the past but the characteristics of video observations of Jupiter and Saturn at high-resolution result in several problems in the development of algorithms able to find these weak flashes over a bright source.

2. DeTeCt

At the UPV/EHU we designed an algorithm able to identify these flashes. The algorithm is based on coregistering the images of the planet, which is continuously moving as a consequence of the distortions imposed by the turbulent atmosphere. The software corrects these distortions and performs differential photometry identifying the regions where the video varies the most in intensity. The basics of this software were implemented as experimental software (DeTeCt1.0) but not widely used. The algorithm was implemented in a software tool running in a console mode (without graphics) by amateur astronomer Marc Delcroix and has been used extensively by many amateur astronomers (DeTeCt2.0). This collaboration succeeded to analyze more than 70,000 video observations of Jupiter providing good constraints on the maximum number of impacts that can happen on Jupiter. The use of the software was difficult and the number of collaborators in the amateur astronomy community was relatively reduced (about 70 people). The new software produced log files that can be analyzed statistically.

As part of the activities of the Planetary Space Weather Service (PSWS) we developed this software a step forward in collaboration with Marc Delcroix. We have included a graphic user interface that makes the software easy to use and a higher stability in the technical aspects of the program. The resulting version was launched as DeTeCt3.0 during the first half of the Europlanet-2020 RI project but some improvements were still possible.

3. Improvements on DeTeCt3.1 over DeTeCt 3.0

DeTeCt3.1 constitutes the main subject of this delivery. It contains several improvements over DeTeCt3.0 listed here:

- Positive detections by the algorithm result now in a quantitative measurement of the strength of the impact and the certainty or confidence of the detection.

- False positive detections can be checked quickly from the visualization of detection images provided by the software. Detection images and examples of them are provided in the Software user guide.
- Correct treatment of color in videos saved with a Bayer-masked detector and saved in the SER astronomical format (the current format more used by planetary observers now and in the foreseeable future).
- Better definition of the area covered by the planet.
- Automatic analysis of detection images.
- Better handling of messages and log files for the user.
- Fast implementation of correlation routines rendering the video analysis an order of magnitude faster.
- Highly documented information about the software options and outputs of the software including a “certainty” factor to quantify the probability of having found a real impact.

4. Launch of DeTeCt 3.1

- * DeTeCt 3.1 is posted online at: <http://pvol2.ehu.eus/psws/>
- * Executable files for Windows in 32 and 64 bits are posted.
- * Source files are also posted publicly for programmers willing to work on the project.
- * Documentation on the software and the science is also available on the same page. Technical documentation on the software source is also posted.

DeTeCt3.1. release on 23 February 2018.

- * The software is announced at the PVOL webpage (with several thousand users in the amateur community) and in amateur astronomy e-mail lists (hst-Jupiter e-mail list) and popular Facebook amateur astronomy groups.
- * We will gather feedback from the users for the next few months including new functionalities if needed.
- * We expect the software will be used in the analysis of the upcoming Jupiter observations which typically peak every year close to the planet astronomical opposition with the Earth. Jupiter’s opposition this year occurs on May 8. The software can also be used to analyze videos stored from previous observations and can analyze hundredths of megabytes of video over 10 hours in most PCs.