EPSC Abstracts Vol. 13, EPSC-DPS2019-970-2, 2019 EPSC-DPS Joint Meeting 2019 © Author(s) 2019. CC Attribution 4.0 license.



# Jupiter and Saturn impact detection project

#### M. Delcroix (1), R.Hueso (2), J. Juaristi (3)

(1) Commission des observations planétaires, Société Astronomique de France (<u>delcroix.marc@free.fr</u>), (2) Dpto. Física Aplicada I, Escuela de Ingeniería de Bilbao, UPV/EHU, Bilbao, Spain, (3) Zentrum Für Astronomie, Universität Heidelberg (Germany)

#### Abstract

A long-term project for detecting impact of small bodies in Jupiter's atmosphere has been running since 2012. We here present the latest developments of the software used for it, and the latest impact frequency estimations resulting from the project.

#### 1. Introduction

Since 2011, professionals made softwares (dtc and JID) available for amateurs to be used on their Jupiter acquisition videos with the aim to detect potential flashes resulting from small bodies impacts in Jupiter atmosphere (see [1]).

In 2012, an amateur made an evolution of one of this software in order to not only focus on flashes detection, but also on collecting all negative analysis in order to refine the impact frequency estimations, launching the DeTeCt project (see [2]).

Since then, several evolutions piloted by professional and amateur resources improved the project (see [3], [4], [5]) and more than 90 000 acquisitions have been analysed.

# 2. Principles

The principle of the project is to have each amateur use DeTeCt software on his own acquisition and check and send the results of the analysis, based on two different algorithms.

The first one aims at identifying burst of brightness in a short area of the atmosphere on the planet, while the second generates detection images for the user to check, showing the maximum value of each pixel of the acquisition over time minus its mean value (see figure 1).

Then the detection logs generated by DeTeCt are sent to the project coordinator, who runs an analysis on all logs collected to identify simultaneous observations to be ruled out and calculate from an impact frequency estimation from the duration of the acquisitions analysed.

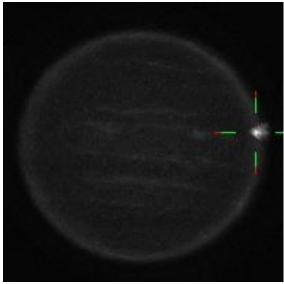


Figure 1: DeTeCt detection image from John Mc Keon's March 17<sup>th</sup>,2016 acquisition video showing the 4<sup>th</sup> impact flash discovered.

# 3. Latest evolutions

The latest developments of DeTect are in 3 different directions.

In order to increase the amount of data processed, usage of DeTeCt was simplified by offering an easy to use Graphical User Interface (see figure 2).

➡ DeTeCt v3.1.7.20190505_x64 — I   File Preferences Help	o x
Welcome to DeTeCt, software to help you to analyze videos of Jupiter to find flashes from impacts. Pick a folder to select all videos in that folder and then click on the 'Detect impacts' button below to run the software.	
Execution log:	
2019-55-08 011224* Addmg 2015-65-09:10.9-8-2.ser for analysis 2019-55-08 011224* Addmg 2015-65-09:10.1-6-2.ser for analysis 2019-55-08 011224* Addmg 2015-65-09:10.1-2-8.2.ar for analysis 2019-55-08 011224* Addmg 2015-65-09:10.1-2-8.2.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.1-4-8.2.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.1-4-8.2.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.1-2-4.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.1-2-4.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.15,2-4.ar for analysis 2019-55-08 011224* Addmg 2015-66-09:10.15,2-4.ar for analysis 2019-55-08 011224* Addmg 2015-06:09:10.11,2-4.ar for analysis 2019-56-08 011224* Addmg 2015-08:2-34:2021.9-6-1.ser for analysis 2019-56-08 011224* Addmg 2015-09:2-34:2021.1-08.07.05:25-0902.JR742.ser for analysis 2019-56-08 011224* Addmg 2015-02:2012.903.05:2421.JL.ee for analysis 2019-56-08 011224* Addmg 2015.012.012.903.05:242.JL.ee for analysis 2019-56-08 011224* Addmg 2015.012.012.903.015:243.Ees for analysis 2019-56-08 011224* Addmg 2015.012.012.903.015:243.Ees for analysis 2019-56-08 011224* Addmg 2015.012.012.903.045.2543.Ees for analysis 2019-56-08 011224* Addmg 2015.012.012.903.045.2543.Ees for analysis 2019-56-08 011224* Addmg 2015.0156 for analysis	^
2019-05-08 01:12:24 - Adding 0001.fits for analysis 2019-05-08 01:12:24 - Adding Capture 2014-11-10T08 39 28.ser for analysis	
2019-05-08 01:12:24 - Adding Capture 2014-11-10108_39_28.ser for analysis 2019-05-08 01:12:24 - Adding Capture 2014-11-10108_39_28.ser for analysis	
2019-05-08 01:12:24 - Adding Capture 2014-11-10108_39_29:58 for analysis	~
Detect inpacts	

Figure 2: DeTeCt software

For the same aim, seamless integration into amateurs processing pipeline is studied, for enabling Autostakkert, the staking and alignment standard software used by the community, to launch automatically DeTeCt after having processed an acquisition.

The latest direction studied is to reduce as much as possible the number of false positives and nondetected positives impacts, by analysing the detection image automatically.

# 3. Project results

Project results are continuously updated on a dedicated webpage (see figure 3).

As of beginning of May 2019, 82 observers ran DeTeCt on 90 000 Jupiter acquisitions from 2004 to 2019, representing 103 days' worth of observations. (not including simultaneous observations counting for more than 5 days, around 5%).

This leads to an estimation of 3.5 impacts on Jupiter per year (absolute number, not "observable" number).

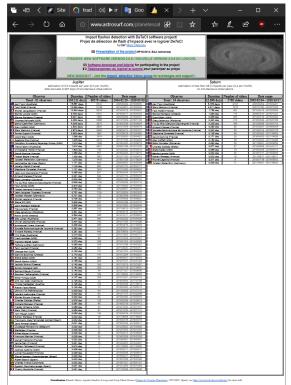


Figure 3: DeTeCt project webpage

(http://www.astrosurf.com/planetessaf/doc/project\_de tect.php)

# 4. Future works and conclusion

Further automation could be implemented in DeTeCt (emailing, uploading data on a central repository, automatic updates, etc.).

Unfortunately, Saturn's data is not representative yet (only 13 days of acquisitions analysed). As the impact frequency on this planet is estimated to be one order of magnitude less as on Jupiter, motivating a large number of users to use DeTeCt on their Saturn's observations.

The results of this pro-am software and project proves useful for studying the impacts on Jupiter (see [6]). This showcases the added value of pro-am collaborations on planetary science studies (see [7]).

# Acknowledgements

We would like to thank the planetary amateur participants to the DeTeCt project for their dedicated time for observing and analysing their Jupiter and Saturn observations.

We are grateful to Emil Kraaikamp for discussions of impact detection and detection algorithms. Part of this work has been developed in the framework of the Europlanet 2020-RI. Europlanet 2020 RI has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654208.

# References

[1] Hueso R. et al., « The flux of impacts in Jupiter: From superbolides to large-scales collisions », A&A, September 2013

[2] Delcroix M. et al., « Jovian impact flashes detection with DeTeCt software project », EPSC 2013, London, September 2013

[3] Delcroix M. et al., « Impact flashes detection on Jupiter (and Saturn) », Juno Europlanet workshop, Nice, May 2016

[4] Delcroix M. et al., « DeTeCt planetary impact detection project - frequency estimations and big data set secondary results »,EPSC 2017, Riga, Latvia, September 2017

[5] Delcroix M. et al., « Jovian impact detection project update », Europlanet Juno workshop, London, UK, May 2018

[6] Hueso R., M. Delcroix et al., « Small impacts on the Giant planet Jupiter », A&A 617, A68 pp1-13 2018

[7] Hueso R. et al., « Detectability of possible weather effects on Mars upper atmosphere and meteor impacts in Jupiter and Saturn with small telescopes », Journal of Space Weather and Space Climate vol.8 November 2018