

EPSC Abstracts Vol., EPSC2020-775, 2020 Europlanet Science Congress 2020 © Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License.



Impact detection on Jupiter through amateurs' processing of their own videos using DeTeCt

Marc Delcroix¹, Salma Sylla^{2,3}, Ricardo Hueso⁴, François Colas³, and David Baratoux⁵

¹French Astronomical Society (SAF), Planetary observations commission, Tournefeuille, France (delcroix.marc@free.fr)

²Cheikh Anta Diop University, Dakar, Sénégal (salma.sylla@ucad.edu.sn)

³Paris Observatory, IMCCE, Paris, France

⁴Física Aplicada I, Escuela de Ingeniería de Bilbao, UPV/EHU, Bilbao, Spain (ricardo.hueso@ehu.es)

⁵Institut de Recherche pour le Développement, UMR5563, Géosciences Environnement Toulouse, IRD, CNRS et Université Toulouse III, Toulouse, France

Impact detection on Jupiter through amateurs' processing of their own videos using DeTeCt

(delcroix.marc@free.fr)

(1) Societé Astronomique de France, Paris, France

(2) Université Cheikh Anta Diop, Dakar, Sénégal

- (3) Observatoire de Paris, IMCCE, Paris, France
- (4) Física Aplicada I, Escuela de Ingeniería de Bilbao, UPV/EHU, Bilbao, Spain

(5) Institut de Recherche pour le Développement, UMR5563, Géosciences Environnement Toulouse, IRD, CNRS et Université Toulouse III, Toulouse, France

Since 2010, amateur astronomers have discovered six flashes in Jupiter caused by the entry of small bodies in Jupiter's atmosphere [1-5]. The last of these impact flashes was discovered thanks to a pro-am collaborative project called "DeTeCt". This project is based on a software tool released to the amateur community that allows the observers themselves to analyze their video observations.

The software DeTeCt performs differential photometry to find sudden brightness variations, generates a detection image and a report. The detection image allows the users to do a quick look of the analysis and the reports and detection images are sent to two of us (MD, SS) for in depth analysis and statistics of the positive and negative detections. In this work we will see the latest evolutions of the project presenting the new features in the software, details of the detection algorithm and changes in the methodology of the statistical analysis.

| 😑 DeTeCt v3.2.3.2020 | 0623_x64 Ar | alysis of Jupiter/Saturn videos to find impact flashes | - 🗆 X | |
|---|-------------------|---|--|--|
| File Preferences H | elp | | | |
| File selection and pro | cess automation | | | |
| Select folder recursively0r S | | Select file auto processing auto exit when done then shutdown PC | Max instances: 12/12 | |
| Impact detection | | | | |
| Detect impacts | | Probability (total): Null / Error 41 Low 13 High 1 | Max instances: 12/12 DeTeC DeTeC Low 13 High 1 -2249_8-MD-IR685.ser Date from: acquisition log SER timestamps FITS File date info botal 12/12 instances ted by the algorithm. ted by the algorithm. | |
| Check detection image | ges, send results | | | |
| File processing | | | | |
| Processing improvement: | G: Just | rkUmpactVestsVdata_setVpugsVproken_serV2016-05-15-2249_8-44D-IR685.ser 16566 frames @ 25 fps (0s duration) | | |
| AS! session dark file | | | timestamps | |
| | | | file date info | |
| Progress | | Duration processed (total): 4525s | | |
| Total (55/223) File | | | | |
| | | | | |
| Execution full log | | Processing time: 1266.2s (file) 1423.9s (total) | 12/12 instances | |
| 2020-06-24 06:41:54 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:43:32 2020-06-24 06:44:08 2020-06-24 06:44:08 | | probability impact in detection image but no impact detected by the algorithm. | | |
| 2020-06-24 06:44:08 | | | | |

Fig. 1: New GUI in the DeTeCt software.

This project has accumulated data acquired over 17 years of Jupiter observations. The total time covered by the videos analyzed is equivalent to 5 full months of observations. This has been possible only thanks to the active participation of a hundred of amateur astronomers worldwide. The accumulated time analyzed in the project allows a more accurate estimation of the impact frequencies on Jupiter [4]. The project website (http://www.astrosurf.com/planetessaf/doc/project_detect.php) maintains up to date results of the statistical analysis, and provides the software to download.

| | m/planetessaf/doc/project_det/ | ect.php | | | | |
|--|--------------------------------|--|--|--|--|--|
| | 30 | Projet de iffware download i téléchar | Inshea detection with DeTeCt a détection de flash d'impacts avec byber <u>Nac Detects</u> <u>ement du logiciel</u> for participating <u>Toroniel in reciscolo inspect</u> (Thu <u>Presentation af the potent</u> (FPS/2013) | | | |
| | | i lei la siay lavel 8 desars sind inped | t doubles & briefs but it bless a tot of ey private time and receive o Donato | | | |
| Jupiter estimation of 15.6 impacts per year (absolute number) total excludes 8,638 days of simultaneous observations | | | | | | |
| Observer | Duration | Number of videos | Date range | | | |
| Total : 98 observers | 140.094 days | 129228 videos | 2003/84/18 - 2020/86/11 | | | |
| Zac Pujic (Australia) | 19.101 days | 7764 | 2005/02/22 - 2019/07/29 | | | |
| Benito Loyola (USA) | 16.341 days | 15028 | 2018/02/17 - 2019/09/24 | | | |
| Michel Jacquesson (France) | 16.285 days | 9448 | 2014/03/12 - 2019/10/11 | | | |
| Paul Rolet (France) | 15.335 days | 12693 | 2012/09/07 - 2020/06/01 | | | |
| Manos Kardasis (Greece) | 9.506 days | 8161 | 2004/02/29 - 2019/11/27 | | | |
| Clyde Foster (South Africa) | 6.066 days | 7626 | 2015/01/30 - 2020/05/02 | | | |
| Thomas Ashcraft (USA) | 4.969 days | 5008 | 2013/10/09 - 2016/11/30 | | | |
| Bernd Gaehrken (Germany) | 4.098 days | 5882 | 2016/03/06 - 2018/06/24 | | | |
| Alan Coffeit (USA) | 3.654 days | 2662 | 2013/10/04 - 2020/05/17 | | | |
| Marc Delcroix (France) | 3,560 days | 2812 | 2006/04/13 - 2020/05/20 | | | |
| Sauveur Pedranghelu (France) | 3.017 days | 3632 | 2017/05/26 - 2019/10/27 | | | |
| Ethan Chappel (USA) | 2.644 days | 2037 | 2013/09/01 - 2020/05/01 | | | |
| Agapios Ella (Cyprus) | 2.444 days | 2968 | 2013/11/09 - 2020/05/31 | | | |
| Christophe Petter (France) | 2,374 days | 206 | 2012/02/20 - 2019/07/28 | | | |
| Jose Luis Pereira (Brazil) | 2.153 days | 2754 | 2019/01/30 - 2020/05/31 | | | |
| Xavier Dupont (France) | 2.062 days | 1867 | 2012/08/16 - 2015/04/25 | | | |
| Hampton University Sayanagi Group (USA) | 2.028 days | 1543 | 2018/03/23 - 2019/03/29 | | | |
| Grant Blair (USA) | 1.988 day | 1874 | 2013/08/20 - 2016/04/21 | | | |
| Trevor Barry (Australia) | 1.615 day | 2425 | 2009/07/06 - 2012/12/30 | | | |
| Michel Miniou (France) | 1.571 day | 1415 | 2003/04/18 - 2020/04/22 | | | |
| Pascal Bayle (France) | 1.494 day | 1702 | 2012/11/30 - 2017/05/21 | | | |
| David Domine (France) | 1,450 day | 907 | 2016/02/25 - 2017/04/10 | | | |
| Jean-Luc Dauvergne (France) | 1.435 day | 1141 | 2016/05/04 - 2020/05/22 | | | |
| Torsten Mellenthin (Germany) | 1.218 day | 1416 | 2016/01/28 - 2017/06/24 | | | |
| Lammertus de Vries (Spain) | 1.171 day | 635 | 2009/08/03 - 2015/05/08 | | | |
| Pic de Midi (Colas/Delcroix/Dauvergne/Sylla) (France) | 1.164 day | 1861 | 2010/09/29 - 2019/08/16 | | | |
| Jocelyn Serot (France) | 1.154 day | 890 | 2014/01/10 - 2019/06/02 | | | |
| Stephane Gonzales (France) | 1.131 day | 1243 | 2013/12/20 - 2018/06/03 | | | |
| Martin Lewis (UK) | 1.020 day | 1509 | 2015/03/22 - 2019/09/05 | | | |
| Matic Smrekar (Slovenia) | 0.956 day | 1648 | 2009/07/29 - 2019/06/10 | | | |
| Arnaud Claisse (France) | 0.941 day | 842 | 2014/01/19 - 2016/05/03 | | | |
| Paul Jones (USA) | 0.819 day | 723 | 2011/08/29 - 2015/04/05 | | | |
| | | | | | | |
| Philippe Chatelain (France) | 0.810 day | 60 | 2017/03/28 - 2019/08/02 | | | |

Fig. 2: Webpage of the project with statistics, estimation of the impact frequency and links to software and tutorial.

Additionally, observational campaigns were organized at Pic du Midi to acquire Jupiter and Saturn videos taking advantage of the excellent seeing of the site of observation. A large number of positive detections is expected based on the combination of an excellent seeing and the large diameter of the telescope (with respect to other observations campaigns, amateur astronomers' telescopes diameters range from 15 to 50cm). The observation campaigns were generally organized around the opposition of Jupiter when the planet was high in the sky. Each night we could acquire at least two hours of video recording of the planet.

The scientific analysis of the different impacts allows to estimate the impact bodies in terms of the released energy and mean mass, which translates in ranges of possible sizes and density. Light curves of the more recent impacts allow to study impact fragmentation and possible densities of the impact body [5].

This project showcases the usefulness of amateur astronomers' observations, who provide unique essential data for this scientific work.

References

[1] Hueso R. et al., 2010, «First Earth-based detection of a superbolide on Jupiter», The Astrophysical Journal Letters, 721, L129-L133.

[2] Hueso R., et al. (incl. M. Delcroix), 2013, «Impact flux in Jupiter: From superbolides to large-scales collisions», Astronomy & Astrophysics, 560, A55.

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

[4] Hueso R., del Rio-Gaztelurrutia, Sánchez-Lavega, Delcroix M. et al. 2018b, « 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, 123,3020-3034

[5] Sankar R. et al. (incl. M. Delcroix) 2020, « Fragmentation modelling of the August 2019 impact on Jupiter », Monthly Notices of the Royal Astronomical Society, 2020