Jovian impact flashes detection with DeTeCt software project

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- Jupiter, the biggest planet, is the planet with the most important gravitational influence on solar system’s small bodies

- From **July 16th to 22nd, 1994**, 21 fragments of **P/Shoemaker-Levy 9** comet impacted Jupiter:

  - All phases could be observed by professionals:
    - **Impactor** bodies before impacts
    - Impacts themselves **forecasted** and **observed** live
    - **Evolutions** of the observed impacts **traces**

- After such a show, jovian observable impacts **frequency** is estimated around **one per century(ies)**, but ...
... amateur discovered:

**July 19th, 2009:** a dark impact trace visible for weeks (A.Wesley) - 15 years after Shoemaker/Levy 9
  - Body ~200/500m

**June 4th, 2010:** impact (a 2s bright flash) observed live (A.Wesley, C. Go)
  - Body ~10m, no trace

**August 20th, 2010:** impact a 2s bright flash) observed live
  (M.Tachikawa, K.Aoki and M. Ichimaru)
  - Body ~10m, no trace after one rotation (M.Delcroix)
September 10th, 2012: a 2s bright flash observed live visually (D.Petersen) and found a posteriori on a video (G.Hall)

Body>10m, no trace

And before, Jean-Dominique Cassini in 1690?
Thousands of amateurs image worldwide Jupiter each apparition. Their acquisitions could contain jovian impact flashes not yet detected.

Video detection softwares developed (http://www.pvol.ehu.es/software): coordination R. Hueso/A. Sanchez-Lavega/J. Maria-Gomez (Grupo de Ciencias Planetarias, UPV-EHU, Spain) with algorithms proposed by amateurs (E. Kraaikamp & M. Delcroix).

Graphical software JID amateur author JC Moreno.
« batch » software **DeTeCt** *(amateur author Luis Calderon)* modified by M. Delcroix for a project collecting amateur detection attempts on their own acquisitions, aiming at constraining the jovian impact rate

- analysis of all old acquisitions (wherever they are stored) in a row **without user interaction**

- focused on a **simple, fast and efficient** algorithm **minimizing false positives** by visual inspection of a single « detection image » per acquisition

- Generating a **single log file** for all videos analyzed, with **datation** and acquisition **information** (using acquisition softwares logs when available – Lucam Recorder, Genika, Firecapture, PlxCapture, Avi felopaul, Genicap, …)

- **Participation to the project is simple**: just send your log files to delcroix.marc@free.fr, informing of course of any possible detection!
Detection principle

- Impacts last ~2s out of amateur acquisition movies usually > 30s
- Impacts are bright compared to all of the surrounding
- Work on the whole movie (not on successive frames) to detect pixels brighter than the average

**Method**

- **alignment** of all frames
- addition of all aligned frames to calculate an « **average image**» (each pixel is the average value for all n frames of the acquisition)

\[ \text{ADU}_{\text{average}} = \frac{\sum_{i=1}^{n} \text{ADU}_i}{n} \]

- construction of a « **maximum image** » composed for each pixel of maximum for all n frames of the acquisition :

\[ \text{ADU}_{\text{max}} = \max_{i=1..n} (\text{ADU}_i) \]

- construction of a final « **detection image** » substracting maximum and average values :

\[ \text{ADU}_{\text{detection}} = \text{ADU}_{\text{max}} - \text{ADU}_{\text{average}} \]

- **normalisation of the final detection image** for easing the visual inspection of the « detection image » where a candidate impact should « pop-up » out of the rest of the image

Impacts last ~2s out of amateur acquisition movies usually > 30s
Impacts are bright compared to all of the surrounding
Work on the whole movie (not on successive frames) to detect pixels brighter than the average

Current results:

- no impact detected
- 6.54 days of acquisitions
- 20 observers (France, Australia, Greece, US)
- 8285 acquisitions
- from 2006 to now

Total 20 observers for a total observing duration of 6d 13h 7m 28.525s (8285 videos) from 2006/04/14 to 2013/09/05

English tutorial for participating to the project: [Planetary impact flashes detection with DeTeCt software](http://www.astrosurf.com/planetessaf/doc/planetary_impact_flashes_detection_with_deteクト_software.html)

Tutorial français pour participer au projet: [Détection de flash d’impacts planétaires avec le logiciel DeTeCt](http://www.astrosurf.com/planetessaf/doc/deteクト_software_francais.html)
We need more amateur data to estimate jovian impact frequency
(including detections, and enough time coverage to be significant)

It’s up to you to contribute to science!

Send us our detection logs, they are useful and will be used!

GO TO

(download, tutorial, results)

Questions?

Presentation will be downloadable one week after the lecture at:

http://astrosurf.com/delcroix
(as well as all of my other publications/presentations)
Jupiter impacts detection project: a pro-am collaboration

BAA Workshop
Sep. 13th, 2013, London, UK

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Kinds of participation to pro-am collaboration

Amateurs having discovered:
- impact flashes
- traces of impacts

Amateurs having:
- developed impact detection softwares
- coordinated a impact detection project
**Detailed STEP by STEP**

1. Gather your acquisitions (files + acquisition logs) directories in a work directory


3. Save the zip file in your work directory, and unzip it here

4. Use the “dtc_tutorial” for any help

5. Double click on « dtc_batch »
A command window opens, processing start for each found acquisition,

Process is done when you see "Please press a key to continue"

Here it is, everything is done, the only thing left for you is to inspect each generated image for each movie, easy, isn't it?
Jupiter impacts detection project: a pro-am collaboration

How to participate to the DeTeCt project

5. Look in the Impact_detection directory (automatically created) for the « xxxx_dtc_max » images

6. Analyze visually in any editor these « xxxx_dtc_max » images for impact detection (using the tutorial “dtc_tutorial” stored in the above directory if needed)
Jupiter impacts detection project: a pro-am collaboration
How to participate to the DeTeCt project

Negative results

Positive results (impacts!)

Single hot pixel

Satellite transiting
A single log file for all acquisitions analyzed was generated, with datation and acquisition information (using acquisition softwares logs when available – Lucam Recorder, Genika, Firecapture, PlxCapture, Avi felopaul, Genicap, …)

7. Participation to the project is simple: just send your log files to delcroix.marc@free.fr, informing of course of any possible detection!
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http://www.astrosurf.com/planetessaf/doc/project_detect.shtml (download, tutorial, results)

Questions?