Automated determination of dust particles trajectories in the coma of comet 67P

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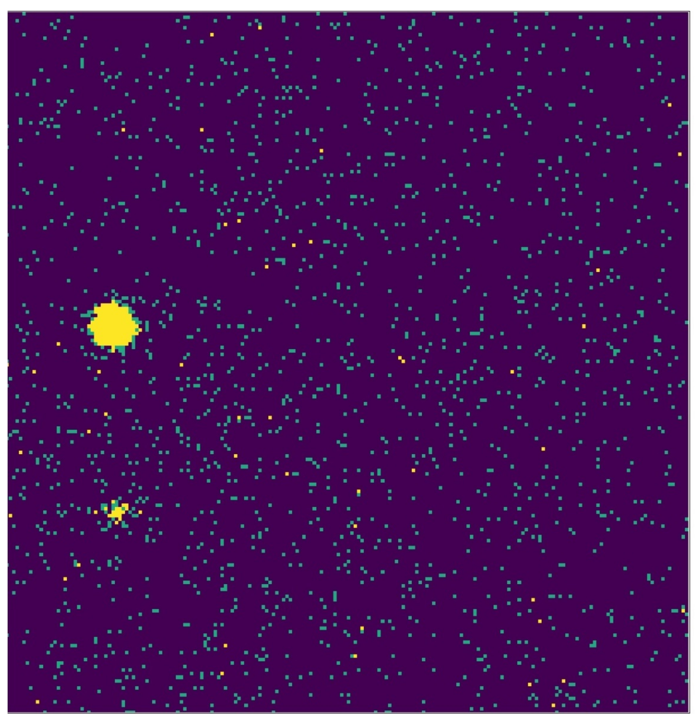
Abstract

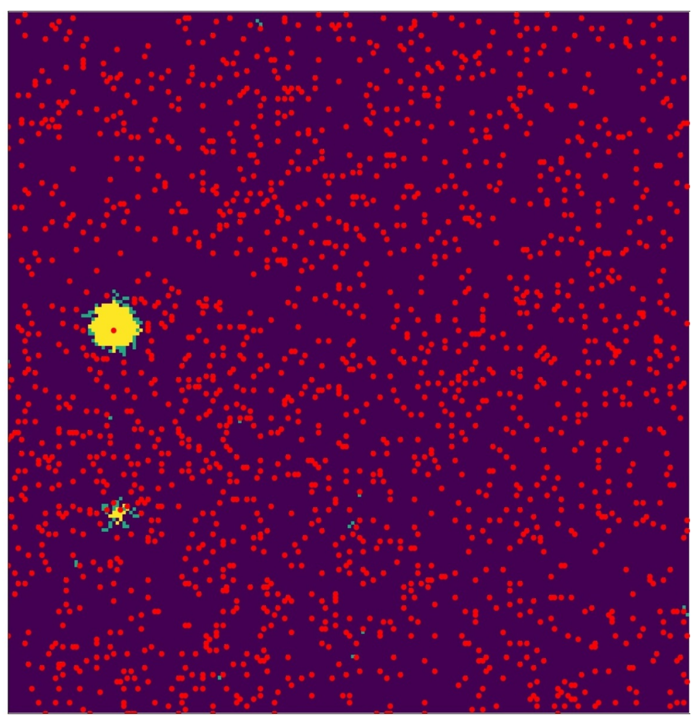
During more than two years Rosetta spent at comet 67P, it took thousands of images that contain individual dust particles. To arrive at a statistics of the dust properties, automatic image analysis is required. We present a new methodology for fast-dust identification using a star mask reference system for matching a set of images automatically.

The main goal is to derive particle size distributions and to determine if traces of the size distribution of primordial pebbles are still present in today's cometary dust [1].

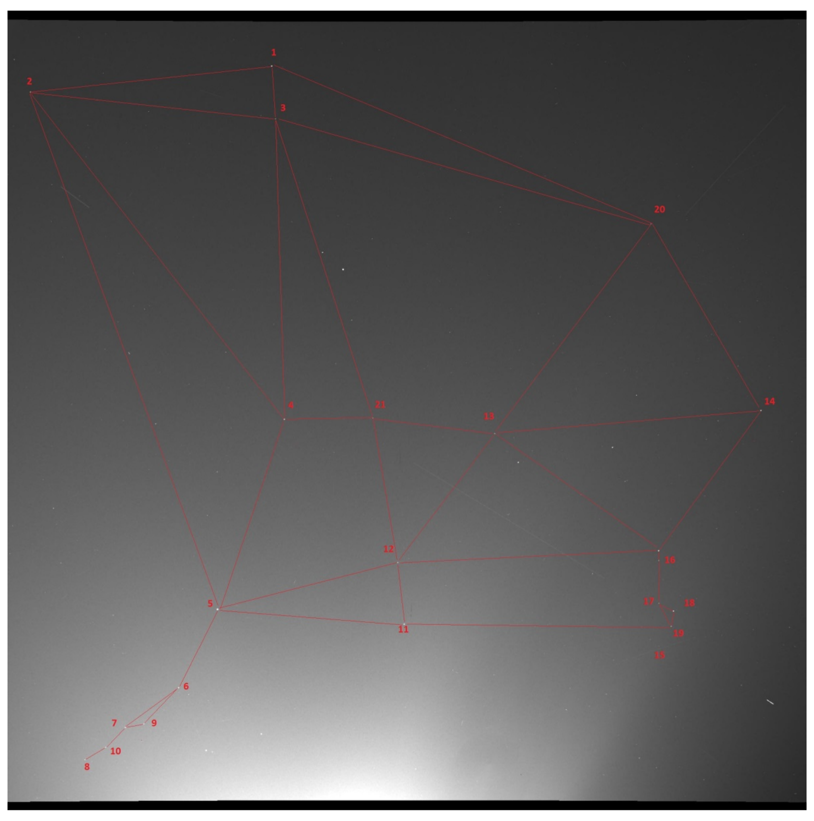
Methodology



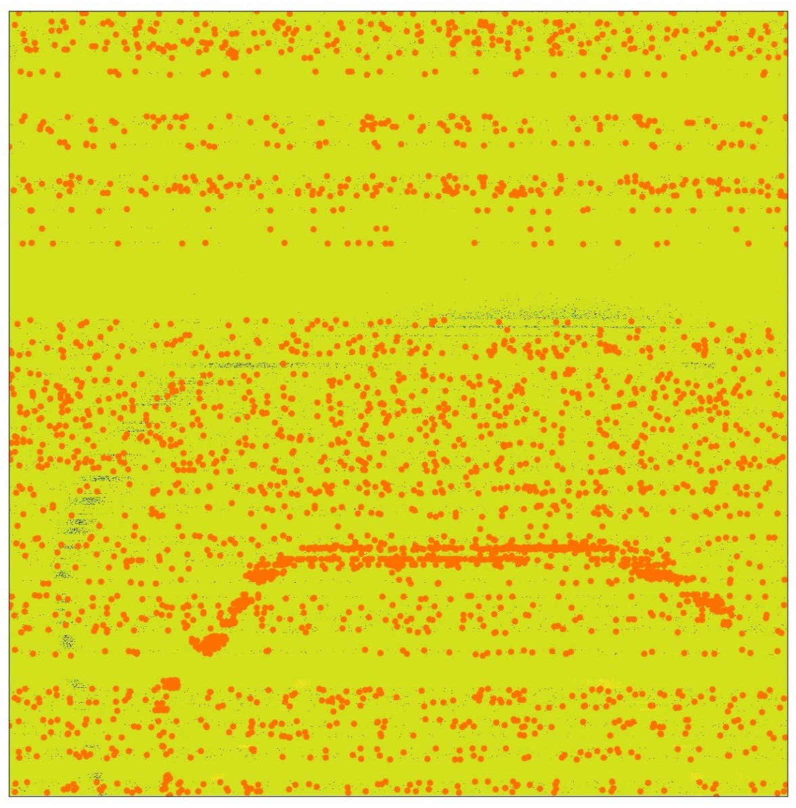
[Fig 1]: Test image obtained from NASA fits samples from HST. https://fits.gsfc.nasa.gov/fits_samples.html. This case was used to verify that under homogeneous background the algorithm selects all samples, included big spots.



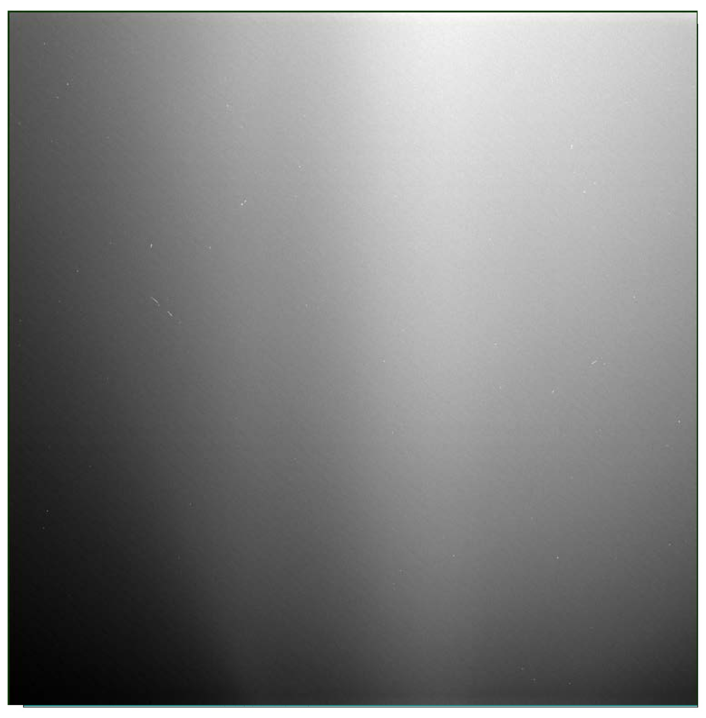
[Fig 2]: Processed image 1 with local maxima algorithm for detection of point sources.

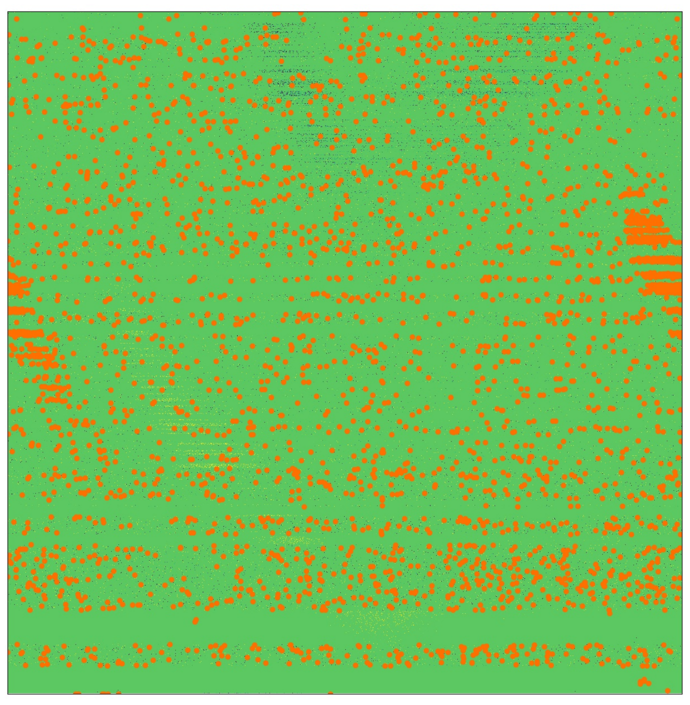


[Fig 3]: Stars identified in an example image.



[Fig 4]: Point sources detected with an algorithm, with tunable detection sensitivity. In the present case, the number of candidate particles is 3186.

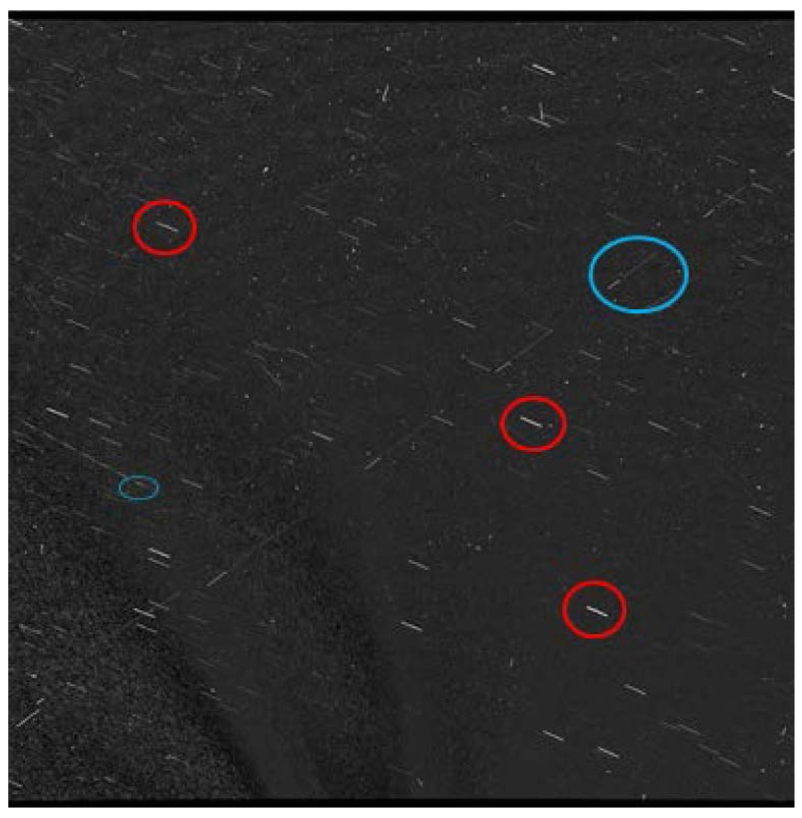




[Fig 6]: The present image shows an example of image with noise and different illumination conditions from limb taken at the last image of the set.

[Fig 7]: Point sources obtained from image 6. The number of particles raises up to 9000 .

[Fig 5]: 22 images taken on 11 May 2015 which each image pixel summed up and divided by the median. Red circles show examples of stars (and some dust particles moving with the spacecraft), blue circles show examples of dust particles



Future plans

The main purpose of the presented study has been to get size and velocity distribution of a large number of particles. That would be contrasted with the results of previous studies, e.g. Agarwal et al [2] but, in addition, it provides additional added-value:

- All results presented have been produced using a python software built from scratch which allows to automate the process for processing any OSIRIS input dust coma image.
- The pipeline source code has been written in python 3 and will be published in a public repository, using GitHub or other similar mechanism, for all interested people and to facilitate future collaborations.
- The next steps will be to include the identification and analysis of aggregates trajectories.
- We are applying our knowledge acquired in Earth Observation missions to Rosetta in the determination of dust particle coma trajectories. In particular, we found 'inspiration' in other dust research methodologies practices in different comets and meteors[4].

Conclusions

- We present an ongoing study with the goal of describing the evolution of the cometary dust population over the mission, and to search for changes on various timescales.
- The outcome will be used to evaluate if there is a preferred size range of dust aggregates and if their measured size distribution is primordial. In terms of methodology, it seems feasible to use stars as reference points.
- The automated pipeline will allow to process any kind of Osiris dust image saving a considerable amount of time. It will be able to applied as well in some limb determination studies.

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References

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