Title : ACDC with deep learning :
Automatic Crater Detection and Characterization with deep learning

URGENT : DEADLINE 30 MARCH 2019

Description:
This study takes place in the data deluge from the numerous space missions across the Solar System. The project proposes to develop a tool to automatically detect and characterize the most ubiquitous feature on planetary body : craters.

The aim is to develop a tool to define precise size and position of all craters in the scene, whatever the illumination conditions, the type of sensor and the scale. As a second goal, the project will have to determine the crater characteristics, such primary / secondary (ejecta from a previous impact, not from a direct impactor), presence / absence of rays, erosion level...

This study will take advantage of the machine learning and deep learning libraries available as open source to propose the most versatile and robust detection method. We propose to develop a new tool dedicated to this task. In addition, we propose to organize a worldwide challenge for any researcher/students as an open source strategy, in a framework called RAMP. This platform is designed for collaborative work and gives access to the source code of the participants (not only the results).
Such software pipeline is required to tackle fundamental questions in planetary science to study the surface processes across the Solar System. It will be a crucial tool to precisely date the surface and open a new era for onboard decisions on landing or targeting, to maximize the science return of future deep space missions.

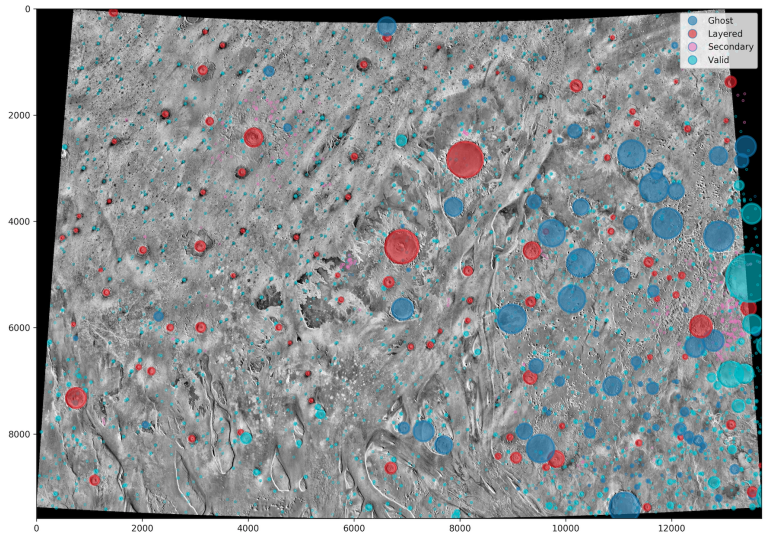

Figure 1 : Example of a region of Mars with identified craters and they label : valid means fresh crater, ghost means crater that has been covered by a layering (such sediments or lava flows), layered means, secondary means that it corresponds to a crater. All labels have been attributed by expert scientist [Lagain et al., 2019].

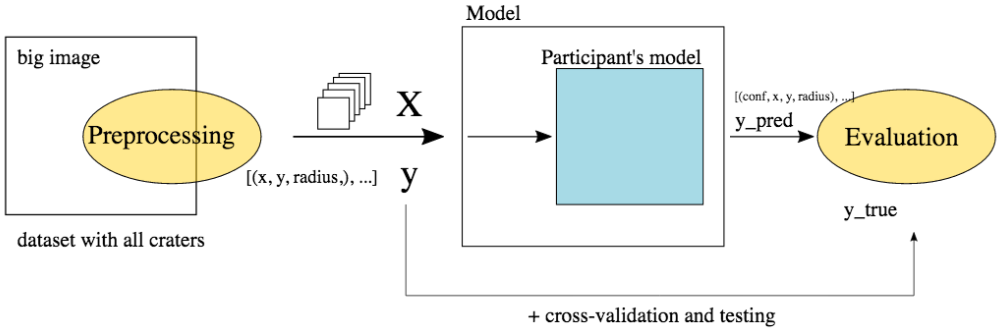

Figure 2 : Proposed workflow : The large mosaic containing the full dataset is divided into small overlapping tiles of 224 x 224 pixels (standard dimension to be treated by convolutional neural net on a single GPU).

Candidate requirements :
The candidate must have a engineer or master grade in machine learning/data mining or in planetary science. Double competence in both fields will be encouraged. An excellent level of programming skills is required (Python, linux). We expect the candidate to have a good level of communication in English (written and oral).

Duration :
PhD : 3 years, starting from October 2020

Location :
UMR8148 GEOPS
Bât 509, Université Paris Saclay
91405 ORSAY, FRANCE

Supervision and contact :
Frédéric Schmidt, Professor, GEOPS, Univ. Paris Saclay, expert of Planetary Science and surface processes, http://planeto.geol.u-psud.fr/spip.php?article83
Hugues Talbot, Professor, Ecole CentraleSupelec, Paris Saclay, expert in Artificial Intelligence and computer vision, https://hugues-talbot.github.io/