Characterizing Mars Craters Using Deep Learning

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The surface of Mars is covered by more than 300,000 craters of varying sizes and shapes. In this project you would apply supervised learning methods with deep learning tools to accurately measure various properties of craters identified by a Deep neural network.

Lee (2019) developed a deep neural network that could identify impact craters on the surface of Mars with an accuracy approaching human experts (Silburt et al., 2019). Over summer 2019 the accuracy of that network was improved and now matches or exceeds human experts at identifying impact features on the surface of Mars and on the Moon.

In this project you will extend the existing Deep Learning tools by developing and training a neural network to determine the ellipticity and depth of the craters that are identified in images of the Martian surface. You will apply the trained machines to characterize more than 100,000 elliptical craters on Mars and compare the features with existing databases of craters developed by human experts (Robbins and Hynek, 2012).

You will also manually validate a sample of the newly identified craters and craters marked as "fale negatives" to improve the existing databases and propose new crater candidates.

The project requires knowledge of Python and data analysis, and you would benefit from experience of using neural networks for image processing. Previous experience with atmospheric physics and geophysics is useful but not necessary.

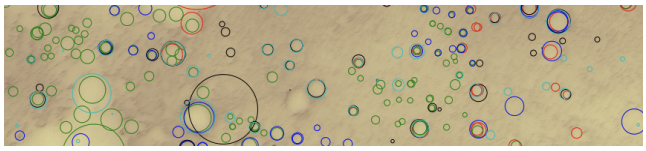

Figure 1: *Craters detected at the landing site of the Mars 2020 rover in Jezero crater, found by neural networks (magenta, cyan, black) and humans (red, green, blue). Topography data from NASA/Caltech/MSSS.*

This project has opportunities for up to 2 students. For more information, please feel free to contact me by email: `clee@atmosp.physics.utoronto.ca`

Bibliography

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