

Applying Bayesian Inference to the Search of Life on Mars using Hyperspectral Sensors

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Mars in recent years has attracted many attentions in the search of life on extraterrestrial bodies. Although the current Mars landscape and atmospheric conditions are very different from Earth and from what we considered as suitable for life to flourish, it might have an early history that is very similar to that of Earth. Therefore, it raises the possibility that the Archaean and Proterozoic history of life on Earth could have a counterpart on Mars. It has been suggested that hydrothermal systems could yield important information in the search for fossilised for of ancient biota on Earth and thus ancient and/or current life on Mars.

Hydrothermal deposits occur where spatially confined warm to hot fluids are in disequilibrium with their host rocks. Individual springs can be hundreds of metres wide, and complexes of springs occupy areas up to several kilometres wide. These systems are hosts to early life on Earth as evident today in the form of stromatolites. The landscape of Mars today indicates a strong possibility of past and/or present subsurface heating of ground water created thermal springs. Rocks in the hydrothermal systems usually turns into clay, minerals generally containing the hydroxyl ion, which has very distinguished spectral features in the near-infrared (NIR) range of the electromagnetic spectrum.

Image spectroscopy is a new technique for obtaining a spectrum in each position of a large array of spatial positions so that one spectral wavelength can be used to make a recognisable image. By analysing the spectral features, and thus specific chemical bonds in the materials, we can map the materials that are on the surface of an area. The process of hyperspectral remote sensing is a lengthy one, requiring a large amount of data analysis, and expert inputs. Bayesian inference methods, however, allows us to automate this process.

In this paper, we showed that by using Bayesian classifier to first train the algorithm to recognise the patterns of the required spectrum, we can highlight areas with high probabilities of minerals containing evidence of hydrothermal systems and possible life signs.