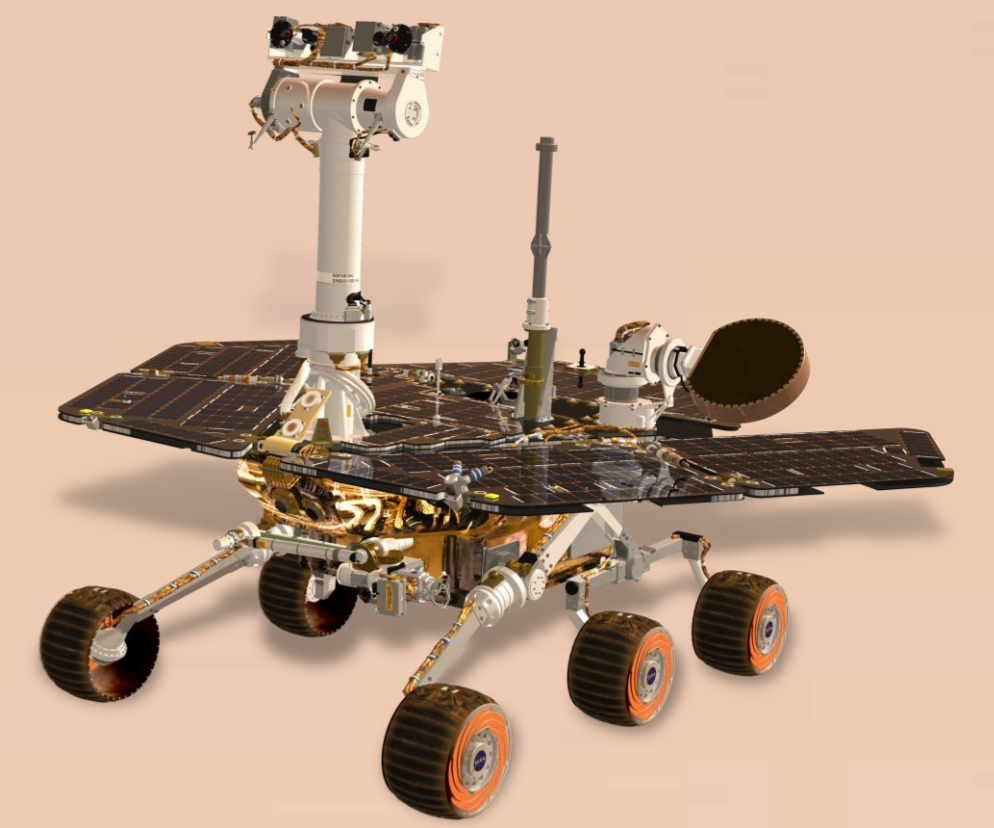# Mars Terrain Visual and Spectral Analysis

Introduction

The presence of non-elevated obstacles such as duricrust layers and sand traps on the Martian surface is not identified by the current in situ remote sensing techniques.

Indeed, although effective in the detection of physical threats, these methods are inadequate for the identification of non-geometrical hazards, for which further information from complementary sources are analysed in the project.

Raw Files Acquisition

Radiance observations | Thermal measurements

Reflectance Analysis
- RAD-PDS label reading
- Binary image extraction

Thermal Analysis
- BTR-PDS label reading
- QUBE identification
- QUBE layers reading
- Thermal image creation

2D Map Construction
- Mosaic creation
- 3D scene reconstruction
- 2D Map achievement

Path Planning
- Hazards map
- Algorithm creation

Aim & Objectives

Aim

Preliminary study for a navigation system, complementary to the existing geometrical techniques, focused on the terrain properties identification and classification through reflectance and thermal models.

Objectives

- Analysis of the bidirectional reflectance distribution functions (BRDF) achieved from the Pancam observations;
- Achievement and analysis of the brightness temperature and spectral emissivity data obtained through the Mini-TES measurements;
- Development and simulation of associated path planning algorithms.
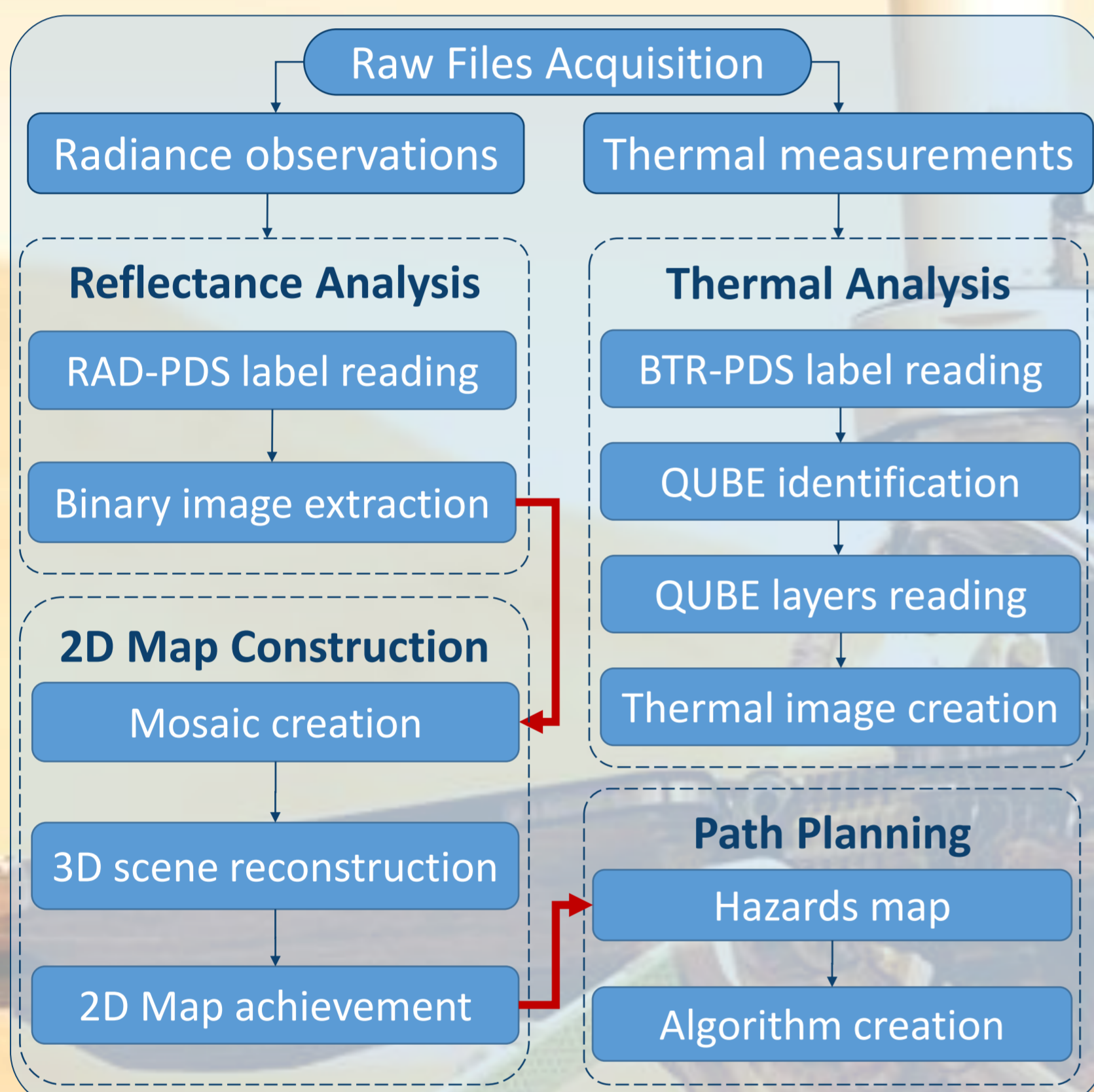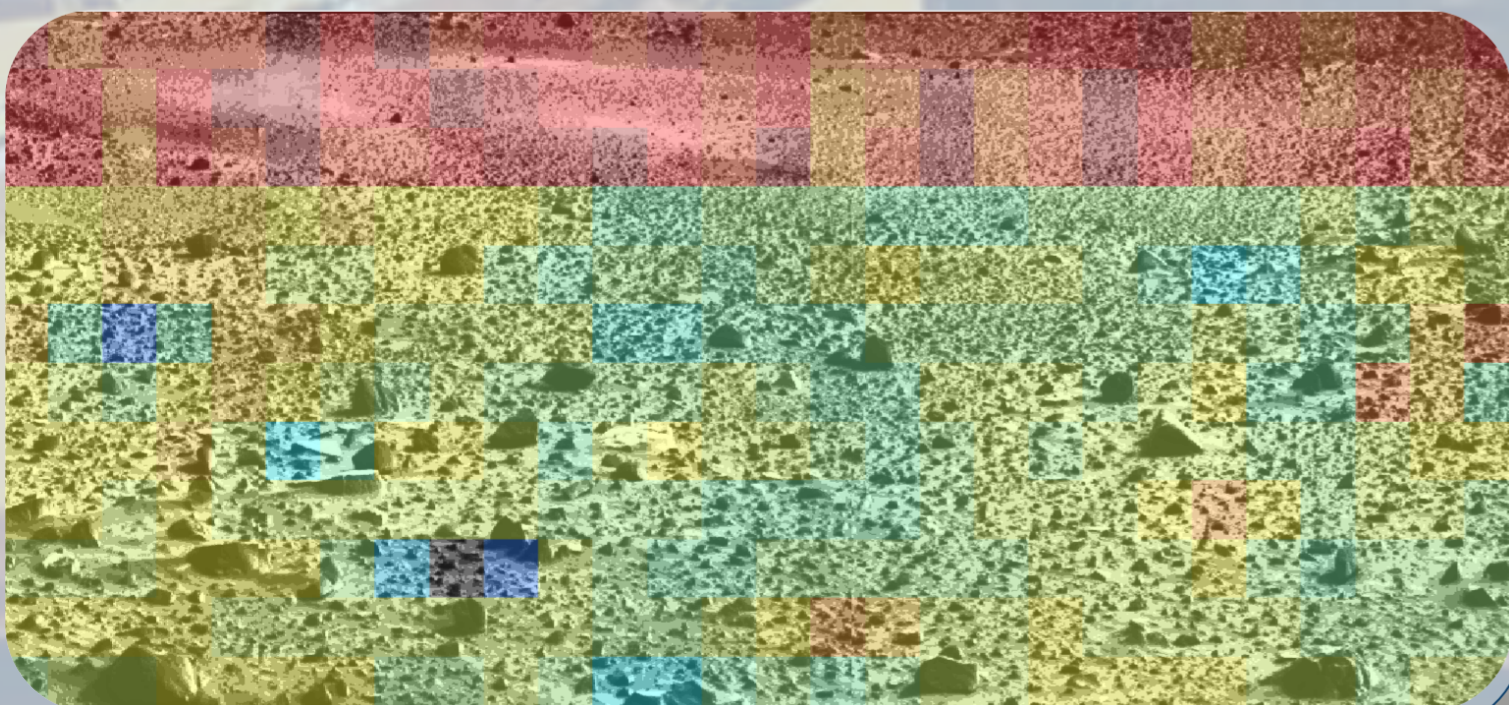
BRDF Analysis

The BRDFs resulting from the Pancam image processing have been analysed through visual inspection techniques to determine the BRDFs threshold value above which the associated image element was considered a rock. Changing the threshold and the size of the analysed area around each image pixel it was possible to detect either all the rocks or only the one able to hinder the passage of the rover.
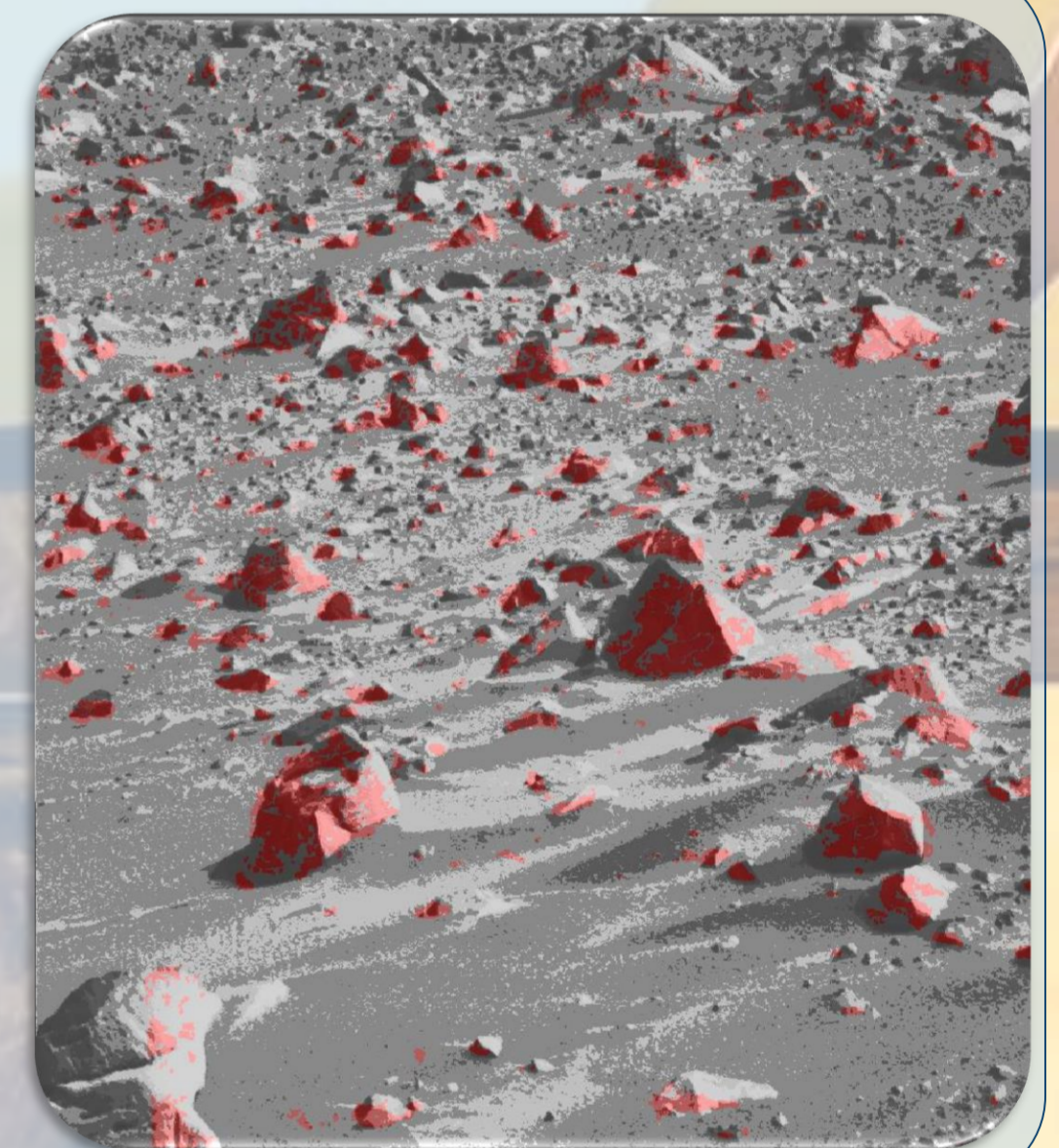
Thermal & Spectral Analysis

The thermal brightness and spectral emissivity data have been extracted from the hyperspectral QUBEs derived from the Mini-TES observations.

The spectrometer measured lower average temperatures in correspondence of rocky surfaces, which tend to be cooler than dust.

Conclusions

The detection technique based on the BRDF analysis results to be effective, however:

- the linearized format of the Pancam derived images causes a loss of fidelity and data; thus an analysis of the variation of the optimal threshold values should be performed;
- the threshold for the identification of rocky surfaces depends on the analysed sol (heliocentric Mars distance);
- clustering techniques would help to classify the size of the rocks detected through the reflectance method.

The thermal analysis provided valid outcomes, though:

- a higher resolution spectrometer would be needed to provide unambiguous data for navigation purposes.

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