THE MULTI-TEMPORAL DATABASE OF PLANETARY IMAGE DATA (MUTED)  
A TOOL TO SUPPORT THE IDENTIFICATION OF SURFACE CHANGES ON MARS

T. Heyer1, G. Erkeling1, H. Hiesinger1, D. Reiss1, D. Luesebrink1, H. Bernhardt1, and R. Jaumann2

INTRODUCTION

Multitemporal observations are key to detect and analyze surface changes and processes on Mars. Since the 1970s, spacecraft observations have revealed that the surface of Mars is changing [1, 6]. The modifications are attributed to aeolian processes, including eolian activity [7], mass movement [8, 9], the growth and retreat of the polar caps [10, 11], and crater-forming impacts [12]. The observation of these variable features is also supported by the increasing number of repeated imaging acquisitions of the same surfaces. MUTED comprises metadata of all major Mars missions and enables scientists to quickly identify the spatial and multitemporal coverage of planetary imaging data from Mars [3, 14]. Images can be searched in temporal and spatial relationship to thematic maps at a global scale or for a specific location of interest.

DATASETS

At the current state, metadata pertaining to over 1.03 million images from various instruments including the Viking Orbiter [15], the Mars Orbiter Camera (MOC) [16], the Mars Orbiter Camera/MER (MOC/MER), the High Resolution Stereo Camera (HiRISE) [17], HiRISE on board Mars Express (MEX), the Thermal Emission Imaging System (THEMIS) [18] on board Mars Odyssey, the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [19], the Context Camera (CTX) [20], and the High Resolution Imaging Science Instrument (HiRISE) [21] on board the Mars Reconnaissance Orbiter (MRO) are integrated into the database [Fig. 3]. The spatial resolution of the integrated imaging varies from ~25 centimeters (HiRISE) to several kilometers per pixel (global observations of Viking and MOC/MER). Data analysis showed that ~52.3% of all images integrated into MUTED have a spatial resolution of <50 m and cover about 31% of the surface of Mars [Fig. 3].

APPLICATION EXAMPLES

MUTED enables planetary scientists, engineers, and mission planners to access multitemporal observations of Mars and their spatial and temporal context. The database will assist and optimize image data searches based on various change detection tasks

(1) The time span between repeated images can be defined to discover surface changes caused by short-term or temporary high-variability processes like dust devils [22].

(2) The number of images within a certain time period can be set according to solar longitude, for example, to observe seasonal changes and processes, e.g., seasonal storm events [23] or seasonal ice and frost cover [23, 24].

(3) The minimum number of overlapping images can be defined to ensure data availability for certain multitemporal data analyses, e.g., long-term changes of the surface of Mars, cratering [25, 26], or mass wasting processes [25, 26].

Due to long-term and continuous data acquisition by spacecraft, the amount of image data is steadily increasing and enables further comprehensive analyses of martian surface changes, caused by eolian, mass wasting, polaris wall assimilation processes.

ARCHITECTURE

MUTED is based on a free and open source software, and consists of a three-level architecture. Metadata of the planetary imaging datasets are included from NASA’s Planetary Data System (PDS) into PostgreSQL database. Additional information, e.g., the number and time-span of overlapping images are defined for each image data respectively. A GeoServer translates the metadata stored in the relational database into web map services (WMS) and web features services (WFS). All services are combined and visualized in the web-based user interface (Fig. 1). The user interface was built using HTML, PHP, and JavaScript and provides several features for data and dataset selection, spatial definition of the area of interest and data filtering. Another feature of the user interface is a timeline that displays all selected images in a chronologically ordered.

FEATURES

- Images can be searched in temporal and spatial relation to other images.
- Define an area of interest based on global multispectral, topographical or geocolor information.
- Filter data by data solar longitude in order to the acquisition geometry.
- Show dataset statistics and the temporal context to other datasets.

MUTED.WWU.DE