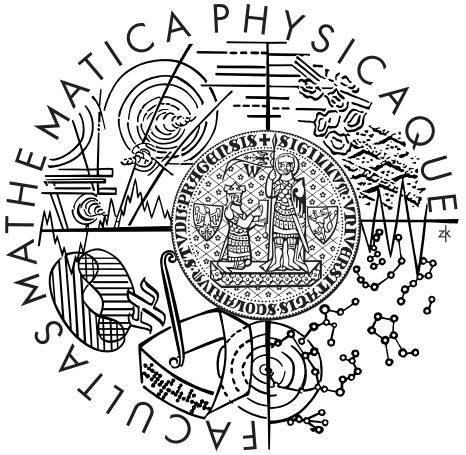
Charles University in Prague
Faculty of Mathematics and Physics

MASTER THESIS



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Detection of 2D features in MARSIS ionogram pictures

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Study programme: Informatics
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Název práce: Hledání 2D jevů v ionografických snímcích přístroje MARSIS

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Abstrakt: Práce se zabývá technikami hledání význačných prvků v ionogramech zachycených přístrojem MARSIS umístěným na kosmické sondě Mars Express. Ionogramy jsou reprezentovány jako dvourozměrné obrázky s hodnotou kódovanou pomocí barvy. Vyvíjené techniky se snaží detekovat v takových snímcích různé zajímavé křivky (definované sadou parametrů), případně měřit další parametry nalezených objektů (perioda opakování přímek).

Klíčová slova: rozpoznávání vzorů, detekce, parametrické křivky, Mars Express, vektorizace

Title: Detection of 2D features in MARSIS ionogram pictures

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Abstract: The work focuses on techniques for finding significant features in ionograms captured by the MARSIS instrument onboard the Mars Express spacecraft. Ionograms are 2D images with values represented in color. The developed techniques try to detect interesting curves (parametrically defined) in such images and measure some more parameters of the found objects (like the repetition period of lines).

Keywords: pattern recognition, detection, parametric curves, Mars Express, vectorization

Contents

Introduction

1. Mars Express, MARSIS and ionograms

1.1 Mars Express

First of all, let us briefly introduce the spacecraft carrying all the equipment needed to acquire ionograms. Its name is *Mars Express* (MEX) and it was launched by the *European Space Agency* (ESA) on 2 June 2003.

MEX arrived to the Mars' orbit on 25 December 2003 [9] with seven onboard scientific instruments and a landing module called Beagle 2. We're going to take a look at all of them in the following subsections; just Beagle 2 description is going to be rather short, because the landing sequence failed (for an unknown reason) and the lander didn't establish connection after it landed (if it landed at all)[9, p. 4].

The mission of MEX has several goals like "global studies of the surface, subsurface and atmosphere at unprecedented spatial and spectral resolutions" [9, p. viii]. One of the goals, however, stands out among all the others. It is the search for water (or its traces) on Mars' surface or subsurface.

Why water? There is lots of geological evidence of former water occurrence. But before the MEX mission nobody had proved or refuted presence of water on Mars in the present. Knowing more about water on Mars and its history, the scientists could postulate better hypotheses about the possibility of (former) life on the planet [9, p. ix].

The original mission lifetime of MEX was projected up to the end of 2005 (which would be 1 Martian year = 687 Earth days) [2]. However, overcoming some small problems (as the Solid State Mass Memory anomalies described in [6] or the MARSIS antennas deployment problems in 2004 [3, 4]), MEX has worked on its science goals up to this day and its science mission was extended until 2014 [7] (after 3 preceding extensions). Fred Jansen, MEX mission manager, said MEX had enough fuel for another 14 years of operation (at the beginning of 2012) [1]. So there is a hopeful prospect of further and deeper Mars exploration (eg. [8] discovered an unexpected way of using the MARSIS instrument so that they "added magnetometer functionality" to MARSIS).

1.1.1 HRSC (*High-Resolution Stereo Camera*)

HRSC is a high-resolution camera

1.1.2 OMEGA (*IR Mineralogical Mapping Spectrometer*)

1.1.3 MARSIS (*Mars Advanced Radar for Subsurface and Ionosphere Sounding*)

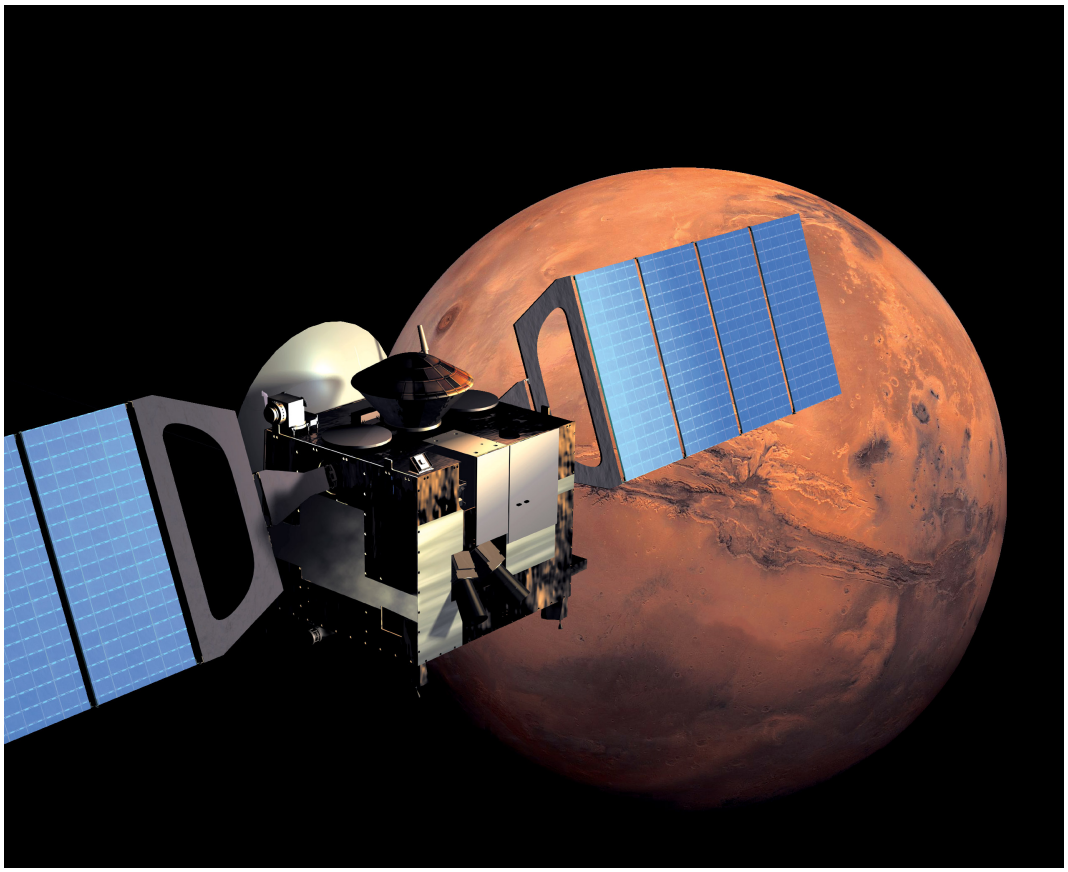

Figure 1.1: Mars Express spacecraft. Credit: ESA [5]

2. Title of the second chapter

2.1 Title of the first subchapter of the second chapter

2.2 Title of the second subchapter of the second chapter

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References

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