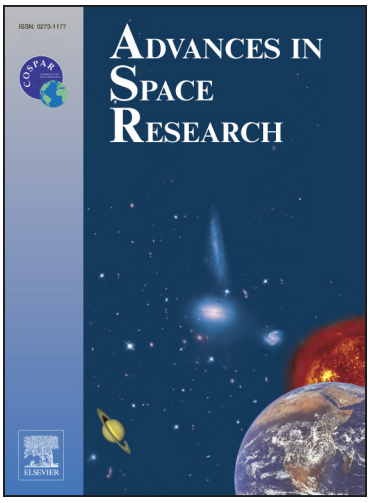

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Jianfeng Deng, Ai Gao, Hua Zong, Pingyuan Cui

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An innovative navigation scheme for Mars entry using dynamic pressure measurement

Jianfeng Deng [a, b, c], Ai Gao* [a, b, c], Hua Zong [d], Pingyuan Cui [a, b, c]

[a] *School of Aerospace Engineering, Beijing Institute of Technology, Beijing, 100081, China.*

[b] *Key Laboratory of Dynamics and Control of Flight Vehicle, Ministry of Education, Beijing, 100081, China.*

[c] *Key Laboratory of Autonomous Navigation and Control for Deep Space Exploration, Ministry of Industry and Information Technology, Beijing, 100081, China.*

[d] *National Key Laboratory of Science and Technology on Aerospace Intelligent Control, Beijing, 100854, China.*

Abstract

Complete observability of dynamic system is a major concern of navigation in Mars precision landing exploration missions. It is demonstrated that, however, the current measurements used for navigation during Mars entry cannot guarantee the complete observability of the dynamic system. This paper proposes an integrated navigation scheme for Mars entry phase using the dynamic pressure and accelerations from inertial measurement unit (IMU). The dynamic pressure derived from the Mars Entry Atmospheric Data System (MEADS), and the triaxle accelerations from IMU are integrated in a filter as navigation measurements to increase the dynamic system observability and perform state estimation on-board. Afterward, the perturbation of the dynamic caused by parameter uncertainties is built. In order to address the impact of perturbation on state estimation, an adaptive estimator based on modified mixture-of-expert framework is given. Numerical simulation results demonstrate that the proposed integrated navigation scheme can ensure the complete observability of the dynamic system, and the state estimation are converged with entry time after the dynamic pressure has built up.

Keywords: Mars entry, integrated navigation scheme, dynamic pressure measurement, observability analysis, state estimation

1. Introduction

Future Mars landing exploration missions will require the entry vehicle with the capability of landing at certain sites for specific interests to gather samples of high scientific quality. One of the significant engineering challenges for delivering the entry

*Corresponding author

Email address: jfdeng@bit.edu.cn (Jianfeng Deng), gaoai@bit.edu.cn (Ai Gao), zonghua3@sina.cn (Hua Zong), cuipy@bit.edu.cn (Pingyuan Cui)

[1]Ph.D. Candidate, Mail box 22, School of Aerospace Engineering, Beijing Institute of Technology, Beijing

[2]Corresponding author, Lecturer, Mail box 22, School of Aerospace Engineering, Beijing Institute of Technology, Beijing

[3]Senior Engineer, National Key Laboratory of Science and Technology on Aerospace Intelligent Control, Beijing, 100854, China

[4]Professor, Mail box 22, School of Aerospace Engineering, Beijing Institute of Technology, Beijing