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Author: Ms. Sagarika Rao Valluri
RNSIT Bangalore, India

Mr. RAJ PANCHAL
Space Generation Advisory Council (SGAC), India
Mr. Ashish Parmar
Student, India
Ms. Nandini Singh
Space Generation Advisory Council (SGAC), India
Mr. Sairaj Dillikar
India

A COMPARATIVE ANALYSIS OF MARS OPERATIONS WITH AN OVERVIEW OF EMERGENT TECHNOLOGY SUPPORTING AUTONOMOUS GROUND NAVIGATION ELECTRONIC SYSTEM (AGNES) FOR FORTHCOMING MISSIONS

Abstract

Growing international interest following successful missions to mars over the last two decades has given rise to scientific operations on the Martian surface that have aided planetary missions focusing on locomotion, sample acquisition, atmospheric testing and surface testing. The data collected from the following landers and rovers - Phoenix, ExoMars, Opportunity and Curiosity, are compared and studied in two stages. The first stage is an analysis of key technological developments within the mission control system, automated navigation, thermal system and communications. Using the data acquired from these particular missions, the second stage of the analysis is developed to compare and analyse instrumentation (e.g. TGO-Trace Gas Orbiter, RSP, etc.) and electronic developments. A key focus is placed on automated instrumentation for navigation, relay communications, and developments through a comparative study under a technological lens. The paper proposes a new design and control code for an automated navigation system to land and move on the Martian surface. The system design accommodates a perception imagery system to collect real-time data of surface and self navigate using optimised visual odometry to perform localisation for landing and deciding operational sites on the surface. The design also incorporates sensors to test temperature, wind speed and atmosphere density and uses the collected data to combine visual and object confirmation. The code developed to study the visual system, images and data collected, incorporates an amateur AI system to minimise delay to determine optimised landing and surface movement. The code aims to provide a basis for the concept of an enhanced self-control system for landers, rovers for current and upcoming missions. The paper attempts to propose a completely self-automated system with minimal interaction and delay between relay communications and ground control to make locomotive decisions on the surface. The code is verified, and the design is simulated using data from current mars missions and operations. The overview and comparative study provide a foundation for new instrumentation developments and a futuristic design for -Automated Ground Navigation Electronic System (AGNES).