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ADAPTIVE REARRANGEMENT BASED HKTM-STORAGE DATA COMPRESSION WITHOUT ANY UPLINK DATA REQUIREMENT

Abstract

This paper describes a novel RLE based adaptive Data Compression algorithm for HKTM-Storage data in Remote-sensing Satellites (RS). Unlike in Communication satellites which are almost always visible to the ground station, RS experience time and bandwidth limitations during the satellite data playback. The mission complexities and resource optimization such as processing, memory and link bandwidth requires minimum data redundancy or increased information content in data systems. In this paper, an RLE based compression scheme is proposed on the preprocessed data. The preprocessing increases the likelihood of zero-bit data in the input data stream thus it tries to achieve the desirable distribution of ones and zeros in the data stream so that the static universal code (to reduce the processing requirement) allocation is as close to the optimal code length as possible. Additionally, robust universal codes are alternated between the zero-bit counts for resistance against data corruption. Since this is an onboard software based implementation, it has been incorporated with the features like simplified operations, reduced RAM area occupancy and real-time processing. The further improvement in compression ratio is achieved using real time adaptive rearrangement of data which is an improvement over the POCKET algorithm [1] which requires masking data to be uplinked from the ground station. This modification is useful in avoiding the uplink data and increasing the self-adaptability of the compression scheme during changes in the HKTM format such as Dwell-telemetry, Programmable-telemetry etc. The assumption made is that the frame to frame correlation is high during normal satellite operations. This modification not only makes compression real-time but also eliminates the ground element of the algorithm as indicated in [1]. It can additionally be used in tandem with the ground element of the algorithm [1] during larger operational life time of the spacecraft.The performance of this compression scheme has been evaluated on the actual HKTM data of some of the present Remote-Sensing satellites and the achieved compression ratio has been ranging from 3.3 to 4.2 depending on the amount of data unit (Master Frames) processed in real-time. Decompression of the compressed data uses APIs to increase the scalability of the ground software. The on-orbit stability and operational performance of this algorithm needs to be evaluated.

References: [1] David Evans, Ugo Moschini, “Ten times more information in your real-time TM”, American Institute of Aeronautics and Astronautics Inc.