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OPTIMIZING SATELLITE IMAGING THROUGH REAL-TIME COMPRESSION: TECHNIQUES AND
STANDARDS

Abstract

Satellite photography is an indispensable tool for a broad range of uses, such as environmental monitoring, disaster management, urban planning, and agricultural assessment. The enormous amount of data produced by satellite sensors presents serious difficulties for processing, transferring, and storing. Image compression methods are vital for addressing these issues since they reduce the data footprint while maintaining and preserving critical information. This abstract examines various image compression techniques designed specifically for satellite imagery, considering the special traits and demands of remote sensing applications. The evaluation of lossless and lossy compression techniques takes into account the preservation of important features, computational complexity, and compression ratio. The idea is to work on developing an algorithm to integrate a satellite imaging sensor with real-time compression optimization in the satellite designed to acquire data while continuously monitoring compression performance and image quality ensuring the best compression ratio while preserving image integrity by constantly adjusting compression settings in response to shifting environmental factors, satellite positions, and data transport capacity. One of the most popular lossy compression methods is JPEG (Joint Photographic Experts Group) compression. Blocks of visual data are converted into frequency components using the Discrete Cosine Transform (DCT), which is then followed by quantization and entropy coding. For satellite photography, JPEG compression works well, particularly in situations where a slight loss of quality is acceptable. Some other image compression techniques include wavelet compression, predictive coding techniques, context-based compression techniques and sparse representation techniques which will also be examined in this paper. The significance of interoperability and compression standards in satellite imaging systems, which promote data sharing and cooperation amongst various stakeholders, is also covered in this paper. Ensuring compatibility and interoperability across a variety of satellite missions and platforms is ensured by standardization initiatives like the Consultative Committee for Space Data Systems (CCSDS) image compression standards. Keywords : Satellite imagery, Lossless and Lossy compression, Compression ratio, Satellite imaging sensor, Real-time Optimization, JPEG, DCT, Quantization, Entropy Coding, CCSDS.