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A NEW ROBOTIC DATA STREAMS COMPRESSION ALGORITHM FOR DEEP SPACE EXPLORATION

Abstract

Deep space probe-mounted sensor networks are constantly generating data. The data streams are massive, temporally ordered, fast changing, and potentially infinite. But the communication bandwidth between the remote deep space probe and Earth is often extremely limited. To provide greater information throughput, raw data streams are often compressed prior to transmission. In this research, a new algorithm for data streams processing and analysis and compression is applied to this source compression problem of deep space exploration. Firstly, a raw data streams is processed by the clustering and classification. During clustering, the data set's data points are partitioned into several disjunct clusters such that the elements of a cluster are similar, and the elements of disjunct clusters are dis-similar. Each cluster is represented by its cluster centroid. So the overall data stream set is represented via the cluster centroids. Secondly, we mine all high-order models and limited number of concepts, or stable distributions offline from a clustered stream, and build high quality models for each of them. At run time, combining historical concept change patterns and cues provided by an online training stream, we find the most likely current concept and use its corresponding models to classify data in the coming unlabeled streams. Furthermore after such processing and analysis, a raw data stream is segmented to different types of information data segments. Different types of information segments require different types of compression algorithms that are dedicated to the types of the information segment to be compressed. In fact, some types of scientific practical measurement data are so important that they need total transmission and no compression. Some of the low frequency information data segments must be compressed using a lossless or near-lossless process, other higher frequency information data segments can be compressed by curve fitting or statistical characterization and still other information data segments can be compressed using very lossy processes. Finally, compression algorithms are robotically selected and combined and optimized according to the characteristics of the type of information segment to be compressed. The research concentrates on specific methodologies and supporting technologies to provide effective processing and analysis and compression of such constantly flowing data streams. The algorithm may be used for real-time transmission of voice and video and other data streams in deep space mission in the near future.