Optimal Codes for the Burst Erasure Channel

This approach offers lower decoding complexity with better burst erasure protection.

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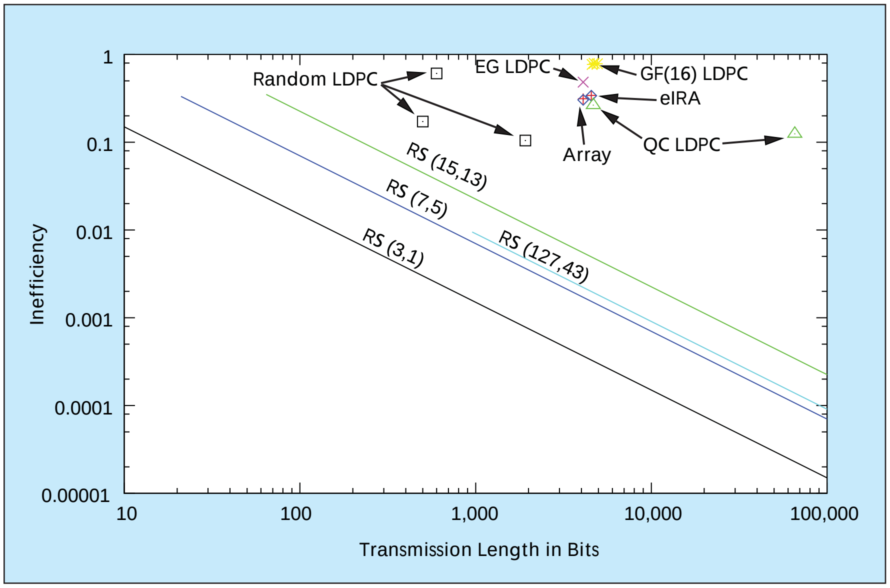
Deep space communications over noisy channels lead to certain packets that are not decodable. These packets leave gaps, or bursts of erasures, in the data stream. Burst erasure correcting codes overcome this problem. These are forward erasure correcting codes that allow one to recover the missing gaps of data. Much of the recent work on this topic concentrated on Low-Density Parity-Check (LDPC) codes. These are more complicated to encode and decode than Single Parity Check (SPC) codes or Reed-Solomon (RS) codes, and so far have not been able to achieve the theoretical limit for burst erasure protection.

A block interleaved maximum distance separable (MDS) code (e.g., an SPC or RS code) offers near-optimal burst erasure protection, in the sense that no other scheme of equal total transmission length and code rate could improve the guaranteed correctible burst erasure length by more than one symbol. The optimality does not depend on the length of the code, i.e., a short MDS code block interleaved to a given length would perform as well as a longer MDS code interleaved to the same overall length. As a result, this approach offers lower decoding complexity with better burst erasure protection compared to other recent designs for the burst erasure channel (e.g., LDPC codes). A limitation of the design is its lack of robustness to channels that have impairments other than burst erasures (e.g., additive white Gaussian noise), making its application best suited for correcting data erasures in layers above the physical layer. The efficiency of a burst erasure code is the length of its burst erasure correction capability divided by the theoretical upper limit on this length. The inefficiency is one minus the efficiency. The illustration compares the inefficiency of interleaved RS codes to Quasi-Cyclic (QC) LDPC codes, Euclidean Geometry (EG) LDPC codes, extended Irregular Repeat Accumulate (eIRA) codes, array codes, and random LDPC codes previously proposed for burst erasure protection. As can be seen, the simple interleaved RS codes have substantially lower inefficiency over a wide range of transmission lengths.



The **Inefficiency of Interleaved RS Codes** is compared with other listed codes.

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The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46903.

Phenological Parameters Estimation Tool

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The Phenological Parameters Estimation Tool (PPET) is a set of algorithms implemented in MATLAB that estimates key vegetative phenological parameters. For a given year, the PPET software package takes in temporally processed vegetation index data (3D spatio-temporal arrays) generated by the time series product tool (TSPT) and outputs spatial grids (2D arrays) of vegetation phenological parameters. As a precursor to PPET, the TSPT uses quality information for each pixel of each date to remove bad or suspect data, and then interpolates and digitally fills data voids in the time series to produce a continuous, smoothed vegetation index product. During processing, the TSPT displays NDVI (Normalized Difference Vegetation Index) time series plots and images from the temporally processed pixels. Both the TSPT and PPET currently use moderate resolution imaging spectroradiometer (MODIS) satellite multispectral data as a default, but each software package is modifiable and could be used with any high-temporal-rate remote sensing data collection system that is capable of producing vegetation indices.

Raw MODIS data from the Aqua and Terra satellites is processed using the TSPT to generate a filtered time series data product. The PPET then uses the TSPT output to generate phenological parameters for desired locations. PPET output data tiles are mosaicked into a Conterminous United States (CONUS) data layer using ERDAS IMAGINE, or equivalent software package. Mosaics of the vegetation phenology data products are then reprojected to the desired map projection using ERDAS IMAGINE.