

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)  
Advanced Systems (6)

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A NEW LOW-COMPLEXITY DIFFERENTIAL DETECTION TECHNIQUE, FRACTIONAL  
MULTI-BIT DIFFERENTIAL DETECTION (FMDD) FOR SUPPORTING FUTURE SPACE  
COMMUNICATIONS

**Abstract**

A new low-complexity differential detection technique, fractional multi-bit differential detection (FMDD), is proposed in order to improve the performance of Gaussian minimum shift keying (GMSK) recommended as one of the most appropriate and efficient modulation techniques for future communication links supporting space exploration and science missions, particularly to the typical application spectrum-constrained S-band TTC links via the SN or DFE/DTE[1]. In comparison to conventional one-bit differential detected (1DD) GMSK, our FMDD-employed GMSK provides a signal-to-noise ratio advantage of up to 1.8 dB in an AWGN channel. Thus, the bit-error rate performance of the proposed FMDD is brought close to that of an ideal coherent detection while avoiding the implementation complexity associated with the carrier recovery. In the adjacent channel interference (ACI) environment, FMDD achieves an even noticeable SNR advantage compared to 1DD, without the use of ACI cancellation technique.

Reference 1. F. Stocklin, L. Deutsch, G. Noreen, J. Hamkins, D. Lee, J. Wesdock, C. Patel, "Formulation of Modulation Recommendations for Future NASA Space Communications," Aerospace Conference, Big Sky, Montana, March 1-8, 2008.