INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Resmi N. C.
Roll Number	:	10610210
Programme of Study	:	Ph.D.
Thesis Title	:	Energy Efficient Communication with Interdependent Source-Channel Coding for Wireless Sensor Networks
Name of Thesis Supervisor(s)	:	Dr. Sonali Chouhan
Thesis Submitted to the Department/ Center	:	Department of Electronics and Electrical Engineering
Date of completion of Thesis Viva-Voce Exam	:	12/05/2021
Key words for description of Thesis Work	:	WSNs, Energy efficiency, Channel coding, Coding gain, Source coding, Compression

SHORT ABSTRACT

Reliable energy-efficient information transmission is the primary design objective of a WSN, considering its unique energy and resource constraints. Energy efficiency and BER performance are the necessary criteria to be taken into account while designing an optimal error correction scheme for WSNs. In this thesis, two methodologies for a novel energy-efficient error control scheme are proposed. The scheme is inclusive of three fundamental convictions for energy efficiency: error correction capability, data compression, and reduced computation. The methodologies achieve a better BER performance compared to the standard schemes with minimized energy overheads of a typical error control scheme. These include additional bits' transmit energy and encoding/decoding energy. The redundant bits' transmit energy is saved by incorporating compression. Coding energy is minimized by employing simpler operations compared to conventional error control schemes. A novel codeword structure is proposed for the same, which combines the source and channel coding methods interdependently, i.e., accomplishing error control without added redundancy, on the contrary, with saving in the number of bits transmitted.

The methodologies are analysed with three performance metrics such as BER performance for error control capability, percentage compression for data compression, and total energy consumed per information bit for energy efficiency. For a comprehensive comparison of the energy efficiency of the schemes, both computation energy for the coding operations and communication energy for the data transmission are considered. This proves that saving in communication energy doesn't come with an increase in total energy due to the additional coding operations, which is essential for a highly populated network of low powered nodes. Both analytical and simulated analyses are performed. The analytical study is performed using the mathematical expressions derived, which validated the simulation results. The validation is further emphasized by deriving the upper and lower bound on the BER performance results. The investigation is performed at two sensor platforms MicaZ and Mica2, under the Additive White Gaussian Noise (AWGN) as well as Rayleigh fading channels.

The significant achievements observed by the proposed methodologies come with a trade-off. By design, the proposed methodologies scramble the transmitted data. In this thesis, we have studied different ways to descramble the data at the receiver for keeping the data in sequence.