SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (6)

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REDUNDANCY-FREE QUANTUM CODING METHODS IN SPACE COMMUNICATIONS

Abstract

Telecommunication and satellite communications always have been a pulling force either in the military or in the civil environment. For well-functioning Near-Earth and interplanetary communications we need channel coding to handle the errors appearing in a communication channel. Instead of the classical approaches we can use the power of quantum communications which is based on the laws on quantum mechanics.

The current state of quantum information theory draws a picture from the currently available limits and possibilities in quantum information processing, such as from the applications of these results in practice. Quantum information theory is the natural extension of the results of classical information theory. But quantum information theory brings something new into the global picture and helps to complete the missing, classically indescribable and even unimaginable parts. As we show in our paper, it is possible to construct communication protocols with zero redundancy error correction with the help of quantum mechanics.

The free-space quantum communication can be extended to ground-to-satellite or satellite-satellite quantum communication and can be used in near-Earth communication as well. One of the main advantages of the usage of space for future quantum communication is the loss-free and distortion-free optical communication. The main element of the free-space quantum communications is a quantum or a classical channel. There are many quantum error coding algorithms which are based on some redundancy. In our paper we introduce our redundancy-free quantum error correction method and we also consider the redundancy-free implementation of a unitary error correcting operator. Our quantum channel coding protocol achieves the redundancy-free communication using local unitary operations and unitary matrices.

Currently the theoretical background for the construction of redundancy free quantum channels is still unknown. Open questions related to the redundancy-free quantum communications in the satellite domain can be solved based on our novel coding approach.