A Cooperative Signaling Scheme for Global Navigation Satellite Systems

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Abstract : Recently, the global navigation satellite system (GNSS) such as Galileo and GPS is employing more satellites to provide a higher degree of accuracy for the location service, thus calling for a more efficient signaling scheme among the satellites used in the overall GNSS network. In that the network throughput is improved, the spatial diversity can be one of the efficient signaling schemes; however, it requires multiple antenna that could cause a significant increase in the complexity of the GNSS. Thus, a diversity scheme called the cooperative signaling was proposed, where the virtual multiple-input multiple-output (MIMO) signaling is realized with using only a single antenna in the transmit satellite of interest and with modeling the neighboring satellites as relay nodes. The main drawback of the cooperative signaling is that the relay nodes receive the transmitted signal at different time instants, i.e., they operate in an asynchronous way, and thus, the overall performance of the GNSS network could degrade severely. To tackle the problem, several modified cooperative signaling schemes were proposed; however, all of them are difficult to implement due to a signal decoding at the relay nodes. Although the implementation at the relay nodes could be simpler to some degree by employing the time-reversal and conjugation operations instead of the signal decoding, it would be more efficient if we could implement the operations of the relay nodes at the source node having more resources than the relay nodes. So, in this paper, we propose a novel cooperative signaling scheme, where the data signals are combined in a unique way at the source node, thus obviating the need of the complex operations such as signal decoding, time-reversal and conjugation at the relay nodes. The numerical results confirm that the proposed scheme provides the same performance in the cooperative diversity and the bit error rate (BER) as the conventional scheme, while reducing the complexity at the relay nodes significantly. Acknowledgment: This work was supported by the National GNSS Research Center program of Defense Acquisition Program Administration and Agency for Defense Development.

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