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PERFORMANCE ANALYSIS OF HIGH THROUGHPUT MULTIBEAM SATELLITE UPLINK UNDER RAIN FADING

Abstract

Future-generation high throughput satellite (HTS) systems need to support ultra-high data rates in order to meet the demands of future high-bandwidth multimedia applications and to integrate with the terrestrial 5G technology. Toward this end, multibeam satellite communication (SatCom) systems, such as Australia's Sky Muster systems, are among the most promising solutions. Contrary to a single global beam transmission system, multibeam SatCom systems simultaneously send data to multiple users via multiple beams with a certain frequency reuse pattern. To achieve high spectral efficiency, an aggressive or full frequency re-use is desirable, i.e. all beams use the same frequency band. Due to the side lobes in the satellite's antenna radiation pattern, this aggressive frequency re-use suffers from interbeam interference (IBI). The IBI can be alleviated using multiuser detection techniques in the uplink (or reverse link) and precoding techniques in the downlink (or forward link).

This work considers the uplink of multibeam SatCom systems and proposes a novel decoding scheme at the gateway (GW). Conventional decoding of user terminals data requires channel state information (CSI) at the GW. The channel acquisition is generally an expensive process both in terms of time and signalling overheads. Our proposed zero-forcing equalizer makes use of users' physical location and antenna radiation pattern available at the gateway to alleviate IBI and hence requires little channel acquisition. Numerical results show that the proposed decoding strategy achieves the same ergodic sum rate as the conventional zero-forcing equalizer. Also, our proposed decoding allows us to derive closed-form approximation and bounds on the ergodic sum rate under rain fading. Monte Carlo simulations are used to validate the accuracy of our analysis.