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Title:A pilot-carrier coherent LEO-to-ground downlink system using an optical injection phase lock loop (OIPLL) technique
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Abstract:A pilot-carrier coherent low-earth-orbit (LEO) satellite to ground (LEO-to-Ground) downlink system using an optical injection phase lock loop (OIPLL) technique is proposed and its feasibility under Doppler frequency shift conditions is demonstrated. A fiber-optic based experimental system is configured and it is demonstrated that a 10 Gbps BPSK transmission system based on the proposed configuration can successfully maintain stable frequency and phase locking status under simulated Doppler frequency shift conditions. It is demonstrated that the stable locking status is maintained over a 10.3 GHz (54 ppm) frequency offset with a maximum rate-of-change of up to 32.4 GHz/s (168 ppm/s), which is ample to meet the requirement for a coherent LEO-to-Ground downlink system. The locking capability of the experimental system for more rapidly changing Doppler frequency shift is investigated. It is shown that the OIPLL receiver remains locked for maximum rates of change of 2.6 THz/s (13 500 ppm/s) or more for peak-to-peak frequency offsets up to 2 GHz (10.7 ppm). The phase noise performance of the system is also investigated and phase noise power of less than -100 dBc/Hz at greater than 1 MHz offset frequency is achieved even if the received laser signal suffers from a simulated Doppler frequency shift with peak-to-peak frequency offset of 2.4 GHz (12.5 ppm) and maximum rate of change of 750 GHz/s (3 900 ppm/s). © 1983-2012 IEEE.
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