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COHERENT OPTICAL DOPPLER ORBITOGRAPHY

Abstract

Doppler orbitography uses the Doppler shift in a transmitted signal to determine the orbital parameters of artificial satellites including range-rate (or inline velocity). We describe a technique for atmospheric-limited optical Doppler orbitography measurements based on a system that is capable of suppressing atmospheric phase noise imprinted on the transmitted optical signals.

We demonstrate the performance of this system over a 2.2 km horizontal link with a simulated satellite Doppler shift at the remote site - A horizontal link of this length has previously been been estimated to comprise around half the total integrated atmospheric turbulence as a vertical link to space. We obtained an estimated statistical range-rate precision of 4.5 nm/s at one second of integration, and 0.35 nm/s when integrated over a five-minute low Earth orbit transit. This represents a five orders-of-magnitude improvement over traditional microwave techniques in terms of statistical range-rate precision.

The performance of this system is a promising proof of concept for optical Doppler orbitography. The next steps are to extend this system to a more realistic vertical link with a moving remote terminal, and consider the systematic biases that would otherwise limit the usable precision of this technique. This will more accurately reflect the Doppler shifts and environmental challenges associated with performing this technique to artificial satellites in low Earth orbit.