An Open Path THz Transmissometer for Deterministic and Random Propagation Studies

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The design of an open-path 320 – 340 GHz coherent transmissometer for experimental measurements of amplitude scintillation, phase scintillation, angle-of-arrival (AoA) fluctuations, and transverse coherence near the 325.1529 GHz water vapor absorption resonance is presented. The system uses a uni-directional transmitter and two phase-coherent receivers with 10 cm diameter apertures and an adjustable transverse separation of up to3 m. The objective of the experiment is to verify and improve existing propagation models for use by designers of applied THz systems for remote sensing, radiolocation, or communications. System stability will be verified using a short range near-ground test path of several ~10's of meters length using a cable for locking the transmitter local oscillator (LO) to the receivers' LOs. This short range configuration, similar to tests conducted at Flatville, Illinois during the 1980s, permits characterization of system errors in all of the above parameters, thus yielding a baseline for the long range experiments. Characterization of the phase-coherent RF link will be studied vis-à-vis anticipated theoretical performance based on the Rytov approximation for a beam wave. The system will then be configured for long term open-path measurements on a an elevated link between the University of Colorado at Boulder (CU) and the National Telecommunications and Information Administration (NTIA) mesa site at the NOAA-NIST campus in Boulder, Colorado with 1.924 km path length and 121m rise. Coherency is achieved utilizing a 40.7 MHz Industrial, Scientific and Medical (ISM) band continuous wave (CW) signal phased locked with the transmitter LO to drive a phase locked loop at the receivers. The system will provide long range coherent THz propagation statistics during continuous long-duration study of turbulent atmospheric propagation effects over an extensive array of atmospheric conditions in a realistic operational environment.