TIME DELAY RANGE BIAS ESTIMATION USING THE PARABOLIC EQUATION

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Time-delay radar range measurements in the lower atmosphere are biased by time lags due to atmospheric bending and a non-vacuum propagation speed. The resultant errors are often appreciable for long-range, high-resolution radars. One can correct for standard atmosphere biases using classical range/angle/height lookup tables, however more complicated environments are not easily characterized.

The Fourier split-step solution to the Parabolic Equation (PE) is a popular method for modeling radar propagation in the lower atmosphere (J.R.Kuttler G.D.Dockery, *Radio Science*, **26**:2, 381-393, 1991). One feature that makes this approach quite powerful is the ability to accommodate both height- and range-varying atmospheric refractivity. Another advantage is that the PE provides full forward-wave solutions. This presentation concerns the feasibility of using the phase of the full forward-wave solution to predict time-delay range errors in an arbitrary atmosphere.

The Tropospheric Electromagnetic Parabolic Equation Routine, a PE solver developed by the Johns Hopkins Applied Physics Lab, is used to generate complex field solutions as a function of range and height for both a measured atmosphere and a reference atmosphere. The relative phase between these two fields is then computed. Ambiguities in the relative phase are resolved using a simple 2-D phase unwrapping algorithm (H.Lim, *IGARSS Proc.*, **1**, 196-198, 1995). The result is a range/height map of range errors incurred if one were to transmit radar energy in the measured atmosphere, while assuming a time delay commensurate with the reference atmosphere. In this way we can, for example, compute the residual errors experienced by a system using standard atmosphere lookup tables for time-lag corrections. This procedure shows promise for PE-based range error prediction. Potential complications, such as surface reflections and multi-mode ducts, are discussed.

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2. F - Wave Propagation and Remote Sensing
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