Study of radial correlation reflectometry using a 2D full-wave code

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A two-dimensional full-wave code in ordinary mode of propagation is used to simulate radial correlation reflectometry. Gaussian beams with normal incidence with respect to cut-off layer are used. Radial correlation lengths estimated from the simulated reflectometry signals are then compared with the true values under a wide range of turbulence conditions. For this study we consider similar turbulence parameters as the ones previously used in [1] to study Doppler reflectometry. The radial correlation length of the turbulence is varied within the range $L_r / \lambda_0 \approx 0.4 - 2$ whereas the turbulence level scan covers $\delta n_{rms} / n = 1 - 15$ %. The radial correlation length and turbulence level scans allow us to study correlation reflectometry measurements both in linear and non-linear regimes [2]. Previous numerical results based on the one-dimensional WKB approximation [3] and a two-dimensional physical optics code [4] showed the possibility of a drastic decrease of coherence with growing the fluctuation level. In refs. [4, 5] it was also shown that neither phase nor homodyne signals will give the true correlation length without some form of correction factor. Our full-wave results show that at moderate turbulence levels, radial correlation lengths satisfying $L_r / \lambda_0 \geq 1$ can be estimated whereas shorter correlation lengths cannot be measured accurately. When non-linear effects become relevant radial correlation lengths are, in most cases, underestimated.

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