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Effect of Random Circuit Fabrication Errors on Small Signal Gain and Phase in Helix Traveling Wave Tubes P. PENGVANICH, University of Michigan, Ann Arbor, D.P. CHERNIN, SAIC, McLean, VA 22102, Y.Y. LAU, University of Michigan, Ann Arbor, J.W. LUGINSLAND, NumerEx, Ithaca, NY 14850, R.M. GILGENBACH, University of Michigan, Ann Arbor — Motivated by the current interest in mm-wave and THz sources, which use miniature, difficult-to-fabricate circuit components, we evaluate the statistical effects of random fabrication errors on a helix traveling wave tube amplifier's small signal characteristics. The small signal theory is treated in a continuum model in which the electron beam is assumed to be monoenergetic, and axially symmetric about the helix axis. Perturbations that vary randomly along the beam axis are introduced in the dimensionless Pierce parameters b, the beam-wave velocity mismatch, C, the gain parameter, and d, the cold tube circuit loss. Our study shows, as expected, that perturbation in b dominates the other two. The extensive numerical data have been confirmed by our analytic theory. They show in particular that the standard deviation of the output phase is linearly proportional to standard deviation of the individual perturbations in b, C, and d. Simple formulas have been derived which yield the output phase variations in terms of the statistical random manufacturing errors. This work was supported by AFOSR and by ONR.

P. Pengvanich
University of Michigan, Ann Arbor

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