A time-variant analysis of the $1/f^2$ phase noise in CMOS parallel LC-Tank quadrature oscillators

This paper presents a study of $1/f^2$ phase noise in quadrature oscillators built by connecting two differential LC-tank oscillators in a parallel fashion. The analysis clearly demonstrates the necessity of adopting a time-variant theory of phase noise, where a more simplistic, time-invariant approach fails to explain numerical simulation results even at the qualitative level. Two topologies of 5-GHz parallel quadrature oscillators are considered, and compact but nevertheless highly general, closed-form formulas are derived for the phase noise caused by the losses in the LC-tanks and by the noisy currents in the MOS transistors. A large number of spectreRF simulations, covering a wide range of working conditions for the oscillators, is used to validate the theoretical analysis.