Abstracts

Phase noise in coupled oscillators: theory and experiment

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Phase noise in mutually synchronized oscillator systems is analyzed for arbitrary coupling and injection-locking topologies, neglecting amplitude noise, and amplitude modulation (AM) to phase modulation (PM) conversion. When the coupling phase is chosen properly (depending on the oscillator model), the near-carrier phase noise is reduced to 1/N that of a single oscillator, provided the coupling network is reciprocal. This is proved In general, and illustrated with specific cases of globally coupled and nearest-neighbor coupled oscillator chains. A slight noise degradation is found for unilaterally coupled (nonreciprocal) chains. The 1/N reduction for reciprocal coupling applies over nearly the entire range of free-running frequency distributions required for beam-scanning, and is verified experimentally using a linear chain of coupled GaAs MESFET voltage-controlled oscillators (VCOs) operating at X-band. The effect of a nonoptimum coupling phase on the phase noise of the system is also studied. As the coupling phase deviates from the optimum value, the phase noise increases significantly near the locking range edge for noise offset frequency near the carrier.

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