Optimization of QPSK Demodulators for Digital Satellite Radio

Direct Broadcasting by Satellite (DBS) together with Quadrature Phase Shift Keying (QPSK) enable the establishment of integral digital transmission between broadcast studios and domestic receivers. As the QPSK signal has no discrete component in its power spectrum, one critical subsystem in domestic receivers is the QPSK demodulator, because it may present problems of synchronism.

The main goal of this research is the analysis of possible structures for QPSK demodulation, determining the optimal structure to receive digital radio, and a hardware implementation presenting the closest performance to the theoretical limit.

The more important structures for coherent demodulation of QPSK signals are considered, and their stochastic differential equations are compared, concluding for the existence of equivalent structures. The optimum receiver loop for QPSK demodulation and two possible practical approximations of this loop are identified, and their performances are analyzed and compared.

A new practical approximation is presented for the optimum quadruphase loop, in which the hyperbolic tangent non linearity is approximated by a saturated amplifier characteristic, and it is shown that this new loop is for all practical purposes identical to the optimum loop. The practical implementation of this loop is studied and a prototype QPSK demodulator for DBS radio signals is presented.

An experimental structure is described for practical performance characterization of QPSK demodulators. Practical performance results of the prototype demodulator are presented which validate the theoretical study presented, as well as the practical solutions adopted, concluding for the feasibility of a QPSK demodulator with a performance very close to the theoretical limit.