RF Processing for Cancellation of Close-In Interferer

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Operation of a communications system in the presence of strong interference that is close by in frequency has been very limited with traditional analog signal processing. Today, one can design practically for software radios, where only the radio frequency (RF) processing is done in analog circuitry. This presentation describes a scheme whereby an incoming signal is processed through two parallel RF channels: one comprising a downconverter and one containing a log detector. The signals from these two paths are separated into in-phase and quadrature components. Multiplication cross-products among the two paths are formed, yielding two signals, both of which contain the desired signal and the interfering signal. A proper combination of these two signals in the software processor of the radio leads to cancellation of the interfering signals.

The scheme has been implemented and tested on a Lyrtech Signal Master software radio platform. Its performance has been evaluated for several common-place waveforms: QPSK, BFSK, QAM and 64 QAM. Both analysis and experimental evaluation reveal that the scheme is not well suited to variable amplitude signals, while phase/timing modulation schemes are served well. Experimental observations for such modulations can be described broadly as providing nominal 20 dB output signal-to-interference ratio (SIR) in the face of a -20 dB input SIR. Detailed results will be presented in the paper.

It was found experimentally that as the modulation rate of the interferer approaches and surpasses the frequency separation of the two signals, an intermodulation product arises in the main signal. The intermodulation rejection is defined as the ratio of side lobe power in the interfering input signal to the side lobe power in the desired output signal. The intermodulation leads to deterioration of performance as the ratio of the symbol rate to the frequency separation of the two signals approaches unity.

This work is expected to find application in dynamic frequency allocation. A secondary user of the spectrum could communicate very close in frequency to a high powered primary user such as an FM transmitter while maintaining a high quality of service and a low interference level for the FM band. Other applications include control of an interfering signal that emerges at a frequency near an ongoing communication. The strength of this system is that the amount of interference rejection grows with a decrease in the input signal to interference ratio. It is therefore most suitable in cases where one man-made interference source is the primary obstacle to signal detection or communication in a narrow band of spectrum.