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Project 8
Clipping Noise Cancellation Using Iterative Methods

One of the problems of multi-carrier systems such as OFDM is high PAPR (Peak to Average Power Ratio) values. Clipping is one of the simplest approaches for PAPR reduction. Iterative methods can be used for clipping noise cancellation in the receiver of these systems with no extra bandwidth.

1) Simulate an OFDM signal $x(t) = \sum_{i=0}^{N-1} \exp(j2\pi i f_0 t)\ ; 0 < t < T$ with clipping for PAPR reduction. Use the iterative method for removing the clipping distortion using the inverse system method.
2) In Simulation of part 1, try to incorporate the signal constellation and mapping in the iteration.
3) Use the CA and CG instead of ordinary iterative method for better convergence rate and find the optimized values for A and B. Add some noise to the system and repeat part 1.
4) Try to simulate the Rician fading channel with the depth of K=2.[1]
5) **Challenge**: Try to simulate a Rayleigh channel ($c(t) = u(t) + jv(t)$) and implement the inverse system method. (Do not worry if the iterative method diverges. You must feed more information to the input signal to enable the iterative method to converge).

References

[1] X. Li and L. J. Cimini, "Effects of clipping and filtering on the performance of OFDM," *in Proc. IEEE Vehicular Technology Conf. (VTC)*, pp. 1634 –1638, May 1997.

[2] R. A. Hemmati and P. Azmi, "Performance analysis of DFT based method for clipping noise suppression in OFDM systems over fading channels," in *Proc. of ICT2004*, Apr. 2004.

[3] R. Ali Hemmati, P. Azmi and F. Marvasti, "OFDM Clipping Distortion Compensation Using an Iterative Method", Accepted in *proc of VTC'06,* Oct,2006.

[4] F. Marvasti, "An iterative method to compensate for the interpolation distortion", *IEEE Trans ASSP*, vol3, no1, pp 1617-1621, 1989.

[5] _____, *Nonuniform Sampling: Theory and Practice*, Kluwer Academic/Plenum Publishers, 2001.

1) [1] . The baseband received signal is $r(t) = c(t).s(t) + n(t)$, where $r(t)$, $s(t)$, and $n(t)$ are the baseband received signal, the baseband transmitted signal, and the baseband equivalent of a white Gaussian complex noise, respectively. For the Rician channel, $c(t)$ is considered as $c(t) = a + u(t) + jv(t)$, where a is the line of sight gain and $u(t)$ and $v(t)$ are white Gaussian random processes with variance σ^2. The fading channel is assumed to be constant over each packet transmission and changes independently from one packet to the other. The fading depth parameter K is the criteria for the Rician channel distortion and is defined as $K = \frac{a^2}{\sigma^2}$.