Adaptive MIMO COFDM Techniques

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Motivation

In future mobile communication systems the valuable good of bandwidth has to be used more efficiently than today. Therefore, it is necessary to adapt transmission techniques to the propagation conditions in a better way. For conventional radio communication systems, the temporal and spatial properties of the radio channel lead to degradations because of time dispersion and fading effects. Time dispersion causes intersymbol interference (ISI) which is avoided by multicarrier transmission. The effects of fading are reduced by adaptive transmission techniques as well as multi-antenna concepts.

Adaptivity

Parameters of a multi-antenna multicarrier system which can be adapted:

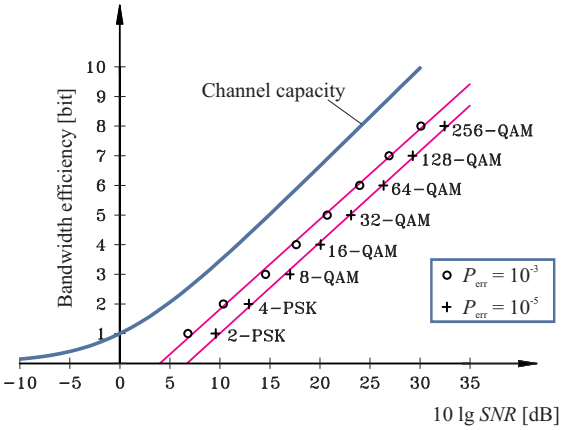
- Type of modulation per subchannel
- Transmit power per subchannel
- Channel Coding
- MIMO techniques: diversity methods, beamforming, spatial multiplexing

Challenges

- The signaling which is needed for error-tolerant adaptive transmission causes an overhead which has to be minimized.
- Criteria for the selection of MIMO techniques depending on the radio channel have to be developed.

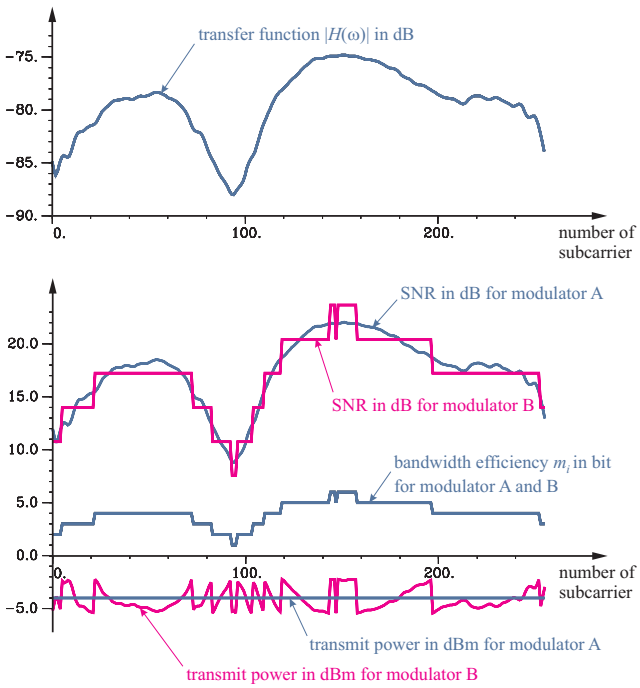
Example: Adaptive Modulation

The channel capacity is the upper bound of the data rate for almost error-free transmission. The figure below shows the channel capacity versus the SNR for an additive white Gaussian noise channel (AWGN). Furthermore, the bandwidth efficiency of different modulation formats at a low symbol error probability P_{err} is compared with channel capacity.



In a multicarrier transmission system, modulation schemes can be selected corresponding to the SNR of each subcarrier.

In the following figure, modulator A optimizes only the bit distribution (modulation formats), modulator B optimizes both bit and power distribution. Simulations show that modulator B exhibits only a gain of 0.5 dB when compared with modulator A.



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