Uebertragungseigenschaften von Frequenzhüpfersystemen für die digitale Nachrichtenübermittlung

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Abhandlung

zur Erlangung

des Titels eines Doktors der technischen Wissenschaften

der

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Abstract

This work deals with the performance of frequency hopping systems (FH-systems), which represent an interesting realization of the general concept of spread spectrum techniques. FH-systems are characterized by a remarkable immunity to jamming and unintentional interference. Therefore, the first part of this work is devoted to the analysis of the system performance as a function of the signal-to-interference ratio at the front end of the receiver. After a description of certain principles applied to FH-systems and of some important properties of broadband channels, the problem mentioned above is subjected to a detailed investigation.

In particular, the study treats the performance of FH-systems operating over channels simultaneously affected by frequency selective fading and partial band interference. Novel results are provided for time-variant and time-invariant channels. It is shown that the calculated error probability for the time-invariant channel represents a rather tight upper bound for arbitrary channels, e.g. for channels with both time-variant and time-invariant components.

The behavior of FH-systems is not completely determined by the signal-to-interference power ratio at the front end of the receiver. Very high interference power levels are permitted, if the bandwidth of the interferers is much smaller than the transmission bandwidth. The influence of such strong narrowband disturbance is investigated too. The analysis of diversity systems requires a considerable effort. Numerical results are therefore presented for relatively simple interference types only. Furthermore, FH-systems using error-correcting codes are examined by means of random coding bounds. In order to estimate the system performance in the presence of different interference types and for various decoding schemes, an improved method is introduced.