Doctoral Thesis

Nichtkohärenter Delay-Locked Loop mit optimalem Systemverhalten für Uebertragungssysteme mit Bandspreizung

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ABHANDLUNG
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vorgelegt von
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Abstract

Receivers for spread-spectrum signals require a locally generated spreading code which is synchronized to the code in the received signal before despreading and data detection are possible. After acquisition has been achieved, code tracking loops such as the delay-locked loop (DLL) are employed for a precise synchronization. Due to the loop nonlinearity these tracking devices may lose synchronism (loss of lock) which severely affects the overall system performance. Therefore, the mean time to lose lock (MTLL) is a very important design objective.

Investigations in the framework of this project were performed for a noncoherent second-order DLL. It has been shown that there exist optimal loop parameters that either minimize the tracking error variance, maximize the MTLL, or minimize the influence of the synchronization error on the bit error probability. Especially, we applied for the first time the singular perturbation method to approximate the MTLL of this loop by an asymptotic expansion of the exact solution. For these investigations we considered the influence of the channel noise and the effects of a varying propagation delay of the received signal. The propagation delay caused by the motion of the receiver relative to the transmitter depends on Doppler effects and on random fluctuations.

The investigations show that at distinct signal-to-noise ratios (SNR) we have to consider different measures of performance. At low SNR the MTLL is the most critical design objective while at high SNR the bit error probability becomes more important. With the results of the corresponding investigations it is now possible to propose a robust loop design that guarantees a maximum MTLL at low SNR and a small bit error probability at high SNR.

Furthermore, we are also able to define the region where the DLL can reliably track the spreading code. From the approximate solution of the MTLL we may for example deduce the minimal required SNR that is necessary for a reliable code tracking loop.