

IMPROVED CHAOTIC COMMUNICATIONS USING NONLINEAR FILTERING

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ABSTRACT. *In this paper, we consider chaotic communication using nonlinear filtering techniques. The main contribution of the paper is proposing a novel antipodal chaotic communication scheme, which is implemented with both the Extended Kalman Filter and the Unscented Kalman Filter. Two different previously proposed Extended Kalman Filter based chaotic schemes are also revisited and implemented using the Unscented Kalman Filter for possible performance improvement. Comparative theoretical and simulation studies are provided to show the superior performance of the new chaotic communication technique.*

Keywords: Chaotic systems, Nonlinear filtering, Communications

1. Introduction. Chaotic communication, a recently developed wideband communication technique, has many unique properties and shows a wide range of applicability in Ultra-Wide Band communications. The Chaotic-Sequence Division Multiple Access can be realized by using different chaotic maps for different transceivers. The properties of the chaotic sequence, such as noise-like wide-bandwidth, self-synchronization, ease of implementation, mitigation of multi-path transmission fading, impulse like autocorrelation and almost zero cross-correlation, make it very suitable for the short distance data transmission [1-3].

Unlike traditional modulation/demodulation techniques using sinusoidal signals as the information carrier, the noise-like chaotic signal serves as the carrier signals for chaotic communications. The estimation and synchronization of chaotic signals are the critical issues of chaotic communication techniques, and have been addressed in recent literature. In this work, nonlinear estimation based chaotic communication will be focused on, e.g. [4-8]; rather than nonlinear control based chaotic synchronization, e.g. [9]. In this paper, we revisit the schemes in [5-8] for the purpose of improving them and design the Unscented Kalman Filter (UKF) [10] for chaotic signals estimation, instead of using the Extended Kalman Filter (EKF) [11] in the original works among other nonlinear estimators [12-15]. Most importantly, we propose a new chaotic communication scheme using both EKF and UKF, which is the main contribution of this work. The Bit Error Rate (BER) performance of all these schemes is compared. Both theoretical analysis and computer simulation results show that the new antipodal chaotic communication yields the best results.

2. Novel Antipodal Chaotic Communications Technique. In our new antipodal chaotic communication scheme, one chaotic map is used in modulation of the signal as shown in Figure 1.