The Vector Tracking Loop Design based on the Extended Kalman Filter

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INTRODUCTION

Recently, several researchers have studied a vector tracking loop, such as a vector delay lock loop (VDLL) and a vector frequency lock loop (VFLL), to obtain an improved tracking performance in GPS receiver [1–6]. The vector based tracking loop technique uses the correlation of each satellite signal and user dynamics. The receiver with the vector tracking loop can get enough total signal power to track signal successfully and can obtain accurate position estimates although the signal strength from individual satellite is so low or weak.

The conventional VDLL/VFLL directly uses the discriminator outputs of each channel. However the vector tracking loop using the discriminator cannot cope with several problems of each channel, such as a rejection of channel with a low quality signal, high dynamic situation and others. So we need the advanced structure to consider above problems of each channel for the future.

The objective of this paper is to propose the vector tracking loop using the EKF. We already proposed the vector tracking loop based on LQG controller and the EKF [6]. However, in this paper, we propose the vector tracking loop structure without LQG controller. The EKF consists of several states such as line-of-sight range rate, code phase error, carrier phase error and signal state. The EKF is based on several models, which consist of I & Q measurement model, code/carrier phase dynamic model and signal fading model.

Section 2 and 3 explain the conventional scalar tracking loop and the conventional vector tracking loop based on the DLL/FLL discriminators, respectively. Section 4 proposes the the vector tracking loop based on the EKF. Signal dynamic modeling, the local filter (EKF) of each channel and the navigation filter (EKF) are explained, respectively [7,8]. Finally, the performance of the vector tracking loop based on the EKF is verified and compared with the conventional scalar and vector tracking loops by simulation in Section 5. The simulation results shows that the vector tracking loop based on the EKF is better than that based on the discriminator.

REFERENCES