The Application of Nonlinear Filter Technique in SINS/GPS Integrated Navigation System

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INTRODUCTION

As we all know, Strapdown Inertial Navigation System (SINS) has the merit of independent work mode, which is widely used in the area of spaceflight, aviation and navigation. However, as the time pass by, the navigation error of SINS is accumulated. Kalman Filter is often used in SINS/GPS system. With the aid of GPS, the SINS/GPS integrated navigation system can keep its high positioning precision in a long term. As Kalman Filter is a type of linear filter, it can't always afford a high integrated precision especially when the carrier lies in acutely dynamic environment. As a result, nonlinear filter are more often discussed in SINS/GPS system in recent years.

When nonlinear filter is applied in SINS/GPS integrated navigation system, the precision and calculating period of the filter will directly determine the positioning performance of the system. Some classical nonlinear filters are discussed in this paper, and the Stirling Interpolation nonlinear Filter (SIF) is analysed which used in SINS/GPS integrated system. Nonlinear state estimation method based on stirling interpolation is introduced first. Then the scheme of SIF which used in SINS/GPS integrated navigation system is proposed. Finally, a simulation is also made to compare the effect between 2-Order SIF and UKF (Unscented Kalman Filter). The result shows that the 2-Order SIF and the UKF have the same precision. However, the algorithm for the interpolation filter is much simpler, which can improve the performance of real time and stability in SINS/GPS integrated system.

CLASSIC NONLINEAR FILTERS

Some classic nonlinear filters, as UKF, EKF, SIF, PF, were briefly introduced and compared.

NONLINEAR STATE ESTIMATION METHODS BASED ON STIRLING INTERPOLATION

Nonlinear state estimation model is established and Stirling Interpolation Filter is introduced.

REALIZATION OF INTERPOLATION FILTER IN INTEGRATED NAVIGATION

The additive quaternion error model is established for the SINS/GPS integrated navigation system. The scheme of SIF used in SINS/GPS integrated system is proposed.

SIMULATION AND ANALYSIS

Compared with UKF, Some simulation results are showed and analysed to prove the algorithm proposed in this paper.

CONCLUSION

The result shows that the algorithm for the interpolation filter is much simpler than UKF, which can improve the performance of real time and stability in SINS/GPS integrated system.

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