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Tuning of Kalman Filter Using Genetic Algorithm

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Abstract : Kalman filter algorithm is an estimator known as the workhorse of estimation. It has an important application in missile guidance, especially in lack of accurate data of the target due to noise or uncertainty. In this paper, a Kalman filter is used as a tracking filter in a simulated target-interceptor scenario with noise. It estimates the position, velocity, and acceleration of the target in the presence of noise. These estimations are needed for both proportional navigation and differential geometry guidance laws. A Kalman filter has a good performance at low noise, but a large noise causes considerable errors leads to performance degradation. Therefore, a new technique is required to overcome this defect using tuning factors to tune a Kalman filter to adapt increasing of noise. The values of the tuning factors are between 0.8 and 1.2, they have a specific value for the first half of range and a different value for the second half. they are multiplied by the estimated values. These factors have its optimum values and are altered with the change of the target heading. A genetic algorithm updates these selections to increase the maximum effective range which was previously reduced by noise. The results show that the selected factors have other benefits such as decreasing the minimum effective range that was increased earlier due to noise. In addition to, the selected factors decrease the miss distance for all ranges of this direction of the target, and expand the effective range which leads to increase probability of kill.

Keywords : proportional navigation, differential geometry, Kalman filter, genetic algorithm
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