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TRACKING HIGHLY MANEUVERING TARGETS USING FUZZY COVARIANCE MATRIX PRESETTING

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Abstract. *In this paper, a new covariance presetting scheme is presented to overcome some drawbacks of highly maneuvering target tracking problems by using a fuzzy logic method. This method is based on fuzzy covariance matrix presetting. The scheme includes an estimation part that uses a modified Kalman filter combined with a fuzzy logic part to improve the tracking performance of highly maneuvering targets. The fuzzy part is designed based on deviation of the last target direction. The results are compared with two conventional covariance matrix presetting methods with and without jerk model. The proposed method is rather robust with respect to the values of sampling time. Simulation results show a superior performance of the proposed covariance presetting method in various scenarios.*

Keywords: Highly maneuvering targets, Fisher and Bayesian uncertainty models, Kalman filtering, Jerk model, Matrix covariance presetting, Fuzzy systems

1. **Introduction.** Currently tracking systems are widely used in various applications. For example video tracking that is surveyed in [1] is applied in various applications such as security, surveillance and monitoring. In [2], they have presented trajectory tracking for robot manipulators, this is also another usage of tracking systems. There exist many approaches about maneuvering target tracking in several applications [3-7]. In fact, all of these approaches try to present an accurate tracking method such as equivalent noise, input detection and estimation, and switching-model approaches. In the equivalent noise approach, the maneuver effect is modeled by a white or color noise process. Input detection and estimation techniques estimate acceleration as an unknown control input and then estimates the state using the estimated input. The switching-model approach consists of two classes of models: maneuvering and non-maneuvering models; tracking is done by a filter that uses one model (maneuvering or non-maneuver) at one time.

Also Singer [8] modeled target acceleration as a random process with known exponential autocorrelation. This model is capable of tracking a maneuvering target, but the performance of the estimation is reduced when a target moves at a constant velocity. [9] have developed an Extended Kalman Filter combined with an algorithm for recursive estimation of the measurement noise variance and the variance of the target acceleration. In [10], additional information about the unknown parameter vector which is called the pseudo-measurement is introduced. This information use to identify the unknown parameter of stepwise or impulsive exogenous input to the linear system from the noisy