
# A low-complexity interacting multiple model filter for maneuvering target tracking

Syed Safwan Khalid, Shafayat Abrar

PII: S1434-8411(17)30128-0
DOI: http://dx.doi.org/10.1016/j.aeue.2017.01.011
Reference: AEUE 51778

To appear in: *International Journal of Electronics and Communications*

Please cite this article as: S.S. Khalid, S. Abrar, A low-complexity interacting multiple model filter for maneuvering target tracking, *International Journal of Electronics and Communications* (2017), doi: http://dx.doi.org/10.1016/j.aeue.2017.01.011

# A low-complexity interacting multiple model filter for maneuvering target tracking

Syed Safwan Khalid[a], Shafayat Abrar[b]

[a]*COMSATS Institute of Information Technology, Islamabad 44000, Pakistan.*
[b]*King Abdullah University of Science & Technology, Thuwal 23955, Saudi Arabia.*

**Abstract**

In this work, we address the target tracking problem for a coordinate-decoupled Markovian jump-mean-acceleration based maneuvering mobility model. A novel low-complexity alternative to the conventional interacting multiple model (IMM) filter is proposed for this class of mobility models. The proposed tracking algorithm utilizes a bank of interacting filters where the interactions are limited to the mixing of the mean estimates, and it exploits a fixed off-line computed Kalman gain matrix for the entire filter bank. Consequently, the proposed filter does not require matrix inversions during on-line operation which significantly reduces its complexity. Simulation results show that the performance of the low-complexity proposed scheme remains comparable to that of the traditional (highly-complex) IMM filter. Furthermore, we derive analytical expressions that iteratively evaluate the transient and steady-state performance of the proposed scheme, and establish the conditions that ensure the stability of the proposed filter. The analytical findings are in close accordance with the simulated results.

*Keywords:* Tracking, Kalman filtering, interacting multiple model filter, maneuvering targets, low-complexity.

## 1. Introduction

Tracking algorithms require an accurate stochastic description of dynamical mobility model of the moving target. Moreover an observation model is required, that describes the relation between the states (i.e., position, velocity, etc.) to be estimated and the available measurements. The information contained in the mobility and observation models is combined, usually in a Bayesian filtering framework, to recursively estimate the current

*Email addresses:* safwan_khalid@comsats.edu.pk (Syed Safwan Khalid), shafayat.abrar@kaust.edu.sa (Shafayat Abrar)