KALMAN FILTER-BASED IDENTIFICATION OF UNKNOWN EXOGENOUS INPUT OF STOCHASTIC LINEAR SYSTEMS VIA PSEUDOMEASUREMENT APPROACH

Akira Ohsumi[1], Takuro Kimura[2] and Michio Kono[2]

[1]Graduate School of Engineering
[2]Interdisciplinary Graduate School of Agricultural and Engineering
University of Miyazaki
Kibana, Gakuen, Miyazaki 889-2192, Japan
{ ohsumi; kouno }@cs.miyazaki-u.ac.jp

ABSTRACT. *In this paper a new approach to identify the unknown parameter of stepwise or impulsive exogenous input to the linear system from the noisy observation data is proposed. The key of the approach is to introduce an additional information about the unknown parameter vector which is called the pseudomeasurement. Augmenting this pseudomeasurement with the original observation data, the identification of unknown vector as well as the state estimation is performed. The efficacy of the proposed approach is confirmed by simulation studies.*
Keywords: Identification, Exogenous input, Pseudomeasurement, Kalman filter

1. **Introduction.** In the Kalman filtering, the accuracy of the state estimation is decided uniquely once the observation mechanism is constructed, because the gain matrix is uniquely determined. In the aerial target tracking, the accuracy of target velocity and acceleration estimates are often quite poor if the target is maneuvering. In order to improve the estimation accuracy, a kinematic constraint such as constant speed is considered as useful information about the relevant target and treated as additional measurements to the actual ones. Such additional measurements are called the *pseudomeasurements* [1]. As far as the authors know, the idea of pseudomeasurement was first introduced in filtering problem by Whitecombe [2] for the purpose of improving the state estimates of dynamical systems, and used mainly in aerial target tracking problems by several researchers (Song, Ahn, and Park [3], Tahk and Speyer [4], Alouani and Blair [5]). This idea was also used by one of the authors (Ohsumi and Yasuki [6], Ohsumi, et al. [7]) in the tracking problem of maneuvering ships to obtain high-accurate estimates. In all papers mentioned above, the kinematic constraint of the relevant target is treated as a pseudomeasurement to improve the performance of the target's state estimates.

Recently, different from these, the idea of pseudomeasurement has been positively introduced by one of the authors (Ohsumi, et al. [8,9]) to the identification problem of an unknown parameter vector which is included in the dynamical system model. Instead of any (kinematic) constraint, a dynamic constraint under which the unknown parameter vector is governed is employed. Indeed, in Ohsumi, et al. [8,9], the problem of identifying the unknown magnitude of pollutive load which is discharged at some location along the river is investigated based on the observation data made on the BOD (biochemical oxygen demand) and DO (dissolved oxygen) that describe the water quality, incorporating with the dynamic constraint on the unknown load as pseudomeasurement.