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MEAN-SQUARE FILTERING FOR INCOMPLETELY MEASURED POLYNOMIAL STATES CONFUSED WITH POISSON NOISES

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Abstract. *This paper presents the mean-square filtering problem for incompletely measured polynomial system states, confused with white Poisson noises, over linear observations. Designing the mean-square filter for polynomial systems with white Poisson noises presents a significant advantage in the filtering theory and practice, since it enables one to address the mean-square estimation problems for nonlinear system states confused with other than Gaussian white noises. The problem is treated proceeding from the general expression for the stochastic Ito differential of the optimal estimate and the error variance. As a result, the Ito differentials for the optimal estimate and error variance corresponding to the stated filtering problem are first derived. The procedure for obtaining a closed system of the filtering equations for any polynomial state with white Poisson noises over linear observations is then established, which yields the explicit closed form of the filtering equations in the particular case of a third-order state equation. In the example, performance of the designed optimal filter is verified against the conventional mean-square polynomial filter designed for systems with white Gaussian noises.*
Keywords: Filtering, Stochastic system, Nonlinear polynomial system, Poisson white noise

1. **Introduction.** It is well known that the mean-square optimal solution of the filtering problem for nonlinear state and observation equations confused with Gaussian white noises is given by the Kushner equation for the conditional density of an unobserved state with respect to observations [1]. There are a very few known examples of nonlinear systems where the Kushner equation can be reduced to a finite-dimensional closed system of filtering equations for a certain number of lower conditional moments. The most famous result, the Kalman-Bucy filter [2], is related to the case of linear state and observation equations, where only two moments, the estimate itself and its variance, form a closed system of filtering equations. Some other mean-square nonlinear finite-dimensional filters can be found in [3-5]. There also exists a considerable bibliography on robust filtering for the linear and nonlinear systems corrupted with white Gaussian noises (see, for example, [6-16]).

Designing the mean-square filter for polynomial systems with white Poisson noises presents a significant advantage in the filtering theory and practice, since it enables one to address the mean-square estimation problems for nonlinear system states confused with other than Gaussian white noises. There are a number of practical situations where dynamic system states are corrupted not with uniformly acting white Gaussian noises (like a static noise in a phone line) but with noises acting in random isolated time moments (like a series of electromagnetic impulses), which are referred to as white Poisson noises. Note that the number of publications about mean-square filtering for systems