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ON A CLASS OF STOCHASTIC IMPULSIVE OPTIMAL PARAMETER SELECTION PROBLEMS

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Abstract. *This paper considers a class of stochastic optimal parameter selection problems described by linear Ito stochastic differential equations with state jumps subject to probabilistic constraints on the state, where the times at which the jumps occurred as well as their heights are decision variables. We show that this constrained stochastic impulsive optimal parameter selection problem is equivalent to a deterministic impulsive optimal parameter selection problem subject to continuous state inequality constraints, where the times at which the jumps occurred as well as their heights remain as decision variables. Then, by introducing a time scaling transform, we show that this constrained deterministic impulsive optimal parameter selection problem is transformed into an equivalent constrained deterministic impulsive optimal parameter selection problem with fixed jump times. A constraint transcription technique is then used to approximate the continuous state inequality constraints by a sequence of canonical inequality constraints. This leads to a sequence of approximate deterministic impulsive optimal parameter selection problems subject to canonical inequality constraints. For each of these approximate problems, we derive the gradient formulas of the cost function and the constraint functions. On this basis, an efficient computational method is developed.*
Keywords: Stochastic impulsive optimal parameter selection problem, Deterministic impulsive optimal parameter selection problem, Probabilistic constraints, Time scaling transformation, Constraint transcription technique, Canonical inequality constraints, Gradient based optimization technique

1. Introduction.

Basic theory of Ito stochastic differential equations driven by Wiener processes and counting processes (for example Poisson processes) and their many important applications can be found in [2], [5] and [14]. In [16], a class of optimal control problems described by linear Ito stochastic differential equations driven by counting processes is considered and studied. In [19], a class of stochastic optimal control problems is considered, where the dynamical system is described by Ito stochastic differential equations driven by Wiener processes. It is shown that this class of stochastic optimal control problems is equivalent to a class of optimal control problems involving linear parabolic partial differential equations. However, numerical solution methods available in the literature (see, for example, [10] and [23]) for solving such deterministic optimal control problems with dynamics being described by partial differential equations are only applicable for small dimensional problems.