Data-driven Neuroendocrine-PID Tuning Based on Safe Experimentation Dynamics for Control of TITO Coupled Tank System with Stochastic Input Delay

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Abstract.
This paper addresses a data-driven neuroendocrine-PID tuning for the control of a two-input-two-output (TITO) coupled tank system with stochastic input time delay based on safe experimentation dynamics (SED). The SED algorithm is an optimization method used as data-driven tools to find the optimal control parameters by using the input-output (I/O) data measurement in an actual system. The advantages of the SED based method are that provides a fast solution, able to solve the high dimensional problem and provides high performance accuracy by keeping the best parameter value while finding the control parameters. Moreover, the gain sequence of the SED is independent of the number of iterations by fixed the interval size in finding the optimal solution. Hence, this will allow the SED method to have enough strength to re-tune in the attempted of finding the new optimal solution when the delay occur during the tuning process. A neuroendocrine-PID controller structure is chosen due to its provide effective and accurate control performances by a combination of PID and neuroendocrine structures. On another note, the neuroendocrine structure is a biologically inspired designed that derived from general secretion rules of the hormone in the human body. In order to evaluate the performances of the data-driven neuroendocrine-PID control based on SED for TITO coupled tank system with stochastic input delays, the numerical examples will be used in terms of the performance tracking and the computational time. Moreover, the performance of the SED based method is compared to simultaneous perturbation stochastic approximation (SPSA) based method. The simulation results show that the SED based method capable to track the desired value of liquid level tanks although the stochastics input delay occurred in the system. In addition, the SED based method also attained better control performance compared to SPSA based method.

Keywords: TITO, neuroendocrine-PID, coupled tank, SED, delay.