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A CAGPC CONTROLLER DESIGN FOR SYSTEMS WITH INPUT WINDUP AND DISTURBANCES

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Abstract. *This paper proposes the design of feedback controllers for systems with inputs windup and disturbances using a novel approach. The proposed approach is based on idea of linear Continuous-time Anti-windup Generalized Predictive Control (CAGPC) and non-linear operator-based design techniques. While CAGPC technique handles exclusively linear systems, the current approach is suitable for both linear and nonlinear plants with conditions of robust stability preserved. The proposed technique designs stable controllers and also ensures control system robust stability.*

In this paper, a unique control design method which extends CAGPC control scheme to systems with both input constraints and disturbances is proposed. Unlike the existing techniques on CAGPC, the proposed method requires a single anti-windup controller to counter the effect of the input windup. In addition to the merits offer generally by CAGPC design scheme, the proposed technique caters for the effect of known input disturbances with the inclusion of a tracking operator in the control structure which ensures the rejection of the disturbance as well as the tracking of the output to input reference. The effectiveness of this method is demonstrated through application to Single Input Single Output (SISO) systems with and without time-delay.

Keywords: CAGPC controllers, SISO systems, Operator-based design, Input windup, Disturbances

1. **Introduction.** The conventional feedback control system is one of the most fundamental systems existing in nature. However, as familiar as the control system design processes to human is, the concept of feedback design has been utilized almost exclusively by engineers and scientists. Generally, in feedback control system design, the output of the system is usually compared with the input so that an appropriate control action may be determined as some functions of the current outputs and the generative inputs. Whereas, in advanced control system design, in some cases, it might be required that process outputs are predicted ahead of time. These future outputs prediction are based on the present input and output, some unknown possible future inputs and their respective derivatives. This procedure underlines the main philosophy of predictive control design.

In recent times, predictive control design techniques have attracted much attention as fundamental design methods for self-tuning controllers as shown in [1-3]. These methods seem to be superior in robust control design compared to some other self-tuning control methods. The Generalized Predictive Control (GPC) technique was introduced by [4] as a discrete time control strategy to predict the future output of a system for an appropriate control action to be applied at present time based on the future output error characterized by some unknown possible inputs and disturbances to the system. The extension of this method in a continuous-time version referred to as Continuous-time Generalized