New Integral Antiwindup Scheme for PI Motor Speed Control

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ABSTRACT
Windup refers to the phenomenon where a control system operates in a nonlinear region when the controller's output exceeds the input limits of the plant being controlled. Windup can lead to performance degradation in terms of overshoot, settling time and even system stability. Many anti-windup strategies involve switching and manipulating the integral control component in various ways when saturation occurs aiming to bring control back into the linear region. For better insight into windup, the proportional–integral (PI) plane is now used as a means to explain the phenomenon in terms of the controller's signals. A PI controller with a built-in closed-loop integral controller that has a reference set based on the input command and external torque is proposed. The performance for this proposed method is compared against existing conditional integration, tracking back calculation and integral state prediction schemes on second and third order systems using MATLAB/SIMULINK simulations of an induction motor and a DC motor respectively. The proposed controller showed promising potential with its ability to eliminate overshoot in both no load and full load conditions due to the decoupling of its parameters from its response and has the shortest settling time when compared against existing schemes, even in the presence of noise.

KEYWORDS: Anti-windup; PI plane; speed control; steady-state integral proportional integral control; tracking back calculation

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