National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Development of controller structures tuned using a modified SAR algorithm for Load Frequency Control
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Abstract	: The primary objective of the current investigation is focused on designing efficient and cogent controllers both in linear and nonlinear domains capable of exhibiting improved performances in load frequency control problems by mitigating the frequency deviations arising out of load perturbations. This endeavor resulted in the development of four high-performing controllers. In the linear framework, the two controller structures are based on the fractional order calculus. The first breakthrough is a blended form of fractional order integral and derivative actions with a tilt control in lieu of a conventional proportional action to showcase a new configuration named Fractional order Tilt-Integral-Derivative (FOTID) controller. Thereafter, another hybrid structure is introduced by combining both the fractional as well as integer order control actions using a master-slave cascaded strategy, called Tilt-Fractional order Integral-Integer order Integral cascaded with the Tilt-Fractional order Derivative-Integer order Derivative (TFOI-I-c-TFOD-D) controller. These innovative ideas further prompted the author to explore a new horizon in the nonlinear control domain inspired by the research articles on Fuzzy PID (FPID) controllers where fuzzy output feeds a conventional PID block. The anatomy of the FPID controller reveals it to be a mixed breed of nonlinear and linear operations. The fuzzy logic block receives the error signal along with its derivative and performs a nonlinear transformation on them. Then, such a mutated error signal excites the linear PID control block. Thus, work is pursued to find other techniques to carry out the nonlinear transformation of error. The search opened the door to the application of the hyperbolic transcendental functions, particularly sine and tangent versions. They both are monotonically increasing functions with nonlinear characteristics. Such mandatory requirements are essential to preserve the sense of the original signal. The structure developed employs a hyperbolic sine function to nonlinearly modify the signal using a weighted sum of the error signal and its derivative. The output then excites a conventional PID block to generate the control action. However, there is a caveat for the hyperbolic sine function to undergo a forced saturation to avoid infinity syndrome. Hence, a modified version, named restricted Hyperbolic Sine PID (re-HSPID) controller, is applied.The resulting system behaviors have been found to be completely stable. Additionally, Bode plots have been presented from the perspective of closed-loop system stability. These outcomes provide ample evidence that the developed controllers have proved their mettle and tenacity and have etched praiseworthy space in the controller paradigm.