Synopsis Seminar

Seminar Title	: Development of novel controller structures tuned using chaotic-mapped elitist-mode Search and Rescue algorithm both in linear and nonlinear domains for Load Frequency control
Speaker	: Sonali Priyadarshani (Rollno : 516ee1005)
Supervisor	: Prof. Jitendriya Kumar Satpathy
Venue	: Seminar Room EE401
Date and Time	: 28 Aug 2024 (10:00AM)

Abstract

: The primary objective of the current investigation is focused on designing efficient andcogent controllers both in linear and nonlinear domains capable of exhibiting much-improved performances in load frequency problems by mitigating the frequency deviations arising out
of load perturbations. And 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. And 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 sine hyperbolic 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 sine hyperbolic function to undergo a forced saturation to avoid infinity syndrome. Hence, a modified
version, named a restricted hyperbolic sine PID (re-HSPID) controller, is applied. But for the sake of brevity, it is treated as an HSPID controller throughout the entire text. Another configuration, which is conceptualized, uses a hyperbolic tangent function to realize a
controller having an identical structural composition to that of an FPID controller, with the only exception being that two independent functions perform nonlinear operations both for error signal and its derivative. The summed output of the transformed error signal and its derivative is then fed to the PID block to produce the control action. It is defined as the Tansig (Tangent sigmoid) PID (TSPID) controller because its characteristic symbolizes the letter `S".All these proposed controllers have shown their potential in comparison to their competitors. Further, exhaustive mathematical analyses have been carried out to unravel thebasic concepts embedded in them, which resulted in improved performances compared to their counterparts. The work further added another achievement to its list of contributions by developing a metaheuristic optimization algorithm for tuning the controller gains and associated parameters. And while pursuing the same, the author came across a recently reported Search and Rescue (SAR) algorithm and successfully modified the original version.