مقاله شماره 1:

Multi-objective states of matter search algorithm for TCSC-based smart controller design

a b s t r a c t

This paper presents a novel controller design of a thyristor controlled series capacitor based on an optimized adaptive neuro-fuzzy inference system. The modified states of matter search algorithm are implemented to fit the premise

and consequent parameters of the neuro fuzzy system. The design objectives are to reduce the power system oscillations and find a minimum number of strongest fuzzy rules, trends toward building a low-size controller model. Therefore, fuzzy decision-making mechanism is employed to rank the Pareto-optimal set to extract the best compromise solution. The proposed controller design depends upon the expected wide range of operating conditions. The effectiveness of smart control strategy based controller is tested and compared on single machine infinite bus and multimachine power systems under small scale disturbance as well as large scale disturbances.

Conclusion

In this paper, a novel design technique is adopted for nonlinear control of TCSC. A complex structure of ANFIS controller is optimized by SMS algorithm with a set of control variables. The control parameters of complicated original-SMS were abolished in adaptive manner to achieve a scale-minimum operator optimizer. Adaptive SMS-based learning mechanism is applied for tuning the parameters of neuro-fuzzy system. Furthermore, the proposed optimization method reduces the number of rules in ANFIS controller. In addition, the optimization design problem is formulated in single and multi-objective space. The developed controller is tested on SMIB and multi-machine power system subject to severe contingencies under different loading conditions and a wide-range of system parameters uncertainties. The simulation results indicate the superiority of the new controller in damping the power system oscillation with better performance quality.

مقاله شماره 2:

Reduced order H1 TCSC controller & PSO optimized fuzzy PSS design in mitigating small signal oscillations in a wide range

Abstract

This paper proposes hybrid control schemes for compensation of parametric and non-parametric uncertainties arising in modern power systems. The robust loop shaping design procedure considering nonparametric uncertainty term is used to design H1 TCSC. To further enhance steady state stability, and consider the effect of parametric uncertainties occurring due to variation in loading conditions, robust TCSC is supplemented with three types of PSS i.e. PSO-PID PSS, PSO Mamdani FPSS and PSO TS FPSS. PSO is used to optimize the parameters of PID based and Fuzzy type PSS. The proposed hybrid control schemes are found to compensate uncertainty well by stabilizing the power system over whole parametric uncertainty range. However, the proposed hybrid controller involving robust TCSC and PSO-Takagi– Sugeno FPSS shows best performance with enhanced steady state stability among all schemes. Also the T–S FPSS performs better as compared to Mamdani FPSS.

Conclusions

The hybrid H1 loop shaping TCSC and PSO tuned Mamdani/Takagi–Sugeno fuzzy PSS design for SMIB system in a wide range has been proposed in this paper. The generator rotor speed deviation (Dx) and acceleration (Dx_) have been used as the feedback signal inputs. The proposed H1 TCSC and PSO – T–S Fuzzy PSS hybrid controllers have been compared with H1 TCSC and PSO-PID PSS, and H1 TCSC and PSO–Mamdani Fuzzy PSS. Due to the complex nature of power system the H1 TCSC and PSO – T–S Fuzzy PSS control scheme gives much better performance as compared to TCSC and PSO tuned Mamdani Fuzzy PSS/PID PSS combinations. The proposed controllers combine the advantages of H1 TCSC and PSO optimized T–S Fuzzy Logic Controller and have an excellent capability in damping power system oscillations and enhance greatly the dynamic stability of the power system. The simulation results show the robustness and superiority of the proposed control. It has been observed from the Fig. 13(a)–(j) that the system without fuzzy PSS or/and H1 TCSC is unstable but with hybrid H1 TCSC controller and PSO – Mamdani/T–S fuzzy PSS the system gains stability quickly and robust stability of the test power system in the presence of system uncertainties in a wide range is ensured.

مقاله شماره 3:

Reaching phase free adaptive fuzzy synergetic power system stabilizer

Abstract

In this paper, an adaptive fuzzy power system stabilizer is developed based on robust synergetic control theory and terminal attractor techniques. The main contribution consists in making the dynamic system insensitive to parameters variation. This aim is achieved using a new synergetic controller design such that power system states start, evolve and remain on a designer chosen attractor toward the equilibrium point therefore avoiding transient mode. Rendering the design more robust, fuzzy logic systems are used to approximate the unknown power system dynamic functions without calling upon usual model linearization and simplifications. Based on an indirect adaptive scheme and Lyapunov theory, adaptation laws are developed to make the controller handle parameters variations due to the different operating conditions occurring on the power system and to guarantee stability. The performance of the proposed stabilizer is evaluated for a single machine infinite bus system and for a multi machine power system under different type of disturbances. Simulation results show the effectiveness and robustness of the proposed stabilizer in damping power system oscillations under various disturbances and better overall performance than classical PSS and some other types of power stabilizers.

Conclusion

A new robust adaptive power system stabilizer based on synergetic control and fuzzy systems, has been proposed in this paper with the following main contribution:

– enhancement in robustness is evident through a convergence time reduction by way of transient mode removal.

– elimination of chattering through the use of a continuous control law.

– ease in implementation for not relying on non-measurable variables.

Simulation studies were carried out for single and multimachine power systems for severe different operating conditions showing the effectiveness of the proposed design stabilizer. Furthermore a comparative study between a classical PSS, Fuzzy PSS, adaptive fuzzy PSS and the proposed alternative has shown better performance of the latter over its counterparts providing faster damping of low frequency oscillations therefore improving greatly power system stability.

مقاله شماره4:

Optimal coordinated design of UPFC and PSS for improving power system performance by using multi-objective water cycle algorithm

Abstract

This paper presents an optimal design for simultaneously locating unified power flow controller (UPFC) and power system stabilizer (PSS). The parameters of their controllers are also tuned coordinately to enhance the power system stability. A mixed integer nonlinear problem is obtained for the design procedure due to the characteristics of selected objective functions. A new population-based meta-heuristic algorithm, called water cycle algorithm (WCA) is used to solve this problem. The best Pareto optimal set is also attained by defining this problem as a multi-objective function. The simulations results on IEEE 39-bus power system confirm the efficiency and the superior performance of the proposed method when compared with other algorithms

Conclusions

In this paper, the locations and controller parameters of UPFC and PSS are coordinately designed by using WCA considering a multi-objective function. Total active power loss, voltage deviation and ITAE are chosen as the objective functions. The Pareto optimization approach is utilized to optimize the multi-objective problem and a group of answers, called Pareto optimal solution is obtained. It was found that the WCA given in this paper has a high speed in convergence for the optimal planning of locations and the operation of UPFC and PSS. To show the ability of the proposed optimization design, it was compared with PSO and GA algorithms. The simulation results show the desirable and acceptable performance of the proposed method in damping the oscillations under different disturbances.

مقاله شماره 5:

Design of PSS and TCSC Damping Controller Using Particle Swarm Optimization

Abstract

In this paper, we propose a methodology to tune power system stabilizers and thyristor-controlled series capacitor damping controllers simultaneously. The particle swarm optimization algorithm is incorporated into a power system model to tune the parameters of supplementary damping controllers. A test power system of 10 generators, 39 buses and 46 transmission lines is simulated to validate the use of this optimization algorithm. The tuning of supplementary damping controllers using the proposed methodology increases their performance to provide additional damping to low-frequency oscillation modes in the simulated power system. The controller position is determined by the participation factors (power system stabilizers) and the distance between the interest pole and the zero of the open-loop transfer function of the power oscillation damping controller (thyristor-controlled series capacitor-power oscillation damping). The results show the operating efficiency of the power system after using the optimization technique to tune damping parameters, thereby improving power system integrity. The power sensitivity model is used for the simulations presented in this work focusing on the analysis small-signal stability.

Conclusions

The work presents discussions related to small-signal stability, considering the performance and simultaneous tuning of controllers, in order to increase damping levels of lowfrequency oscillation modes in power systems. The efficiency of the proposed optimization algorithm will depend on the complexity of the power system. In a less complex power system, the solution using the PSO algorithm is faster compared with other published studies (Menezes et al. 2014). The same objective function was used in the work cited with just the coordinated solution search structure being different. The PSO algorithm was used to adjust the parameters of the supplementary damping controllers. The objective function of the algorithm is to position the oscillation mode of interest in a defined region using the desired damping coef- ficients (5% for local modes and 10% for inter-area modes).

مقاله شماره6:

Optimal Location-Allocation of TCSC Devices on a Transmission Network

Abstract

—Installing a thyristor controlled series capacitor (TCSC) device on a transmission network reduces network congestion and generation cost. We formulate the TCSC locationallocation problem as a mixed integer nonlinear program, and propose a novel decomposition procedure for determining the optimal location of TCSCs and their respective size for a network. The load uncertainty, AC characteristic of transmission lines, and nonlinear cost of TCSCs explicitly are considered. The results of applying the procedure to the IEEE 118-bus test system are reported, and insights into the TCSC location-allocation problem are provided. Index Terms—Transmission network, TCSC location-allocation, Benders' decomposition, reactive power balance.

CONCLUSION

We proposed a new procedure for optimal location-allocation of a TCSC in a power transmission network. At the core of this procedure there is a two-stage stochastic program. The first stage identifies the optimal placement and an upper limit on the number of TCSCs. The second stage checks the AC feasibility of the solution obtained in the first stage for different load scenarios to account for load uncertainties. A generalized Benders' decomposition approach that considers both the active and reactive power flow of the transmission network has been employed to solve the problem iteratively. The IEEE 118-bus was used to test the fidelity of the proposed procedure and enhance our understanding of the TCSC location-allocation problem. The results showed: a) both the location and the size of compensation (allocation) are important decision variables, and there are optimal location and compensation levels for installing TCSC devices; b) a heuristic procedure, such as a congestion rent, may not identify the correct lines for compensation in order to alleviate the congestion; c) changing the maximum compensation level and the range of operating voltages result in a change to the sets of selected transmission lines for compensation; d) the optimal placement of TCSCs depends on the load level and the upper bound on the number of TCSCs that could be placed; e) since the cost of a TCSC is a function of its operating point, the optimal placement of TCSCs requires explicit consideration of TCSCs installation costs under different load conditions; and f) computation time and the number of allowed TCSCs in the system does not have a direct relationship.