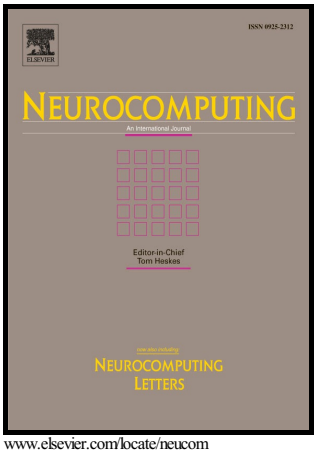


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# An Application of Backtracking Search Algorithm in Designing Power System Stabilizers for Large Multi-machine System

Naz Niamul Islam[1], M A Hannan[1], Hussain Shareef[2], Azah Mohamed[1]
[1]Department of Electrical, Electronic and System Engineering, Universiti Kebangsaan Malaysia, Bangi, 43600, Selangor, Malaysia
[2]Electrical Engineering Department, F-1 Building, Level 1 College of Engineering, United Arab Emirates University, P.O. Box 15551 Al Ain, United Arab Emirates
niamul@eng.ukm.my
hannan@eng.ukm.my
shareef@uaeu.ac.ae
azah@eng.ukm.my

**Abstract:**

This paper deals with the backtracking search algorithm (BSA) optimization technique to solve the design problems of multi-machine power system stabilizers (PSSs) in large power system. Power system stability problem is formulated by an optimization problem using the LTI state space model of the power system. To conduct a comprehensive analysis, two test systems (2-AREA and 5-AREA) are considered to explain the variation of design performance with increase in system size. Additionally, two metaheuristic algorithms, namely bacterial foraging optimization algorithm (BFOA) and particle swarm optimization (PSO) are accounted to evaluate the overall design assessment. The obtained results show that BSA is superior to find consistent solution than BFOA and PSO regardless of system size. The damping performance that achieved from both test systems are sufficient to achieve fast system stability. System stability in linearized model is ensured in terms of eigenvalue shifting towards stability regions. On the other hand, damping performance in the non-linear model is evaluated in terms of overshoot and setting times. The obtained damping in both test systems are stable for BSA based design. However, BFOA and PSO based design perform worst in case of large power system. It is also found that the performance of BSA is not affected for large numbers of parameter optimization compared to PSO, and BFOA optimization techniques. This unique feature encourages recommending the developed backtracking search algorithm for PSS design of large multi-machine power system.

**Keywords:**

Power system stability, power system oscillations, power system damping, power system stabilizer, backtracking search algorithm, multi-machine power system.

## 1. Introduction:

Stability of modern power system is very important for its secure and reliable operation and it is achieved through proper design of power system stabilizers (PSS). However, instability [1] may arise through growing of power system oscillations and its consecutive events originated from various changes in the system. The changes may be in terms of generator tripping, load addition (suspension or change) and miscellaneous type of faults. Those changes eventually may lead to growing the oscillations of active power generated by synchronous generators [2]. In multi-machine system scenario, two types of power oscillations are observable [3]. The oscillations among the nearby generators of same area are called the local modes of oscillations. Another type of oscillations are the inter-area modes of power oscillations that may tempt other generators of different regions to oscillate along with affected generators [3]. In case of interconnected systems, power oscillations especially inter-area oscillations can be very dangerous, causing the entire system collapse by affecting and tripping generators one by one. The purpose of PSS installation is to damp those oscillations effectively in order to restore system stability [2, 3]. For many