Artificial Intelligent Based Damping Controller Optimization for the Multi-Machine Power System: A Review

By: Hannan, MA (Hannan, Mahammad A.)[1]; Islam, NN (Islam, Naz Niamul)[2]; Mohamed, A (Mohamed, Azah)[3]; Lipu, MSH (Lipu, Molla S. Hossain)[3]; Ker, PJ (Ker, Pin Jern)[1]; Rashid, MM (Rashid, Muhammad Mahbubur)[4]; Shareef, H (Shareef, Hussain)[5]

View ResearcherID and ORCID

IEEE ACCESS
Volume: 6 Pages: 39574-39594
DOI: 10.1109/ACCESS.2018.2855681
Published: 2018
Document Type: Review
View Journal Impact

Abstract

Power system oscillation is a major threat to the stability of an interconnected power system. The safe operation of a modern power system is largely related to the success of oscillation damping. However, damping controller development is a constraint-based multimodal optimization problem, which is relatively difficult to resolve utilizing conventional optimization algorithms. This paper presents a critical examination of different damping schemes and a stability analysis of a damping controller to solve these existing problems and enhance the performance of a multi-machine power system. This paper also describes different approaches used to derive the objective function formulation. Consequently, a comprehensive review of the optimized objective functions and techniques is explained on the basis of their topologies, types, execution times, control difficulties, efficiencies, advantages, and disadvantages to develop intelligent damping controllers for the systems. Furthermore, the optimization strategies for the damping controller are reviewed along with the benefits and limitations, current issues and challenges, and recommendations. All the highlighted insights of this paper will hopefully lead to increasing efforts toward the development of an advanced optimized damping controller for future high-tech multi-machine power systems.

Keywords

Author Keywords: Damping controller; optimization; objective function; oscillations; power system stabilizers (PSS); flexible alternating current transmission system (FACTS)

KeyWords Plus: PARTICLE SWARM OPTIMIZATION; GRAVITATIONAL SEARCH ALGORITHM; MACHINE INFINITE-BUS; FUZZY PID CONTROLLER; LEAD-LAG CONTROLLER; TRANSIENT STABILITY; COORDINATED DESIGN; GENETIC ALGORITHM; MULTIOBJECTIVE OPTIMIZATION; OPTIMAL RECONFIGURATION

Author Information

Reprint Address: Hannan, MA (reprint author)

Univ Tenaga Nas, Inst Power Engn, Dept Elect Power Engn, Coll Engn, Kajang 4300, Malaysia.

Addresses:

[1] Univ Tenaga Nas, Inst Power Engn, Dept Elect Power Engn, Coll Engn, Kajang 4300, Malaysia

[2] Univ Queensland, Sch Informat Technol & Elect Engn, Brisbane, Qld 4072, Australia

[3] Univ Kebangsaan Malaysia, FKAB, Ctr Integrated Syst Engn & Adv Technol, Bangi 43600, Malaysia

[4] Univ Islam Antarabangsa Malaysia, Dept Mechatron Engn, Fac Engn, Kuala Lumpur 53100, Malaysia

[5] United Arab Emirates Univ, Dept Elect Engn, Coll Engn, Al Ain 15551, U Arab Emirates

E-mail Addresses: hannan@uniten.edu.my

Funding

Funding Agency	Grant Number
Universiti Tenaga Nasional	RJO10289176/D/2018/J49-J50

View funding text

Publisher

IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC, 445 HOES LANE, PISCATAWAY, NJ 08855-4141 USA

Categories / Classification

Research Areas: Computer Science; Engineering; Telecommunications

Web of Science Categories: Computer Science, Information Systems; Engineering, Electrical & Electronic; Telecommunications

See more data fields

Cited References: 186

Showing 30 of 186 **View All in Cited References page** *(from Web of Science Core Collection)*

1. **Optimal SSSC design for damping power systems oscillations via Gravitational Search Algorithm** — Times Cited: 17
By: Abd Elazim, S. M.; Ali, E. S.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 82 Pages: 161-168 Published: NOV 2016

2. **Bacteria Foraging Optimization Algorithm based SVC damping controller design for power system stability enhancement** — Times Cited: 28
By: Abd-Elazim, S. M.; Ali, E. S.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 43 Issue: 1 Pages: 933-940 Published: DEC 2012

3. **Coordinated design of PSSs and SVC via bacteria foraging optimization algorithm in a multimachine power system** — Times Cited: 38
By: Abd-Elazim, S. M.; Ali, E. S.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 41 Issue: 1 Pages: 44-53 Published: OCT 2012

4. **Optimal design of power system stabilizers using evolutionary programming** — Times Cited: 70
By: Abido, MA; Abdel-Magid, YL
IEEE TRANSACTIONS ON ENERGY CONVERSION Volume: 17 Issue: 4 Pages: 429-436 Published: DEC 2002

5. **Optimal power flow with UPFC using security constrained self-adaptive differential evolutionary algorithm for restructured power system** — Times Cited: 6
By: Acharjee, P.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 76 Pages: 69-81 Published: MAR 2016

6. **Analysis of the simultaneous coordinated design of STATCOM-based damping stabilizers and PSS in a multi-machine power system using the seeker optimization algorithm** — Times Cited: 9
By: Afzalan, Ehsan; Joorabian, Mahmood
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 53 Pages: 1003-1017 Published: DEC 2013

7. **A Modified Differential Evolution Algorithm Based on a New Mutation Strategy and Chaos Local Search for Optimization Problems** — Times Cited: 3
By: ahadzadeh, Behrouz; Menhaj, Mohammad Bagher
2014 4TH INTERNATIONAL CONFERENCE ON COMPUTER AND KNOWLEDGE ENGINEERING (ICCKE) Pages: 468-473 Published: 2014

8. **A comprehensive review on uncertainty modeling techniques in power system studies** — Times Cited: 45
By: Aien, Morteza; Hajebrahimi, Ali; Fotuhi-Firuzabad, Mahmud
RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 57 Pages: 1077-1089 Published: MAY 2016

9. **Optimization of Power System Stabilizers using BAT search algorithm** — Times Cited: 65
By: Ali, E. S.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 61 Pages: 683-690 Published: OCT 2014

10. **TCSC damping controller design based on bacteria foraging optimization algorithm for a multimachine power system** — Times Cited: 27
By: Ali, E. S.; Abd-Elazim, S. M.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 37 Issue: 1 Pages: 23-30 Published: MAY 2012

11. **Coordinated design of PSSs and TCSC via bacterial swarm optimization algorithm in a multimachine power system** — Times Cited: 58
By: Ali, E. S.; Abd-Elazim, S. M.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 36 Issue: 1 Pages: 84-92 Published: MAR 2012

12. **Optimal Power System Stabilizers Design for Multimachine Power System Using Hybrid BFOA-PSO Approach** — Times Cited: 2
By: Ali, E.S.; Abd-Elazim, S.M.
WSEAS Transactions on Power Systems Volume: 8 Issue: 2 Pages: 85-94 Published: April 2013

13. **Simultaneous coordinated design of PSS and SSSC using improved Lozi map based chaotic optimization algorithm (ILCOA)** — Times Cited: 7
By: Alizadeh, Mojtaba; Alizadeh, Morteza; Ganjefar, Soheil
NEUROCOMPUTING Volume: 122 Special Issue: SI Pages: 181-192 Published: DEC 25 2013

14. **Dynamic genetic algorithms for robust design of multimachine power system stabilizers** — Times Cited: 40
By: Alkhatib, Hasan; Duveau, Jean
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 45 Issue: 1 Pages: 242-251 Published: FEB 2013

15. **Optimal Tuning of Power System Stabilizers in a Multi-Machine System Using Firefly Algorithm** — Times Cited: 2
By: Ameli, A.; Farrokhifard, M.; Ahmadifar, A.; et al.
2013 12TH INTERNATIONAL CONFERENCE ON ENVIRONMENT AND ELECTRICAL ENGINEERING (EEEIC 2013) Pages: 461-466 Published: 2013

16. **Causes of the 2003 major grid blackouts in north America and Europe, and recommended means to improve System Dynamic Performance** — Times Cited: 521
By: Andersson, G; Donalek, P; Farmer, R; et al.
IEEE TRANSACTIONS ON POWER SYSTEMS Volume: 20 Issue: 4 Pages: 1922-1928 Published: NOV 2005

17. **Analyzing the Static Security Functions of a Power System Dynamic Security Assessment Toolbox** — Times Cited: 2
By: Arava, V. S. Narasimham; Vanfretti, Luigi
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 101 Pages: 323-330 Published: OCT 2018

18. **A Procedure to Design Fault-Tolerant Wide-Area Damping Controllers** — Times Cited: 3
By: Bento, Murilo E. C.; Dotta, Daniel; Kuiava, Roman; et al.
IEEE ACCESS Volume: 6 Pages: 23383-23405 Published: 2018

19. **Major grid blackouts: Analysis, classiFIcation, and prevention** — Times Cited: 6
By: Besanger, Y.; Eremia, M.; Voropai, N.
HDB ELECT POWER SYST Pages: 789-863 Published: 2013
Publisher: Wiley, Hoboken, NJ, USA

20. **Robust Frequency Control in an Islanded Microgrid: H-infinity and mu-Synthesis Approaches** — Times Cited: 53
By: Bevrani, Hassan; Feizi, Mohammad Ramin; Ataee, Sirwan
IEEE TRANSACTIONS ON SMART GRID Volume: 7 Issue: 2 Special Issue: SI Pages: 706-717 Published: MAR 2016

21. **Approach for the solution of transmission congestion with multi-type FACTS devices** — Times Cited: 10
By: Bhattacharyya, Biplab; Kumar, Sanjay
IET GENERATION TRANSMISSION & DISTRIBUTION Volume: 10 Issue: 11 Pages: 2802-2809 Published: AUG 4 2016

22. **Effects of parameter variation in DFIG-based grid connected system with a FACTS device for small-signal stability analysis** — Times Cited: 2
By: Bhushan, Ravi; Chatterjee, Kalyan
IET GENERATION TRANSMISSION & DISTRIBUTION Volume: 11 Issue: 11 Pages: 2762-2777 Published: AUG 3 2017

23. **Benefits and challenges of expanding grid electricity in Africa: A review of rigorous evidence on household impacts in developing countries** — Times Cited: 2
By: Bos, Kristine; Chaplin, Duncan; Mamun, Arif
ENERGY FOR SUSTAINABLE DEVELOPMENT Volume: 44 Pages: 64-77 Published: JUN 2018

24. **Transient Stability in Oscillating Multi-Machine Systems Using Lyapunov Vectors** — Times Cited: 2
By: Bosetti, Hadrien; Khan, Sohail
IEEE TRANSACTIONS ON POWER SYSTEMS Volume: 33 Issue: 2 Pages: 2078-2086 Published: MAR 2018

25. **Simultaneous coordinated tuning of PSS and FACTS damping controllers in large power systems** — Times Cited: 138

By: Cai, LJ; Erlich, I
IEEE TRANSACTIONS ON POWER SYSTEMS Volume: 20 Issue: 1 Pages: 294-300 Published: FEB 2005

26. **Placement and performance analysis of STATCOM and SVC for damping oscillation** Times Cited: 4
By: Cakir, G.; Radman, G.
P IEEE INT C EL POW Pages: 1-5 Published: 2013

27. **A hybrid algorithm to tune power oscillation dampers for FACTS devices in power systems** Times Cited: 13
By: Castoldi, M. F.; Sanches, D. S.; Mansour, M. R.; et al.
CONTROL ENGINEERING PRACTICE Volume: 24 Pages: 25-32 Published: MAR 2014

28. **Simultaneous and coordinated tuning of PSSs and PODs using differential evolution** Times Cited: 5
By: Castoldi, M. F.; Mazucato Jr, S. C.; Rodrigues, C. R.; et al.
P 16 IEEE MED EL C M Pages: 1-8 Published: 2012
[Show additional data]

29. **Simulated annealing based optimal frequency and terminal voltage control of multi source multi area system** Times Cited: 9
By: Chandrakala, K. R. M. Vijaya; Balamurugan, S.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 78 Pages: 823-829 Published: JUN 2016

30. **Optimized design method for grid-current-feedback active damping to improve dynamic characteristic of LCL-type grid-connected inverter** Times Cited: 1
By: Chen, Yandong; Xie, Zhiwei; Zhou, Leming; et al.
INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS Volume: 100 Pages: 19-28 Published: SEP 2018

Showing 30 of 186 **View All in Cited References page**