International Conference on Electromechanical and Energy Systems (SIELMEN)
6-8 October 2021, Iasi, Romania
pag. 115-120

Optimal PMU Placement and Algorithms' Development of Accelerated Calculations of State Estimation Performance in Power Systems

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https://doi.org/10.1109/SIELMEN53755.2021.9600298

Abstract

Reducing the cost of implementing phasor measurement units (PMUs) can be achieved by determining the minimum number of devices needed to provide the electrical network observability. This article describes the optimal PMU placement algorithm, based on the analysis of the topological properties of the electrical network. It was shown that the optimal placement of PMUs can be achieved by dividing the nodal admittance matrix into four submatrices, one of them will be a band submatrix, which can be reduced to a lower triangular matrix of maximum rank by elementary transformations. Results reflecting the number of installed PMUs were obtained for IEEE test bus systems with 9, 14, 19, 30 and 57 nodes. For all test bus systems, the proposed PMU placement algorithm provides complete observability of the system with the same or fewer nodes of installation in comparison with the results of other authors. There were carried out computations with the help of the algorithm accelerated calculations of state estimation performance in power systems, in order to confirm the correctness of this approach. There were determined conditions under which the equations of nodal voltages were solved linearly and nonlinearly (iteratively).

Keywords: electrical networks, matrixes, phasors , mathematical models, power system reliability, admittance, reliability

References

1. E. Murdid and I Stratan, "Optimal placement of synchronized phasor measurement technologies based on different methods of optimization", *SIELMEN-2015; ALMA*, pp. 199-204.
Google Scholar

2. O.M. Bogatyrev, "Elementarnaya metodika rascheta linejnykh elektricheskikh tsepej", *ElektrichestvO*, no. 4, 1953.
Google Scholar

3. N.G. Maksimovich, "Linejnye elektricheskie tsepi i ikh preobrazovaniya", *GosenergoizdaT*, pp. 263, 1961.
Google Scholar

4. Ene Marian, "Metoda mărimilor determinate", *Modelul reţelelor electrice. – Bucureşti. Editura Academiei R.S.R.*, pp. 228, 1971.
Google Scholar

5. P.I. Bartolomej and L.V. Pletneva, "Optimizatsiya rasstanovki RMU dlya ukorennykh raschetov rezhimov EES", *Nauchnye trudy mezhdunarodnoj nauchno-tekhnicheskoj konferentsii «Energetika glazami molodezhi - 2013» Novocherkassk T.2 Oktyabr*, pp. 207-212.
Google Scholar

6. P.I. Bartolomej, E.N. Kotova, L.V. Pletneva and A.S. Shiryaev, "Uskorennye raschety rezhimov elektricheskoj sistemy s ispolzovaniem izmeritelnykh sredstv WAMS", *Elektroenergetika glazami molodezhI». Nauchnye Trudy mezhdunarodnoj nauchno-tekhnicheskoj konferentsii Sbornik statej v 2 t. Ekaterinburg URFU*, no. 2, pp. 24-28, 2012.
Google Scholar

7. P.I. Bartolomej and S.I. Semenenko, "Minimizatsiya kolichestva vektornykh izmerenij dlya uskorennykh raschetov EES", *Nauchnye trudy mezhdunarodnoj nauchno-tekhnicheskoj konferentsii «Energetika glazami molodezhi - 2015» Ivanovo T.1*, pp. 259-264, Noyabr 2015.
Google Scholar

8. S. I. Semenenko, *Razrabotka algoritmov razmeshcheniya sinkhronizirovannykh vektornykh izmerenij dlya povysheniya effektivnosti otsenivaniya sostoyaniya EES: dissertatsiya na soiskanie uchenoj stepeni kandidata tekhnicheskikh nauk : 05.14.02*.
Google Scholar

9. Marco António Do Rosário Santos Cruz, Helder Roberto de Oliveira Rocha, Marcia Helena Moreira Paiva, Marcelo Eduardo Vieira Segatto, Eglantine Camby et al., "An algorithm for cost optimization of PMU and communication infrastructure in WAMS", *International Journal of Electrical Power and Energy Systems Elsevier*, vol. 106, pp. 96-104, 2019.
Google Scholar

10. N.H.A. Rahman and A.F. Zobaa, "Optimal PMU Placement using Topology Transformation Method in Power Systems", *Journal of Advanced Research*, 2016, [online] Available: http://dx.doi.org/10.1016/j.jare.2016.06.003.
CrossRef Google Scholar

11. A. Laouid, M.M. Rezaoui, A. Kouzou and R. Mohammedi, "Optimal PMUs Placement Using Hybrid PSO-GSA Algorithm", *2019 4th International Conference on Power Electronics and their Applications (ICPEA)*, pp. 1-5, 2019.
View Article Full Text: PDF (295KB) Google Scholar

12. B. Mohammadi-Ivatloo, "Optimal Placement of PMUs for Power System Observability Using Topology Based Formulated Algorithms", *Journal of Applied Sciences*, vol. 9, pp. 2463-2468, 2009, [online] Available: https://scialert.net/abstract/?doi=jas.2009.2463.2468.
Google Scholar