論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Department of Computer Science 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（ Philosophy ）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Power grids are facing serious cyber-security issues due to the rapid development of the smart grid and increasingly integrated communication networks. State Estimation (SE) is one of the essential tasks to monitor and control the smart power grid. The impact of false data injection (FDI) attacks on static state estimation of power systems has been actively studied in the past decade.

This thesis studies the robust static state estimation under false data injection attacks targeting both the measurement vector and the regressor matrix which result in observation outliers and leverage points. The objective is to find how decomposing power systems to islands and implementing robust regression estimators affect the detection of random and coordinated attacks.

For decomposing the system to generate islands, we propose an algorithm for the on-line implementation of a robust static state estimator on large power systems. This algorithm increases the number of outliers and cyber-attacks that the estimator can resist while giving reliable estimates. In particular, the large power system is decomposed in several islands or subsystems and a highly robust regression estimator, namely the least trimmed squares estimator (LTS), is implemented on each island to detect bad data. Further, executing the estimators in parallel will greatly reduce the computation time of the robust static state estimator.

The introduced method is compared with two cycle detection graph-theory approaches, namely depth-first search (DFS) and minimum spanning tree (MST), which have been adapted here for power state estimation. Simulations on IEEE 14, 30, 57, 118, 145, and 300 bus systems show the superior performance of the proposed algorithm over the adapted DFS and MST. The algorithm could reduce significantly the number and size of cycles in the system. Furthermore, the number of detected outliers and attacks is maximized while the observability of the system is ensured. Attacks or outliers on both measurements and topology of the grid are detected as well.

We further compare the two methods namely, proposed and MST method by implementing different robust static state estimators such as the Huber M-estimation, the least absolute value (LAV), which are implemented for each island to detect the corrupted data. In particular, we focus on highly adversarial cases where the attacker can falsify both the measurement vector and the regressor matrix and attempts to manipulate the states to targeted values.

Extensive simulations on the IEEE bus systems show the superior performance of the proposed LTS with the proposed decomposition-based algorithm over other estimation and decomposition methods. The simulation results show also the limits of each robust method especially when the attacks are designed in a coordinated fashion. To this end, we analyze the structure of the system topology and measurements and perform extensive simulations using the IEEE 14 and 118 bus systems. Furthermore, we investigate robustness improvement when phasor measurement units (PMUs) are available and hybrid state estimation can be employed.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).