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Enhancing power transfer capability through flexible AC transmission system devices: a review

Key words: FACTS devices, Available transfer capability, Power transfer capability, Artificial intelligence

Contact: Fadi M. Albatsh
E-mail: fbatsh83@yahoo.com
ORCID: http://orcid.org/0000-0002-2999-9458

Motivation

- Global demand for power has significantly increased, but power generation and transmission capacities have not increased proportionally with this increasing demand.
- As a result, power consumers suffer from various problems, such as voltage and frequency instability and power quality issues.
- To overcome these problems, the capacity for available power transfer of a transmission network should be enhanced.

Motivation (Con'd)

- Researchers worldwide have addressed this issue by using flexible AC transmission system (FACTS) devices.
- In this paper, a comprehensive review of how FACTS controllers are used to enhance the available transfer capability (ATC) and power transfer capability (PTC) of power system networks has been conducted.

Review contents

- This review includes a discussion of the classification of different FACTS devices according to different factors.
- The popularity and applications of these devices have been discussed together with relevant statistics.
- The operating principles of six major FACTS devices and their application in increasing ATC and PRC have been presented.
- Finally, we evaluated the performance of FACTS devices in ATC and PTC improvement with respect to different control algorithms.

Critical analysis

- Based on the critical analysis of six major FACTS devices (SVC, TCSC, TCPST, SSSC, STATCOM, UPFC) and their effect on ATC and PTC, the features of each controller have been summarized.
- The behaviors of different FACTS controllers are also included.
- The research on using *d*-*q* transformation, artificial neural networks, and fuzzy logic controllers to increase ATC and PTC has been insufficient.

Critical analysis (Con'd)

- The combination of neural network and the fuzzy expert systems (i.e., neuro-fuzzy systems) has good potential for enhancing ATC by using different FACTS controllers.
- Several studies have focused on the steady-state model of FACTS devices. However, steady-state analysis is effective only for the planning stage of power system networks. Therefore, it is essential to develop a dynamic model of FACTS devices to be able to conduct the real-time analysis.

Conclusions

- We have presented an overview of FACTS devices and their classification, and reviewed studies of their applications in enhancing ATC from year 1990 to 2012.
- The six major FACTS controllers and their basic structures and effects on enhancing ATC and PTC were examined.
- A critical analysis of various control techniques for the main FACTS controllers was investigated.
- This survey will be helpful to researchers of ATC and PTC enhancement through the use of FACTS controllers.