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Data clustering based probabilistic UPFC allocation for improving power system reliability considering correlated uncertain variables

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Abstract-

Flexible alternating-current transmission system (FACTS) devices as power electronic-based technologies have been developed to improve the performance of power systems. This paper proposes a probabilistic framework for optimal allocation of unified power flow controller (UPFC) as one of the most beneficial FACTS devices to increase the reliability of the power system. For this purpose, the expected power not served (EPNS) is considered as a reliability index that is obtained based on the summation of required load shedding in all buses during single contingencies, including transmission lines and generators outage. Power demands and wind speed are considered as uncertain input variables. In addition, the correlations among these variables are included in the proposed study method. The well-known particle swarm optimization (PSO) algorithm is used to optimize the proposed objective function. Also, the firefly algorithm (FA) is implemented to determine the total amount of load shedding for the calculation of EPNS, considering each possible generated solution by the PSO. The k-means based data clustering method (DCM) is used for probabilistic evaluation of the problem, for the first time. Also, the correlations among uncertain input variables are modeled with the Cholesky decomposition method. Extraction of statistical information of UPFC parameters for improving power system reliability in a probabilistic framework is one of the most important achievements of the proposed method. This information is very important in deciding on the UPFC sizing. In order to evaluate the effectiveness of the proposed method, the IEEE 14-bus and 30-bus test systems have been used.

Index Terms-

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