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International Journal of Electrical Power & Energy Systems
Volume 123, December 2020, 106299

Numerical methods for power flow analysis in DC networks: State of the art, methods and challenges

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https://doi.org/10.1016/j.ijepes.2020.106299

Abstract

This study addresses the power-flow-analysis problem for direct-current (DC) grids from a numerical perspective. Classical and emerging algorithms for power flow solutions in DC networks such as Gauss--Seidel, successive approximations, Newton--Raphson, and Taylor-based methods are reviewed herein in detail by providing their mathematical derivations and algorithmic implementations. All these numerical methods can be applied to high-voltage DC and low-voltage DC networks irrespective of their topologies and the number of voltage-controlled nodes. The MATLAB programming environment is used to implement these power flow algorithms using DC networks with 6, 21, 33, and 69 nodes. The simulation results show that these power flow methods are equivalent in terms of voltage estimation and power losses and only differ from one another in terms of processing time.