Design Engineering

ISSN: 0011-9342 | Year 2022
Issue: 1 | Pages: 1009 - 1017

Model for Disturbance Estimation during Transient in an Islanded Microgrid

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Abstract

During the past decade, there has been a profuse increase in the global electricity consumption. Even though fossil fuel still accounts for majority of this energy demand, the world is gradually moving towards clean and renewable energy sources (RES). In this direction, wind and solar energy sources are being integrated to the existing power system/grid, mostly in the form of microgrids. However, these RESs are power converter based which poses negligible inertia. Due to the lack of inertia, microgrids are susceptible to voltage and frequency stability in the event of sudden and large power imbalance. In this paper, author proposes a model of frequency dynamics, which can be used to estimate the power imbalance at the instant of disturbance in the microgrid. An approximated linear model of microgrid, comprised of parallel connected synchronous generators and inverter based distributed generators is developed for the estimation of power imbalance in the event of transient. Typhoon real-time hardware-in-the-loop simulator is used for verification of performance of proposed model and power imbalance estimation method.

Keywords: Disturbance estimation, frequency regulation, renewable energy sources, model-based control, grid forming and grid following.

1. Introduction

In traditional power systems several number of large synchronous generators having large rotor inertia are connected to the grid that's why small variation in load or small faults does not make significant impact on the stability of the grid. On the other hand microgrids comprise of low inertia based sources like renewable energy sources (RES), distributed generators (DGs) and energy storage units along with distributed load. Therefore microgridgs are more vulnerable to power imbalance.

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