

**Thesis Title: CONTROL STRATEGIES FOR ADAPTIVE DSTATCOM
WITH AN ACCOMMODATING POWER MANAGEMENT
SYSTEM IN AC MICROGRID**

Name of Candidate: Epsita Das

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Abstract

The aim of this thesis are as follows:

1. To investigate plug-and-play operation for DSTATCOM for reactive power management and voltage regulation.
2. To investigate a strategic method for reducing energy consumption cost of the small residential energy producers in microgrid (MG)

Proportional-integral-derivative (PID) controllers need rigorous installation tuning processes, which require sufficient time and human expertise. This thesis investigates a plug-and-play operation of DSTATCOM for voltage regulation. Artificial neural network (ANN) is used for system identification to avoid human intervention. Two adaptive techniques were introduced to achieve this aim.

- i) an adaptive neuro-fuzzy inference system (ANFIS)
- ii) continuous control set (CCS) model predictive control (MPC)

Both methods yield good results for voltage regulation when used in plug and play mode.

The penetration of the distributed energy resources (DER) in the power market initiates changes in the price dynamics. Demand Side Management (DSM) is the measure to optimize energy consumption, providing incentives for less energy consumption, especially during peak demand. In this thesis DSM is performed using smart electrical gadgets over the internet. It uses low-cost, open-source IoT devices to monitor and control domestic loads of microgrids. Two distinct modes of operation of MG are considered :

- a) within the MG (peer-to-peer or P2P)
- b) with the utility grid.

Selling energy by a prosumer when needed by fellow residents in the MG is considered a token of social service towards the community. A social service counter (SSC) is chosen to identify services for each prosumer in the MG. Few residents from the community are elected as delegates because they support community welfare. This approach distributes the surplus generated energy among community members at price lower than that from the grid. MO only

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allows prosumers to participate in energy trading with the grid during the high-demand hours of the day.

Delegates are essential in protecting the community's interest while selling energy outside the community. They try to form a coalition among participants to reduce installed capacity and maximize the cumulative payoff. An index called Shapley value is used as a tool that identifies each delegate's contribution during the game.

S. Biswas
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Dr. Sujit K. Biswas
Former Professor & Head
Department of Electrical Engineering
Jadavpur University, Kolkata-700032

Dr. Ambarnath Banerji
14/02/2024

Dr. Ambarnath Banerji
Professor,
Department of Electrical Engineering
Narula Institute of Technology

S. Debnath

Professor
Electrical Engineering Department
JADAVPUR UNIVERSITY
Kolkata - 700 032

Epsila Dan.