MITIGATING DISTRIBUTION FEEDER VOLTAGE RISE OPTIMALLY USING AN ON-LOAD TAP CHANGING TRANSFORMER AND SMART INVERTERS

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DECLARATION OF THE CANDIDATE AND SUPERVISOR

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ABSTRACT

Higher utilization of distributed generation using solar PV can be observed in recent years due to the gradual reduction of solar panel cost. More additions of solar PV generation in the LV grid can be expected in the future. One of the major challenges encountered by distribution grid operators due to high solar penetration is the voltage rise at the far end of the distribution lines. The centralized control of PV inverters and other controllable devices such as on-load tap changer transformers are a potential solution to solve the voltage rise problem. Optimum centralized control is a heavily investigated topic in the recent past. The optimum control of controllable devices in LV grids can prevent the voltage rise while minimising the energy loss due to resistive loss and generation curtailment. Optimum power flow can be utilized for optimum centralized control.

Optimum power flow is a non-convex problem, and there are different solutions to solve it. A sequential mixed-integer second-order cone program-based methodology is suggested in this thesis. According to simulation results, the suggested method has a faster execution time and higher accuracy than the methods discussed in the literature. Also, the thesis proves that the voltage rise can be successfully mitigated by applying the proposed algorithm.

KEYWORDS: Optimum power flow, power distribution system, distributed generation, second-order cone programming

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	**Description**
DG	Distributed Generation
GA	Genetic Algorithm
LDC	Line Drop Compensation
LP	Linear Program
LV	Low Voltage
LVDN	Low Voltage Distribution Networks
MINLP	Mixed Integer Nonlinear Program
MISOCP	Mixed Integer Second Order Cone Programming
MPPT	Maximum Power Point Tracking
MV	Medium Voltage
NLP	Nonlinear Program
OLTC	On Load Tap Changer
OPF	Optimum Power Flow
PSO	Particle Swarm Optimisation
PV	Photovoltaic
QP	Quadratic Program
SCP	Sequential Convex Programing
SDP	Semidefinite Program
SLP	Sequential Linear Programing
SOCP	Second Order Cone Program
SQP	Sequential Quadratic Programming
STATCOM	Static Synchronous Compensator
SVC	Static Var Compensator
SVR	Step Voltage Regulators
TO	Tap Operations