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RESEARCH ARTICLE

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Low switching frequency modulation of a 3 × 3 matrix converter in UPFC application using differential evolution method

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Summary

This paper presents a low switching frequency–based pulse width modulation technique for a 3 × 3 indirect matrix converter. The nontriplen lower-order harmonics are considered for minimization using differential evolution–based metaheuristic technique. The mathematical equations are formulated while considering minimization of nontriplet lower-order harmonics along with control of fundamental voltage. An objective function is constructed by considering all the constraints on the feasible region and then it is minimized by using differential evolution technique. It is observed that the solution in the entire modulation range exists along with multiple solutions. Various cases of switching angles are considered, and solution trajectories are reported in practically feasible range. This type of modulation and control scheme is extremely useful in high power applications such as unified power flow controller as it minimizes the switching losses in the converter. The theoretical findings are verified by simulation and hardware results.

KEYWORDS

differential evolution, dSpace, low switching frequency, matrix converter, pulse width modulation, UPFC

1 | INTRODUCTION

The matrix converter (MC) is a good alternative to the ac-dc-ac and conventional voltage source inverters in many applications because it can provide bidirectional power flow along with very close to sinusoidal input/output waveforms and controllable power factor at input.[1,2] The major advantage lies in the fact that there is no need of DC link reactive components as in the case of its counterpart ac-dc-ac converters.[3] The matrix converters nowadays are used in diverse range of applications such as effective power supply, maximum power point tracking in wind energy conversion system, power factor correction, electrical drives, and industrial applications.[4-9] After its introduction, the research groups have worked to improve its performance by introducing new control and modulation schemes.[10-18] In comparison with most commonly used voltage source converters (VSCs) in many industrial applications, the modulation techniques for the

LIST OF SYMBOLS AND ABBREVIATIONS: DE, Differential Evolution; Ns, Number of Switching Angles; UPFC, Unified Power Flow Controller; VSC, Voltage Source Converter; θ, Switching Angles

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