Optimal HE-PWM inverter switching patterns using differential evolution algorithm

Muhammad Ikram Mohd Rashid[a]; Ayong Hiendro[b] and Makbul Anwari[c]
[a]Faculty of Electrical and Electronics Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b]Department of Electrical Engineering, Tanjungpura University, Pontianak, Indonesia 3
[c]Electrical Engineering Department, Umm Al-Qura University, Makkah 21955, Saudi Arabia

ABSTRACT
This paper presents a differential evolution (DE) algorithm to solve the optimum switching angles problem in the harmonic elimination pulse width modulation (HE-PWM) inverter. Reformulated equations for two-level schemes are proposed to satisfy the DE algorithm. Optimum solutions are found for odd value of switching angles (odd N) case within all range of modulation index M. The DE algorithm needs a relative small amount of generations to reach accurate solutions with appropriate control parameters. The comparison of some common variants in the DE shows that all variants may generate the same precision results by using their best specific crossover rate and mutation factor values. MATLAB/Simulink simulation results confirm that the solutions obtained by the proposed technique can be applied to eliminate the entire undesired specific harmonics as expected by the proposed formulation.

KEYWORDS:
Differential evolution; harmonic elimination; pulse width modulation; three-phase inverter.

REFERENCE

1. H.S. Patel and R.G. Hoft (1973, May/Jun). Generalized techniques of harmonic elimination and voltage control in thyristor inverter: Part I-harmonic elimination. IEEE Transaction on Industrial Applications. IA-9(3). pp. 310-317.

2. J.A. Taufiq, B. Mellitt, and C.J. Goodman (1985, Mar). "Novel algorithm for generating near optimal PWM waveforms for AC traction drives," in IEE Proceedings B on Electric Power applications. 133(2), pp. 85-94.

3. P. Enjeti and J.F. Lindsay (1987). Solving nonlinear equation of harmonic elimination PWM in power control. Electronics Letter. 23(12). pp. 656-657.

4. J. Sun and H. Grotstollen (1992). "Solving nonlinear equations for selective harmonic eliminated PWM using predicted initial values," in Proceedings 1992 International Conference on Industrial Electronics, Control, Instrumentation and Automation, pp. 259-264

5. D. Czarkowski, D.V. Chudnovsky, G.V. Chudnovsky and I. W. Selesnick (2002, Apr). Solving the optimal PWM for singlephase inverters. IEEE Transactions on Circuits and Systems-I: Fundamental Theory and Applications. 49(4). pp. 465-475.