OPTIMAL CURRENT QUALITY OF A SINGLE-PHASE MULTILEVEL INVERTER WITH A STAIRCASE MODULATION

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Introduction. The authors address the problem of optimal current quality for a single-phase multilevel inverter with a staircase modulation (Fig.1). The current quality is characterized by current ripple Normalized Mean Square (NMSc). The goal is to find theoretically optimal switching angles and respective minimal NMSc values. The previous research didn't provide comprehensive solutions for arbitrary modulation indices and level counts.

Materials and methods. Optimal current quality problem is formulated in time domain as a constrained optimization one thus accounting for all switching harmonics. A numerical solution is obtained using available optimization software (e.g., Matlab).

Results and discussion. This research resulted in: 1) analytical NMSc expression for arbitrary modulation indices and level counts assuming pure inductive load; 2) optimal switching angles (Fig.2), minimal NMSc (Fig.3) and current Total Harmonic Distortion (THD) (Fig.4).

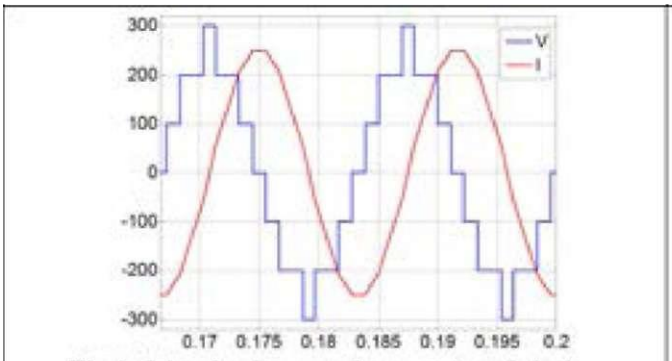

Fig.1. 3-level voltage and current modulation example

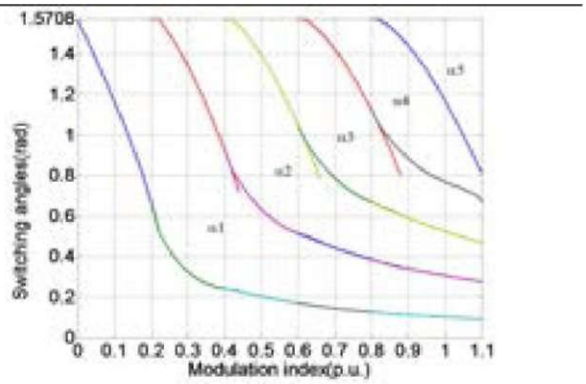

Fig.2. Current optimal switching angles

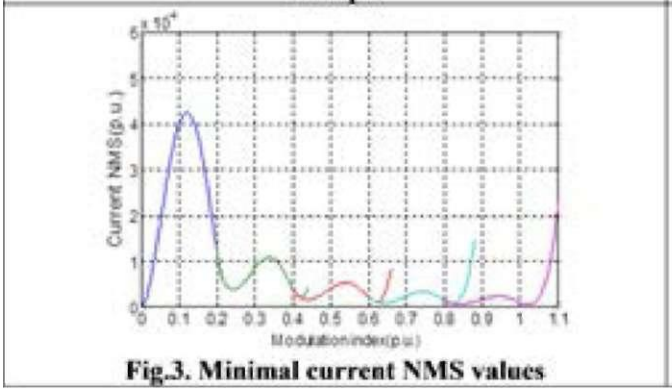

Fig.3. Minimal current NMS values

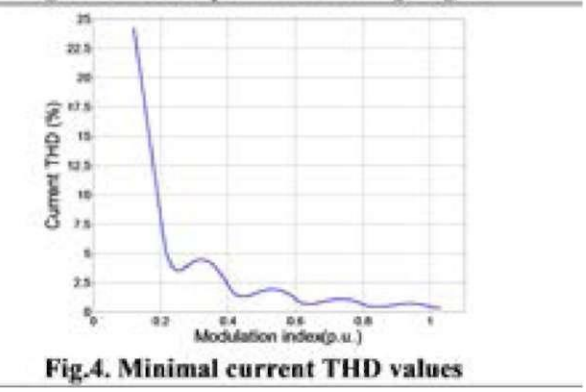

Fig.4. Minimal current THD values

Conclusions. Single-phase multilevel inverter optimal current quality problem is formulated in time domain to account for all switching harmonics. For inductance dominated loads, presented are theoretical current quality lower bounds for single-phase multilevel inverters achieved for staircase modulation for entire voltage dynamic range and different voltage levels count.

References.

1. A. Ruderman, G. Mehlmann, and B. Reznikov, "PWM voltage quality bounds of a single-phase multilevel inverter," *Proc. Int. Conf. on Optim. of Electr. and Electron. Equip. (OPTIM),* May 2012, pp. 58-68.