

SIMPLE TIME DOMAIN ANALYSIS OF NATURAL BALANCING IN FLYING CAPACITOR STACKED MULTICELL CONVERTERS

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Introduction. Stack Multicell Converters (SMC) is a class of converters derived from a classic Flying Capacitor Converter (FCC). The paper presents simple closed-form analysis of average capacitor natural voltage balancing dynamics in several basic SMC with different load types.

Materials and methods. Natural voltage balancing dynamics of 2x2 and 2x3 SMC with resistive and RL-load (Fig.1) was analyzed using time domain methodology and results obtained in [1, 2].

Results and discussion. The outcome of this research is simple closed-form expressions for natural balancing time constants (Fig.2,a,b), oscillation frequency (Fig.2,c), and overall SMC natural balancing dynamics over the entire voltage modulation dynamic range $0 < M < 1$.

Conclusions. Unlike previously reported frequency domain solutions, the presented time domain simple analytical results provide a comprehensive insight into natural balancing dependences on capacitances, load parameters, carrier frequency, and modulation index. The time domain averaging methodology power is demonstrated for 2x2 and 2x3 SMC with pure resistive and RL-load. Analytical formulas were confirmed by comparison with extensive computer simulations.

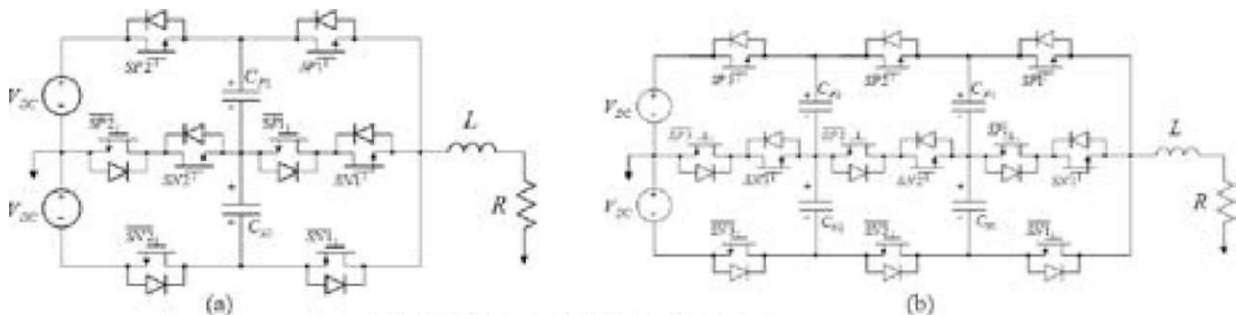
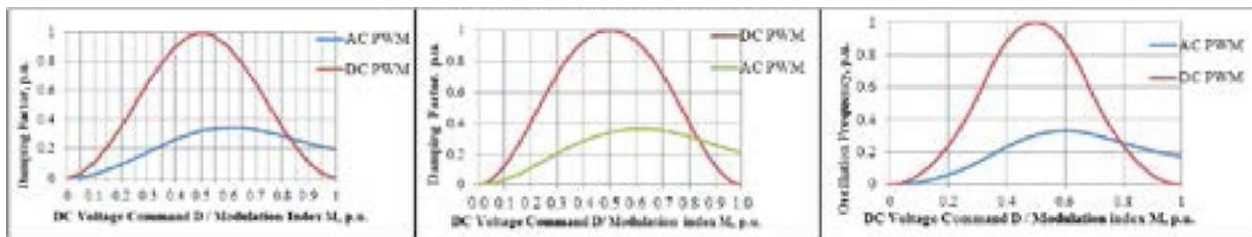


Fig.1. 2*2 bid 2*3 SMC v.-ilk fel. -Iiud



(a)

(b)

(c)

(a) (b) (c)

References.

1. A. Ruderman and B. Reznikov, "Simple time domain averaging methodology for flying capacitor converter voltage balancing dynamics analysis," *Proc. Int. Symp. Power Electronics (ISIE)*, Bari, Italy, 2010, pp. 1064-1069.
2. S. Thielemans, A. Ruderman, and J. Melkebeek, "Flying-capacitor multilevel converter voltage balance dynamics for pure resistive load," in *Proc. Adv. Electromech. Motion Systems & Electric Drives Joint Sym. (ELECTROMOTION)*, 2009, pp. 1-6.