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STUDY ON FAST-SCALE INSTABILITY PHENOMENA OF SINGLE-PHASE FULL-BRIDGE INVERTERS

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Abstract. *The main circuit is a voltage-controlled single-phase inverter. This work investigates fast-scale instability phenomena with a valid and novel approach. Firstly, the operational principle of a single-phase full-bridge inverter is examined and mapping state-space equations are generated. Additionally, the MATLAB/SIMULINK tool for experimental simulation and IsSpice for approximately physical simulation are adopted. The input DC voltage is changed to analyze the fast-scale instability waveforms of the inductor current and output voltage. Simulation results clearly demonstrate that MATLAB/SIMULINK and IsSpice provide consistent results and validate the mathematical models.*
Keywords: Single-phase full-bridge inverter, Fast-scale instability phenomena

1. **Introduction.** Single-phase full-bridge inverters are currently used in practical applications [1]. Notably, DC-AC inverters are also used in renewable energy applications [2,3]. Generally, DC-AC inverters operate in pulse width modulation (PWM) mode and switch between different circuit topologies, indicating that the inverter is a nonlinear system, specifically a piecewise smooth system [4].

Recent studies on the complex behavior of DC-AC inverters have generated an increasing amount of results. Many nonlinear phenomena, such as Hopf bifurcation, chaos, border collision and coexisting attractors, have been identified. Most studies focused on systems, including DC-DC converters and AC-DC power factor correction (PFC) converters, with DC power supplies [5-8]. However, systems with AC power supplies and the nonlinear phenomena of single-phase full-bridge inverters have seldom been addressed.

B. Robert and C. Robert utilized current feedback control to regulate the proportional gain (K_p) but only obtained border collision bifurcation [9]. Iu and Robert proposed a time-delayed feedback control that reduces chaotic phenomenon [10]. Zou et al. proposed fast-scale bifurcation in PFC buck-boost converters [11]. This study investigates fast-scale instability phenomena of a single-phase full-bridge inverter with a novel approach. First, this study analyzes the operational principle of a single-phase full-bridge inverter and constructs mapping state-space equations. Second, this study adopts the MATLAB/SIMULINK tool for experimental simulations and IsSpice for approximately physical simulations. Third, the input DC voltage is changed to examine the fast-scale