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DESIGN OF AN ADAPTIVE OUTPUT FEEDBACK CONTROLLER FOR A DC/DC BOOST CONVERTER SUBJECT TO LOAD VARIATION

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Abstract. *An adaptive output feedback controller using only voltage measurement is proposed for the regulation of the output voltage in pulse-width-modulation controlled DC/DC power converters of the boost type. In order to maintain a robust performance against parameter uncertainties, e.g., load variations and the magnetic saturation of induction coils, the simple adaptive control (SAC) approach is presented for a converter having a parasitic inductor resistance. Unlike the buck type converter case, the regulation problem of the boost converter is particularly difficult because the system is in a non-minimum phase with respect to the output voltage to be regulated. Since the SAC algorithm requires the transfer function of the controlled plant to be in a minimum phase and to have a relative degree of one, the approach cannot be directly applied to the boost converter. A parallel feedforward compensator (PFC) is developed according to the proposed control architecture. The effectiveness of the proposed controller is illustrated through comparative computer simulations with four other different control laws.*

Keywords: DC/DC boost converter, Simple adaptive control (SAC), Non-minimum phase system, Parallel feedforward compensator (PFC)

1. **Introduction.** As the reserves of fossil fuel decrease, it is necessary to explore other solutions for electric power energy generation. Increasing demands for renewable energy sources such as fuel cells and photovoltaic devices have attracted many researchers, e.g., [1, 2]. Since the DC voltage generated by fuel cells or photovoltaic systems varies widely in magnitude, a DC/DC boost (step-up) conversion stage is essential to provide highly regulated DC voltage. In the process of the voltage step-up, the unexpected transient frequently happens owing to uncertain load variations. This motivates various control algorithms for the boost converters along with the study on renewable energy sources [3, 4, 5].

Because the boost converter exhibits highly nonlinear and non-minimum phase properties with uncertain loads, it is not an easy task to design a robust controller for compensating the load perturbation. Though the controllers based on classical linear control techniques are simple to implement, it is difficult to deal with the variation of system parameters. Hence, there have been continuous efforts to design control strategies to improve the performance of the power converter. (See [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18] and therein.) However, further improvements are needed for transient responses of the converter control systems to guarantee the reliable and stable operation of the distributed renewable energy sources.

This paper concentrates on the regulation of the output voltage of the DC/DC boost converter subject to load variation. Unlike [12, 13, 14, 15] a parasitic inductor resistance