Proposal for Faster Disturbance Rejection of Boost DC-DC Converter Based on Simplified Current Minor Loop

Aviti Mushi.
Graduate School of Engineering
Yokohama National University
79-5 Tokiwadai, Hodogayaku
Yokohama 240-8501, Japan
Email: mushi-thadei-bf@ynu.jp

Takahiro Nozaki
System Design Engineering
Keio University
3-14-1 Hiyoshi, Kohoku
Yokohama 223-8522, Japan
Email: nozaki@sd.keio.ac.jp

Atsuo Kawamura
Yokohama National University
79-5 Tokiwadai, Hodogayaku
Yokohama 240-8501, Japan
Email: kawamura@ynu.ac.jp

***Abstract*— Boost converters contain a right half plane (RHP) zero. This RHP has severe limitations on the bandwidth of controllers. Further, this RHP makes it difficult to design fast disturbance rejection approaches, such as disturbance observers (DOB). This paper tackles the problem of designing a DOB based control law of the boost converter. This is done by designing a dual loop feedback controller. The designed controller is called current-minor-loop (CML) control. With CML, it is possible to make a fast response of inductor current to track reference current. Following that, the CML can be reformulated such that the current loop is considered unity. Further, the CML is simplified to make the boost converter minimum phase (MP) system. The formulated control approach is validated by simulations using PSIM software. Then, this method is verified by experiments on a boost converter loaded with resistive load.**

I. Introduction

[6]. System loads and parameters are estimated by algebraic estimation method with nonlinear adaptive control [7]. Faster adaptations on reference trajectory and feedback is done by generalized-proportional-integral control [8]. Boost converter state-plane is transformed into state-energy plane [9] and thereby avoids using the RHP zero in control action. Enumeration-based model predictive control turns boost converter into a discrete hybrid model [10]. State estimation method estimates load current and other uncertainties in the system, and calculates a proper control input to offset them. RHP zero is moved to higher frequencies by time-multiplexing switching [11] control method. This allows the controller enough bandwidth well below the RHP zero. NMP system is turned into minimum-phase (MP) system by complementary proportional-integral-derivative to parallel-damped passivity-