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FUZZY GAIN SCHEDULING OF PI CONTROLLER FOR DISTRIBUTED CONTROL OF PARALLEL AC/DC CONVERTERS

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Abstract. *This paper presents a fuzzy gain scheduling of proportional-integral (FGPI) controller which is used for controlling the output voltage of an AC/DC converter. In the proposed system, the converter is composed of isolated CUK power factor correction circuits those parallel-connected for increasing power capacity. For the flexibility and modularity purpose, each converter module employs an individual microcontroller to control the power converter operation and communicate among other converter modules for load current sharing. The microcontroller in each module communicates to each other via RS485 serial communication bus. To avoid the data collision on the communication bus, a synchronization signal is used to synchronize the time slot of microcontrollers in the system for sending and receiving data. The FGPI controller is used to improve dynamic response of the output voltage loop while an analog hysteresis current controller is used to control the input current of each converter. Three-250 W/module AC/DC converters are designed and built to verify the operation of the proposed system. The experimental results show that the proposed system provides fast response of the output voltage control, and that current sharing of each module is quite good and that a high input power factor is achieved.*
Keywords: Fuzzy gain scheduling of PI controller, Distributed control, Parallel AC/DC converters, Current sharing, Serial communication bus

1. Introduction.

Normally, a parallel-connected AC/DC converters system is used for increasing the output power capacity, in which the load current will be distributed among the converter modules. The controller of the parallel operation of power converter modules may be divided into three categories [1-7]. The first one is a centralized control method; the advantages of this method are: easily adjusting the control signal because it is performed by a single centralized controller, good current sharing and tight output voltage regulation [2,3]. However, it exhibits a drawback such as degraded system on reliability and modularity. Moreover, the case of the controller is malfunction so that the power processing is also fault. Second, the droop method, features of this method are without a communication bus among converters and its individual controller to control the power converter [4,5]. The merits of this method are that the system provides high modularity and reliability. On the contrary, the system performs in a slow transient response, and the current sharing and the tight output voltage are quite poor. Finally, the