State Space based Control as an Alternative to Conventional Loop Design in Power Converters for Microprocessors

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Computers and digital platforms are widespread which makes their power consumption very important. Since most dc/dc power stages for computer or telecom applications are currently optimized as modules by manufacturers, the effort in development moves towards controller implementation. While conventional feedback control design methods in frequency domain (lead-lag, or PI-D) are well mastered in industry, with numerous digital or power IC implementation options, this presentation proposes and demonstrates a major leap forward with the use of State Space based design. This time-domain modern control is usually perceived as an advanced control or research topic due to its inherent mathematical support. The advanced concept can however be scaled down for making it easier for either analog or digital implementation by hands-on engineers. Comparatively to PI(D) or lead-lag approaches, the State Space based design guarantees controllability, and provides an easier optimization within a tool like MATLAB®. It is demonstrated to be physically equivalent with cascaded control set around either peak or average current control. Instead of the conventional loop tuning procedures, the simple Ackerman formula calculates gains instantly. Another unique advantage is also proven for the multi-phase dc/dc converters with phase dropping. An in-depth presentation of the method's actual simplicity, rich in worked examples for either analog or digital implementation, opens this topic to any introductory to intermediate audience.