Master Thesis

Digitally Controlled Switched Mode Power Supply (SMPS) for a Dental X-Ray Tube

Institute for Power Electronics and Control of Drives
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Background

X-Ray tubes are supplied by a DC-voltage in multiples of 10 kV by a switched mode power supply and a consecutive voltage multiplier. In the past, X-ray tubes were predominantly regulated by analog systems, often resulting in inaccurate settings and higher maintenance requirements. Analog systems require manual calibration, which is time consuming and prone to errors. This leads to longer downtimes and reduced efficiency in medical imaging. By implementing the control systems on digital platforms like microcontroller, a more precise regulation and an exact adjustment of radiation parameters is possible. This leads to an overall increase in systems performance as well as efficiency.

Fig. 1 X-Ray machine
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Goal of the Master Thesis

Utilizing simualtions, the goal of this thesis is the design of a digital control system for the dental X-Ray tube. Crucial elements are thereby the control of the anode-potential, provided by a LLC DC/DC converter with subsequent Greinacher-Cascade voltage booster as well as a control for the voltage supply of the Cathode heating.

Tasks

1. Research of relevant Topics.
2. Analysis and Simulation of the given Power-Supply Topology with identification of control plant parameters (including non linearities), its transfer function as well as other critical parameters.
3. Analysis of the present, analog control system.
4. Design of a digitally controlled system based on the analysis results.
5. Comparison of the new digitally controlled system and the analog system.
6. **Optional**: Implentation of the digital control method on a microcontroller and verification using CIL (Controller In the Loop) simulations.

Used Software/Skills: amongst other Plecs, Matlab, LateX, Citavi/Zotero

Outlook: If successful, this work is planned to be continued within a research project, including the option for a dissertation (obtaining the Dr.-Ing.)

Working Language: German, English