Abstract of the Doctoral Thesis: *Analysis and examination of selected methods of pulsed-field magnetization of high-temperature superconductors*

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High-temperature superconducting (HTS) bulks can be used as a source of a strong magnetic field, exceeding that of permanent magnets. One of the techniques to magnetise superconducting bulks is the pulsed-field magnetisation (PFM) method, which utilises short pulses of current generated by flux pumps.

The research presented in the thesis focuses on the influence of the RLC flux pump system with emphasis on the description of current and magnetic field waveforms generated by the flux pump. The extensive literature review suggested minuscule exploration of magnetic field rate-of-change on the trapped magnetic field inside the HTS bulk; instead, most of the conducted research focused on applying stronger fields.

The developed methodology of designing a solenoidal coil for the PFM system is presented to achieve desired features of the flux pump, like a peak of magnetic field and its rate-of-change. A generalised mathematical description relevant for the single and multi-pulse operation of the RLC flux pump was derived. The analysed system has been designed and constructed to verify the influence of magnetic field gradient experimentally over time on the effectiveness of the PFM process for three designed coils. The trapped field inside the bulk cooled with liquid nitrogen was measured on the surface with seven linear-hall sensors in transient and steady states.

Numerical models based on the finite-element method (FEM) were created to verify and expand the results of the measurements. The mathematical description of the flux pump circuit was used to generate the current waveform in the FEM simulations. The numerical simulation provided an insight into otherwise unmeasurable values such as current density distribution within bulk and power losses during pulsed-field magnetisation.

Experimental and numerical results had confirmed that increasing applied field rate-of-change results in higher trapped fields at lower peak values in a consistent manner. As a consequence, the designed PFM system, especially coil, can be smaller and used inside devices such as electrical machines as a source of magnetic field replacing permanent magnets.