Abstract of the Doctoral Thesis: ***Studies of the effect of an external magnetic field on the properties of superconducting tapes***

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This doctoral dissertation focuses on research into the application of superconducting technologies in advanced power systems. Special attention is given to the investigation of the fundamental properties of superconducting materials, particularly first and second-generation superconducting tapes, in external magnetic fields. The implementation of superconducting technologies in electrical devices has significant potential to enhance the operation of modern power systems, including increasing power density, enabling lossless energy transmission over long distances, and reducing short-circuit currents. The adoption of superconducting technologies in everyday use could revolutionize contemporary power systems and transportation. The subject of the research presented in this dissertation is the characterization of the current properties of high-temperature superconducting tapes.

The work considers the impact of the external magnetic field (its amplitude and angle) on the reduction of critical currents, This is a significant limitation that greatly affects the use of superconducting materials in industrial applications. The dissertation follows a typical scientific approach, beginning with the characterization of the fundamental properties of superconducting tapes. Based on measurement data available in the literature, a comparison of the angular characteristics of selected superconducting tapes was then conducted. Subsequently, numerical research results were presented, showcasing an original non-parametric method (MBP) for analyzing the properties of HTS tape models, which allows for the estimation of critical current densities based on measurement data. Measurement systems known from the literature, used for the characterization of superconducting tapes, were compared, and a concept for an original measurement setup was proposed.

The proposed measurement setup was constructed and tested, utilizing 3D printing technology to produce its structural components. The methodology of this work includes literature analysis, meta-analysis of measurement data from other systems, analytical and numerical studies, as well as the design and testing of an original solution for a setup to characterize tapes in a cylindrical structure of permanent magnets arranged in a Halbach array. The results presented in the dissertation pertain to three main areas: the characteristics of superconducting tapes and their current density models, the application of the non-parametric method (MBP), and the design of a test setup used to conduct measurements.