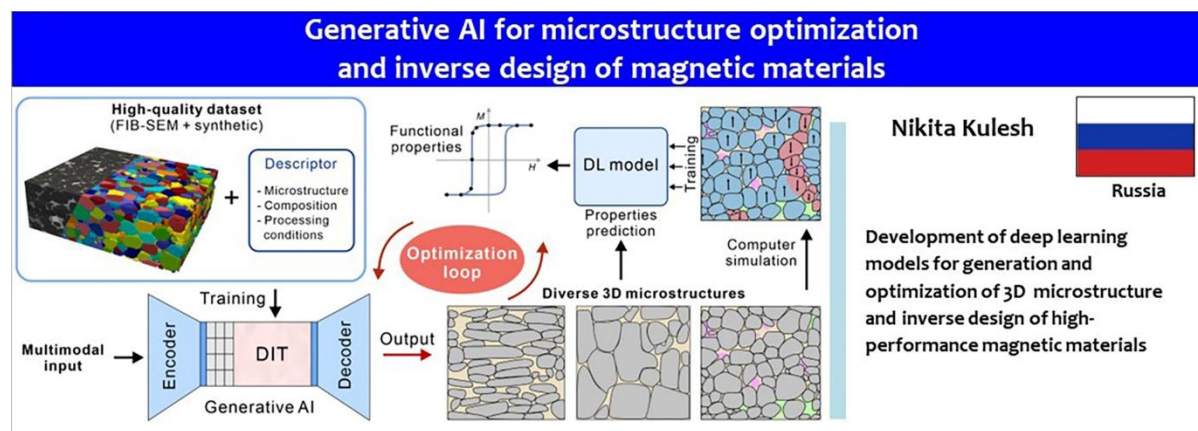


<Research Topics>

Generative AI for microstructure optimization and inverse design of magnetic materials

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■ Research

The goal of my research is to develop an advanced deep learning model for guided generation of realistic microstructures and an optimization pipeline to correlate microstructural features of magnetic materials with physical properties and processing conditions. The project leverages cutting-edge generative AI with transformer architecture to significantly enhance the quality of finite element models and advance towards the inverse material design paradigm. The main motivation of this work is to reduce the cost and development time required for the multi-target optimization of high-performance permanent magnets, which are essential components for various green energy applications, such as wind turbines and electric vehicles. For instance, using a realistic microstructure generator can accelerate the optimization of permanent magnets with high energy product, improved temperature stability, and increased electrical resistivity, all of which are critical for traction motor applications. Although the current focus of my research is on hard magnetic materials, the generative AI model and the optimization pipeline can be easily adapted for other functional or structural materials if suitable training data is available.

■ Comments

I am honored to join the ICYS team at NIMS, where I will have the privilege of working alongside outstanding young researchers. Prior to becoming part of ICYS in August 2024, I was a postdoctoral fellow at NIMS from 12/2021 to 07/2024. During that time, I deeply appreciated the excellent research infrastructure and the highly professional environment. At ICYS, I look forward to expanding my professional network and collaborating closely with my mentors to maximize the research output. I will use this unique opportunity to focus on my research topic, maximize the impact of the work, and accelerate the professional development.

■ Link

<https://www.nims.go.jp/icys/research/#KULESH>