10. Pro²Future Partner Conference

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THE NEXT WAVE OF DISRUPTION IN ENGINEERING

ABSTRACT

In the era of LLMs, one gets notoriously confronted with the question of where we stand with applicability of large-scale deep learning models within scientific or engineering domains. Or slightly differently put, what type of scaling is needed for disrupting verticals besides language and vision. The discussion starts by reiterating recent triumphs in weather and climate modeling, which culminated in the first foundation model for earth systems. Secondly, we discuss challenges and conceptual barriers which need to be overcome for the next wave of disruption in engineering fields. We end with recent breakthroughs in multi-physics modeling, computational fluid dynamics, and related fields.

SHORT BIO

I am leading a group “AI for data-driven simulations” at the Institute for Machine Learning at the Johannes Kepler University (JKU) Linz. Additionally, I am a Co-founder and Chief Scientist at Emmi AI - our push towards the data-driven revolution in science/engineering.

I have obtained my PhD after working several years at the CMS experiment at CERN. During this time, I had the privilege of learning from brilliant minds from all around the world and got the chance to co-author seminal papers in the realm of Higgs boson physics. In 2018, after completing my PhD, my career trajectory shifted towards machine learning, and I was fortunate to join the research group of Mr LSTM Sepp Hochreiter in Linz. Under Sepp’s mentorship, I delved into the intricacies of machine learning and modern deep learning over a span of 2.5 years.

From 2021 to 2023, I had the pleasure of spending three remarkable years in Amsterdam. Initially, I was part of the Amsterdam Machine Learning Lab lead by Max Welling and subsequently joined Microsoft Research for 2 years. During this period, my passion for Geometric Deep Learning, particularly involving Geometric (Clifford) algebras, and my interest in partial differential equations (PDEs), with a particular focus on developing neural surrogates for (PDEs), became profound. Most importantly, I pivoted towards large-scale PDEs, including weather and climate modelling, which culminated in Aurora.

My years in Amsterdam have shaped my research vision. I am firmly convinced that AI is on the cusp of disrupting simulations at industry-scale. Everyday thousands and thousands of compute hours are spent on turbulence modelling, simulations of fluid or air flows, heat transfer in materials, traffic flows, and many more. Many of these processes follow similar underlying patterns, but yet need different and extremely specialized software to simulate. Even worse, for different parameter settings the costly simulations need to be run at full length from scratch.

This is what I want to change! Therefore, I have started a new group at JKU Linz which has strong computer vision, numerical simulation, and engineering components. We want to advance data-driven simulations at industry-scale and place the Austrian industry engine Linz as a centre for doing that.