Contribution ID: **38** Type: **Parallel talk**

Can AI understand Hamiltonian mechanics?

Thursday, 21 August 2025 17:10 (20 minutes)

With recent breakthroughs in deep learning, particularly in areas like natural language processing and image recognition, AI has shown remarkable abilities in understanding complex patterns. This raises a fundamental question: Can AI grasp the core concepts of physics that govern the natural world?
In this talk, as a first step towards addressing this question, we will discuss the possibility of AI understanding Hamiltonian mechanics. We will first introduce the concept of operator learning, a novel technique that allows AI to learn mappings between infinite-dimensional spaces, and its application to Hamiltonian mechanics by reformulating it within this framework. Then, we will test whether AI can derive trajectories in phase space given an arbitrary potential function, without relying on any equations or numerical solvers. We will then showcase our findings, demonstrating AI's capability to predict phase space trajectories under certain constraints. Finally, we will discuss the limitations, future research directions, and the potential for AI to contribute to scientific discovery.

Primary author: KIM, Tae-Geun (Yonsei University)

Co-author: PARK, Seong Chan (Yonsei University)

Presenter: KIM, Tae-Geun (Yonsei University)

Session Classification: Parallel session 7