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Real-time Reinforcement Learning on FPGA with Online Training for Autonomous Accelerators

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Reinforcement Learning (RL) is a promising approach for the autonomous AI-based control of particle accelerators. Real-time requirements for these algorithms can often not be satisfied with conventional hardware platforms.

In this contribution, the unique KINGFISHER platform being developed at KIT will be presented. Based on the novel AMD-Xilinx Versal platform, this system provides cutting-edge general microsecond-latency RL agents, specifically designed to perform online-training in a live environment.

The successful application of this system to dampen horizontal betatron oscillations at the KArlsruhe Research Accelerator (KARA) will be discussed. Additionally, preliminary results of the application of the system to the highly non-linear problem of controlling microbunching instabilities will be presented.

Primary Keyword

reinforcement learning

Secondary Keyword

AI-based controls

Tertiary Keyword

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