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Machine learning-enhanced deterministic controls in lasers and accelerators

Wednesday 13 August 2025 11:00 (30 minutes)

Modern laser and accelerator systems demand fast, precise, and scalable multi-input multi-output (MIMO) feedback control. As requirements extend into high-repetition-rate and nonlinear regimes, traditional strategies increasingly struggle to deliver the necessary speed and adaptability. This talk presents two cases where machine learning (ML) enhances deterministic feedback control. In both, ML models—trained on experimental or simulated data—provide rapid predictions to guide real-time decisions. Integrated into conventional feedback loops, they substantially improve response speed and robustness across diverse operating conditions. At Lawrence Berkeley National Laboratory, ML feedback enabled the first preemptive pointing stabilization at the BELLA Petawatt beamline, achieving a ˜60% reduction in jitter and reduced response time in a coherent beam combining system by nearly an order of magnitude. These results show that ML can increase speed, stability, and adaptability without compromising determinism, opening new opportunities for intelligent control in next-generation facilities.

Please consider my poster for contributed oral presentation

Yes

Would you like to submit this poster in student poster session on Sunday (August 10th)

Yes

Footnotes

Funding Agency

I have read and accept the Privacy Policy Statement

Yes

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