
Contribution ID: **377** Contribution code: **WEYN02** Type: **Invited Oral Presentation**

# Safe extremum seeking for real-time adaptive accelerator control

*Wednesday 13 August 2025 11:30 (30 minutes)*

This talk presents Safe Extremum Seeking (Safe ES), a robust n-dimensional adaptive control method, applied to automatic tuning and optimization tasks of accelerators while guaranteeing that the system remains within safe operating conditions. A key strength of Safe ES is its ability to handle safety measures that are analytically unknown. For instance, the algorithm can adaptively tune quadrupole magnets to achieve a desired beam profile while maintaining safety by keeping beam losses below a user-defined threshold.

The presentation provides a comprehensive technical overview of this optimization technique, highlighting its theoretical foundations and practical applications. It includes simulation studies demonstrating its effectiveness for accelerator systems, as well as results from an in-hardware demonstration conducted on the LANSCE accelerator at LANL. Also, the talk explores how Safe ES can be integrated with generative machine learning models to enable adaptive machine learning.

## Please consider my poster for contributed oral presentation

Yes

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

No

## Footnotes

## Funding Agency

## I have read and accept the Privacy Policy Statement

Yes

**Authors:** WILLIAMS, Alan (Los Alamos National Laboratory); SCHEINKER, Alexander (Los Alamos National Laboratory)

**Presenter:** WILLIAMS, Alan (Los Alamos National Laboratory)

**Session Classification:** Beam Instrumentation, Controls, AI/ML, and Operational Aspects (Invited)

**Track Classification:** MC6 - Beam Instrumentation, Controls, AI/ML, and Operational Aspects