d-scan in Action

Hands-on Ultrafast Pulse Characterization

Introduction

Ultrashort laser pulses are defined not only by their spectrum, but also by their spectral phase. In few-cycle and broadband systems, small amounts of residual dispersion can significantly change the pulse duration, peak power, and experimental performance.

The dispersion-scan technique offers an intuitive way to connect what is seen in the lab - a two-dimensional trace - with the complete temporal profile of the pulse. It turns pulse characterization into a practical measurement that can guide alignment, compression, and troubleshooting.

This hands-on course is designed to move from the physical concept to real laboratory use. Participants will see how a d-scan measurement is prepared, acquired, retrieved, and interpreted, and how the results can be used to improve the performance of an ultrafast laser system.

Course objectives

- Understand what information is contained in a d-scan trace.
- Learn the practical steps required to acquire a clean and reliable measurement.
- Retrieve the temporal intensity and spectral phase from experimental data.
- Use the result to support pulse compression, system optimization, and troubleshooting.

Who should attend

This course is intended for scientists, engineers, students, and application specialists working with ultrafast lasers, OPAs, hollow-core fibers, multipass cells, or pulse compressors. A basic knowledge of ultrafast laser systems is useful, but the course will focus on practical use and interpretation.

Course format

The session combines a short technical introduction, a live laboratory demonstration, guided software use, and open discussion around typical experimental challenges. The emphasis is on what to look for during the measurement and how to make decisions from the retrieved pulse.

What will happen during the hands-on course

Participants will follow the complete measurement workflow, from the first experimental checks to the interpretation of the retrieved pulse. The course is structured to make the d-scan trace meaningful, not just as an image, but as a diagnostic tool for improving ultrafast systems.

#	Step	Focus
1	**Motivation and context**	Why temporal characterization matters; how residual dispersion affects pulse duration, peak power, and experimental results.
2	**Reading a d-scan trace**	How dispersion, nonlinear signal generation, and spectral information appear in the two-dimensional measurement.
3	**Experimental preparation**	Beam preparation, coupling strategy, signal level, spectrometer settings, background correction, and basic safety checks.
4	**Trace acquisition**	Choosing scan parameters, checking trace quality, avoiding saturation, and evaluating repeatability
5	**Pulse retrieval**	Running the retrieval, validating the result, and extracting pulse duration, temporal profile and spectral phase.
6	**Compression and optimization**	Using the retrieved phase and software tool to simulate wedges, chirped mirrors, compressors, or target material dispersion towards pulse optimization.
7	**Troubleshooting and discussion**	Identifying noisy traces, limited bandwidth, spatial chirp, alignment problems, and measurement conditions that affect reliability.

Expected outcomes

By the end of the course, participants should be able to follow a practical checklist for d-scan measurements, recognize whether a trace is suitable for retrieval, interpret the main pulse parameters, and identify the next experimental steps needed to improve compression or measurement quality.

Recommended preparation

For the discussion, participants are encouraged to bring basic information about their laser system, such as central wavelength, bandwidth, repetition rate, pulse energy or average power, and compressor configuration. Example traces or questions from the lab are also welcome.

Main message: the course connects the measurement trace to the real pulse, so participants can use d-scan as a practical tool for ultrafast laser optimization.