



Livermore Software Technology Corp.

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Optimization and Probabilistic Design Using LS-OPT[®]

Instructor: Dr. Anirban Basudhar

3-1/2 Days - \$750 Students \$375 w/student ID

Includes on-site continental breakfasts, lunches, breaks, Welcome Dinner (first night of class)

Includes 30-day LS-DYNA demo license to practice

Description: This course provides an introduction to the use of the optimization code LS-OPT for optimal design and probabilistic analysis. It covers both theoretical concepts and practical aspects of design optimization and probabilistic analysis. An emphasis is placed on interfacing with LS-DYNA. Advanced topics such as multi-objective and collaborative optimization and optimization under uncertainties are also covered. The course includes workshop sessions in which the theoretical topics of the day are applied. The LS-OPT Version 5.1 graphical user interface is used to teach input preparation and post-processing.

Over the duration of the class, students work individually (sometimes in groups of two) to solve the exercises. The exercises are simple, so that they take a short time to run, but contain enough complexity to give insight into the optimization process. Most of the problems are nonlinear (large deformation) dynamic and will be solved using LS-DYNA simulation.

DAY 1

- Course outline
- Introduction to Design optimization using industrial examples
- LS-OPT features
- Optimization Theory:
 - Optimization fundamentals
 - Response Surface Methodology
 - Experimental Design
 - Metamodeling
 - Design model adequacy checking
 - Optimization strategies
 - Sensitivity analysis and variable screening
 - Optimization examples
- Running LS-OPT and using the post-processor
 - Studying the different LS-OPT components using the GUI setup of a simple optimization example and running the example
 - Post-processing using the viewer, e.g. simulation and approximation results, optimization history etc.

Day 1 - continued

- Simple optimization with LS-DYNA stage
 - Setting up a simple optimization with LS-DYNA stage from start
 - Resource allocation
 - Sampling, metamodeling and stage options
 - LS-DYNA interface features, e.g. ASCII database, binary database, filtering, time history functions, injury criteria
 - Composite functions
 - Simple design optimization formulation
 - Program execution
 - Job monitoring
 - Database and output
 - Post-processing using the viewer

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DAY 2

- Simple optimization setup and post-processing
 - Continue post-processing using the viewer if not completed
 - Restarting the simple optimization with additional constraint
- Setting up and running a sequential optimization
- Discrete optimization
- Optimization with user defined stage/solver
- Importing analysis results table
- Direct Optimization
- Theory
 - Parameter Identification using curve matching
 - Multidisciplinary Optimization (MDO)
 - Mode tracking
- Setting up, running and post-processing material parameter identification examples
- Variable screening and MDO with reduced variables

DAY 3

- Advanced optimization theory
 - Multi-objective Optimization (MOO)
 - Multi-level Optimization (optional)
- Setting up and running MOO example - construct Pareto Front
- Post-processing MOO problems
 - Trade-off Plot
 - Parallel Coordinate Plot (PCP)
 - Self-Organizing Maps (SOM)
 - Hyper Radial Visualization (HRV)
- Probabilistic Analysis and Optimization Theory
 - Statistics fundamentals
 - Probabilistic analysis methods
 - Reliability-based design optimization (RBDO)
- Direct Monte Carlo Analysis
 - Noise Variables
 - Statistical distribution
 - Latin Hypercube Sampling
 - Failure probability calculation
 - Statistical post-processing tools
 - DYNASStats
- Metamodel-based Monte Carlo Analysis
 - Reliability calculation with noise variables and control variables
 - Statistical post-processing tools
 - Stochastic contribution
 - DYNASStats

DAY 4 (half day, instruction ends at noon)

- Reliability-based design optimization
 - Optimization of Control Variables
 - Target probability of failure
- Robust design
 - Noise and Control variables
 - Standard deviation composite
 - Minimize effect of noise variables
- Stochastic Fields
- Outlier Analysis
- Metal Forming
- Tolerance Optimization (optional)