Livermore Software Technology Corp.
Locations:
7374 Las Positas Rd, Livermore, CA 94551
1740 West Big Beaver Rd, Troy, MI 48084
Contact: classes@lstc.com www.lstc.com/training

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
  - DYNAStats
- Metamodel-based Monte Carlo Analysis
  - Reliabilibility calculation with noise variables and control variables
  - Statistical post-processing tools
  - Stochastic contribution
  - DYNAStats

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)