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Advanced LS-OPT: Deterministic & Probabilistic Optimization

Instructor: **Dr. Anirban Basudhar**

3 Day - $600, Students $300 w/student ID
Includes on-site continental breakfast, lunch, breaks, class notes, class dinner
Includes 30-day demonstration license

Prerequisite:
Required:
Basic knowledge about metamodel-based optimization and result analysis using LS-OPT.
Strongly Recommended:
"Introduction to LS-OPT" class to build a foundation for some of the advanced topics.
Recommended not required:
An introductory class in LS-DYNA for familiarity with a few keywords.

Objective: This 3 day course provides a deeper insight into the optimization and probabilistic analysis capabilities of LS-OPT. It covers both theoretical and practical aspects of design. An emphasis is placed on interfacing with LS-DYNA. Advanced topics such as multiobjective and collaborative optimization, digital image correlation, statistical classification and probabilistic optimization are covered. The course includes workshop sessions in which the theoretical topics of the day are applied. The LS-OPT Version 6.0 graphical user interface is used to teach input preparation and post-processing.

Description: This course is intended to enable attendees with basic knowledge of LS-DYNA and LS-OPT to become proficient in advanced optimization and probabilistic design methods. The goal is to enable higher productivity in design and parameter identification of complex systems, e.g. multidisciplinary systems with competing objectives, advanced material testing and models, systems with discontinuous responses etc. The course also provides an insight into reliability and robustness in order to facilitate higher quality product design.

Contents:

Day 1

- Course outline
- Introduction to Design optimization & LS-OPT basic features summary
- Theory: Parameter Identification
  - Noisy data: Filtering Computed Curves
  - Dynamic Time Warping (DTW)
  - Digital Image Correlation (DIC)

- Examples: Set up, run and post-process parameter identification examples
  - GISSMO failure model example
  - Defining multi-point histories for spatial data
  - Full field calibration using DIC data
- Theory: Collaborative Optimization
  - Multidisciplinary Optimization (MDO)
  - Multilevel Optimization
- Examples: Set up, run and post-process collaborative optimization examples
  - Mode tracking
  - Variable screening
  - MDO using a reduced set of variables
  - Multilevel Optimization
- Theory: Classification-based constraint handling
  - Discontinuous and binary responses
  - Classification-based constraint boundary definition
  - Support Vector Machine Classification (SVC)
- Example: Optimization with discontinuous constraint response
  - Defining a classifier
  - Optimization using a constraint defined by an SVC classifier

Day 2

- Theory: Multiobjective Optimization (MOO)
  - Pareto front definition and MOO algorithm
  - Analyzing the Pareto front using the Viewer
- Example: Setting up, running and post-processing MOO example
  - Create Pareto Optimal front
  - Trade-off Plot, Parallel Coordinate Plot (PCP), Self Organizing Maps (SOM), Hyper Radial Vizualization (HRV)
- Theory: Probabilistic analysis
  - Statistics fundamentals
  - Probabilistic analysis methods
- Example: Direct Monte Carlo Analysis
  - Uncertainty quantification using noise variables and statistical distributions
  - Latin Hypercube Sampling
  - Failure probability calculation
  - Statistical post-processing tools
  - DYNAStats
- Example: Metamodel-based Monte Carlo Analysis
  - Reliabilibility calculation with noise variables and control variables
  - Statistical post-processing tools
  - Stochastic contribution
  - DYNAStats
- Theory: Probabilistic optimization
  - Reliability-based design optimization (RBDO)
  - Robust design

Day 3

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