



**Locations:**

Livermore Software Technology Corp.

7374 Las Positas Rd. Livermore, CA 94551

1740 West Big Beaver Road Troy, MI 48084

Contact: [classes@lstc.com](mailto:classes@lstc.com)

[www.lstc.com/training](http://www.lstc.com/training)

## **NVH, Fatigue & Frequency Domain Analysis**

**Instructor: Yun Huang, LSTC**

**2 Day - \$400, Students \$200 w/student ID**

Includes on-site continental breakfasts, lunches, breaks, class notes, class dinner

Includes 30-day demonstration license

**Objective:** This course is recommended for attendees who want to run NVH or other frequency domain vibration, fatigue and acoustic simulation problems with LS-DYNA. This course is useful for working in the area of vehicle NVH, aircraft / spacecraft vibro-acoustics, engine noise simulation, machine vibration testing and simulation, etc.

The three-day training course is to introduce the frequency domain vibration, fatigue and acoustic features of LS-DYNA to users, and give a detailed look at the application of these features in vehicle NVH simulation and durability analysis.

### **Course contents**

- Introduction
  - NVH Theory and lab testing technology
  - Overview of LS-DYNA frequency domain features and applications
  - Frequency domain analysis vs. Time domain analysis
  - Fourier transform
- FRF
  - Modal superposition method
  - Damping (viscous damping, structural damping)
  - Nodal force / Resultant force FRF
- SSD
  - Large mass method
  - ERP (Equivalent Radiated Power)
  - Mode expansion with LS-PrePost
  - Mode contribution fraction plot
  - Direct SSD
- Random vibration with PSD loading
  - Correlated and uncorrelated multiple excitations
  - Acoustic waves
  - Pre-stress condition

- Acoustics
  - BEM, FEM
  - Vibro-acoustics
  - Incident waves
  - Acoustic panel / element contribution analysis
  - ATV and MATV
  - Frequency weighted SPL (dB)
  - Radiated sound power, radiation efficiency
  - Acoustic eigenvalue analysis
- Response spectrum analysis
  - Input earthquake spectrum
  - Modal combination methods (SRSS, CQC, etc.)
  - Multi input spectra
  - DDAM
- Fatigue
  - Fatigue theories
  - Fatigue analysis in harmonic / random vibration environment
  - Miner's rule
  - Dirlik Method
  - Time domain fatigue (based on stress / strain)
  - Multiaxial fatigue
  - Mean stress correction
- Advanced topics
  - SEA (Statistical Energy Analysis)
  - Brake Squeal Analysis
  - NVH analysis based on IGA
- Auto NVH examples
  - FRF on BIW
  - Noise Transfer Functions (NTF)
  - Vehicle interior noise
  - Muffler Transmission Loss Analysis
- Workshop
  - Hands-on exercise
  - Post-processing of binary and ASCII databases (d3ssd, d3acs, d3ftg, nodout\_ssd, elout\_ssd, etc.)