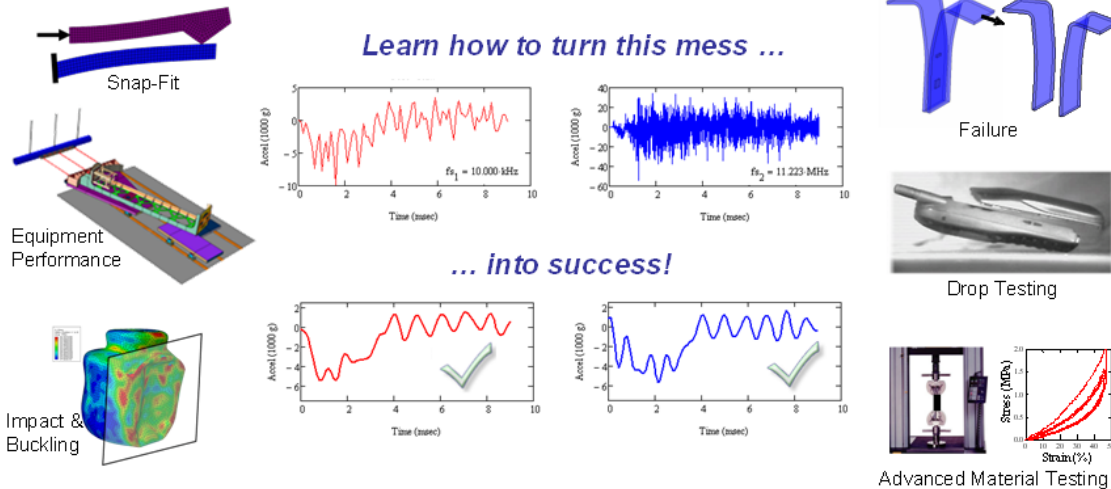


Analyzing Noisy Data via Filtering and DSP

3 or 4 Day Training Seminar

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Course Description

Have you struggled with noisy data from either implicit or explicit FEA simulations and/or experiments?
Not sure what filtering, FFT, and other DSP tools are really doing to your data?

This 3 or 4 day seminar teaches the basics of working with noisy and transient data - from both experiments and simulations. This seminar is taught in the language of Mechanical Engineering. It provides a fundamental understanding of DSP theory and its application to the field of nonlinear structural mechanics with many relevant examples and workshops using data from explicit dynamics FEA and experimental measurements.

Benefits

- Learn how to collect data to avoid aliasing, how to interpret its frequency content with DFS, FFT, and PSD analysis, and then how to filter it with confidence to remove high frequency noise or low frequency drifting.
- Improve accuracy, efficiency, and usefulness of explicit dynamics simulations (LS-Dyna, Abaqus, others) including impact, shock, buckling, failure, penetration, sliding contact, & quasi-static analyses.
- Robustly turn experimentally measured material data that is “messy” or noisy into accurate and useful material data to create advanced material laws.
- Obtain better correlations between physical experiments and FEA simulations. Learn:
 - Sources that cause distortions in experimental measurements and simulations and then how to potentially remove them.
 - How to make appropriate comparisons between simulations and experiments.
 - How to get BOTH the experimentalist and simulation user on the same page!
- Seminar specifically developed for users of nonlinear explicit dynamics FEA and those performing challenging experimental measurements that create noisy data.
- Workshop data provided in ASCII files. Attendees can perform workshops using Kornucopia®, Abaqus/Viewer, and/or their own DSP software such as MATLAB or whatever they prefer.

"Your DSP course taught techniques that helped me create a standardized approach for processing noisy Explicit Dynamics simulations. This has improved my analysis and helped me deliver more useful FEA results on recent projects - your course is the best I have taken in a long time."

Michael J. Iacchei, Mechanical Engineer, U.S. Army, AMSAA

Who Should Attend

Engineers, scientists, and technicians working with any of the following:

- Assessment of shock, impact, blast, failure, penetration, buckling, contact, or other noisy events.
- Simulations ranging from highly transient to vibratory to noisy quasi-static, especially those from explicit dynamics codes (LS-Dyna, Abaqus, and others).
- Experimentally measured data of frequency rich, noisy events or messy/challenging data.
- Noisy or messy measurement data that needs to be converted into material models or other uses.

Prerequisites: None, although exposure to noisy data from either experimental work or FEA simulations is beneficial.

Learning Objectives

After successfully completing this course an attendee should be able to:

- Avoid aliasing output data from simulations and experiments. Properly decimate data to reduce data file size.
- Understand and appropriately apply Fourier analysis (DFS, FFT, PSD) to understand frequency content.
- Understand differences and similarities between various filtering approaches (IIR, FIR, lowpass, highpass...), key filtering parameters (sampling rate, cutoff frequency, filter order...), and filtering implementation (single pass, bi-directional, end-effect minimization).
- Appropriately apply filtering to remove noise or drifting in signals.
- Accurately evaluate accelerations and reaction forces, as well as velocities, displacements, stress, & strain.
- Identify several causes of distortions in simulation and experimental data.
- Question and challenge data from others that might be distorted due to DSP-related issues.
- Apply various strategies to utilize DSP for improving interpretations of simulations and experimental data
 - Recognize that there are significant differences in results from various DSP software
 - Learn strategies to confirm what your DSP software is and is not doing to your data

Course Content

Lectures

1. Motivation for Using DSP with Simulations and Experiments
2. DSP Fundamentals
3. DSP Using Various Software
4. Developing a DSP Strategy for a Given Problem
5. Using Energy to Enhance Analysis
6. Working with Experimental Data and Validating Simulations/Experiments
7. Working with Transient-Dynamic Models
8. Working with Quasi-Static Models from Explicit FEA
9. Improving the Modeling of Failure
10. Creating Viable FEA Material Data from Noisy and Challenging Material Measurement Data
11. Summary of Best Practices

Workshops

1. Experiencing Common DSP-related Mistakes
2. Learning DSP Using Simple Signals
3. Transient Impact of a Structure
4. Transient Penetration - Comparing Models and an Experiment
5. Salvaging Shock Data via Highpass Filtering
6. Quasi-Static Cam Mechanism
7. Analyzing Failure and Crack Propagation
8. Computing Derivatives and Integrals From Noisy Data
9. Creating Elastic/Plastic Material Law From Slightly Noisy Experimental Data
10. Cleaning Problematic Hysteresis Data