Simulation for Kinematic and Dynamic Behavior

Manufacturers are pressured to deliver more complex products with increased quality in shorter development cycles. Engineering the performance of mechanical designs with traditional test-based development processes is no longer an option. The only valid alternative is evaluating functional performance attributes on a virtual prototype. The simulation of mechanical or mechatronic systems enables engineers to effectively analyze and optimize real-life performance, long before physical testing.

For engineers, the challenge is to guarantee that the dynamic performance of their mechanical systems matches the specifications. They need to make sure that numerous components interact and move as planned under real-life conditions, such as gravity and frictional forces. Virtual prototyping has to deliver the right answers on time and with the required accuracy to positively impact the development process.

- First, the basics of how to quickly assemble analyze and optimize the real world behavior of dynamic mechanical systems on your desktop. You will learn how to define parameterized mechanical system models for more advanced design studies and how to perform a durability analysis.

- Next, participants will learn the basics of Fatigue Life Prediction methods (Stress-Life and Strain-Life Approach) and Numerical Life Prediction based on FEM Results.

- Lastly, participants will be shown how to run the model and interpret output results on LMS software products. A thorough understanding of what these results mean and how to use them to improve the product design will be discussed.
Course Syllabus

I  IDENTIFYING INFORMATION

Course: Simulation of Mechanical or Mechatronic Systems for Kinematic and Dynamic Behavior and Fatigue Life
Prerequisite: Durability Fundamentals
Road Load Data Acquisition Processing
Time Frame: 40 total contact hours
Instructor: A technical specialist with LMS International
BS in Mechanical Engineering
5 years of experience with LMS software
5 years of applicable industrial experience
Phone: (248) 952-5664
E-mail: caesupport.us@lmsintl.com

II  REFERENCE MATERIALS

1. LMS software usage documentation

III COURSE GOALS AND OBJECTIVES

1. Introduce the concepts behind mechanical or mechatronic simulation
2. Understand the necessary pre-processing steps
3. Assess the real-life behavior of complex mechanical systems
4. Generate accurate loads for structural analysis, durability and noise and vibration studies
5. Analyze and optimize real-life performance of mechanical systems before prototype testing
6. Perform a durability analysis and predict fatigue life
IV METHODOLOGY

This course will demonstrate how to simulate realistic motion and mechanical system loads and how use that information in a fatigue life prediction. Each module will introduce new material that the student will be allowed to experience for himself with the associate In-class Tutorials.

Lectures

Each detailed subject will be presented in a lecture format outlining the theory and standardized accepted methodology. A printed copy of the lecture material will be provided for the student’s personal in-class use and as a reference material.

Specific Industry Examples

Real life examples will be covered that explain the application of the theory to various industries such as automotive, aerospace, home appliance. This will give the students a clear understanding of how and why these techniques are utilized in different industries and the value they add to noise and vibration enhancement.

In-Class Assignments

The student will conduct several hands-on tutorials to reinforce the theoretical concepts. These tutorials will increase in complexity as the students further develop their skills.
V COURSE OUTLINE & ASSIGNMENTS

Module 1 – An Introduction to the software interface
  Introduction to the Interface
  Adding a Part to a Part Document
  Compass Introduction / Moving Parts in the Product Document
  In-class Tutorial – Interface Lab
  In-class Tutorial – Adding a Part
  In-class Tutorial – Creating and Moving Parts

Module 2 – Introduction Mechanism Modeling
  Introduction to the Mechanism Model
  Assigning Bodies to a Part
  Manipulation using the Compass
  Mechanism Modeling
  In-class Tutorial – Assigning Bodies to a Part
  In-class Tutorial – Camero Lab
  In-class Tutorial – Manipulating Objects Using the Compass
  In-class Tutorial – Slider Model

Module 3 – Basic Geometry Creation
  Basic Geometry Creation
  In-class Tutorial – Creating Simple Geometry
  In-class Tutorial – Importing CAD Geometry
  In-class Tutorial – Creating Bodies and Associating Geometry

Module 4 – Joint and Force Creation
  Joint Creation
  Force Creation
  In-class Tutorial – Creating Joins and Constraints
  In-class Tutorial – Creating Forces

Module 5 – Analysis of Results
  Analysis of Results
  In-class Tutorial – Analysis of Results
Module 6 – Introduction to Flexible Bodies
   Introduction & Examples of Flexible Bodies
   Modal Synthesis Overview
   Types and Sets of Modes
   Overview of Driving MSC/NASTRAN
   In-class Tutorial – Flexible Body Analysis

Module 7 – Basics of Fatigue Life Prediction
   Basics of Fatigue Life Prediction
   Stress-Life Approach
   Strain-Life Approach
   Numerical Life Prediction based on FEM Results
   Component Fatigue
   System-Level Fatigue
   In-class Tutorial – Run Durability Analysis and Display Results
   In-class Tutorial – Post Processing Durability Results
   In-class Tutorial – Linear Superposition
   In-class Tutorial – Set up a Durability Analysis from scratch
   In-class Tutorial – Grouping In-class Tutorial – Combine Events
   In-class Tutorial – Creating Unit Load Cases
   In-class Tutorial – System Level Fatigue
   In-class Tutorial – Flexible Body System Level Fatigue