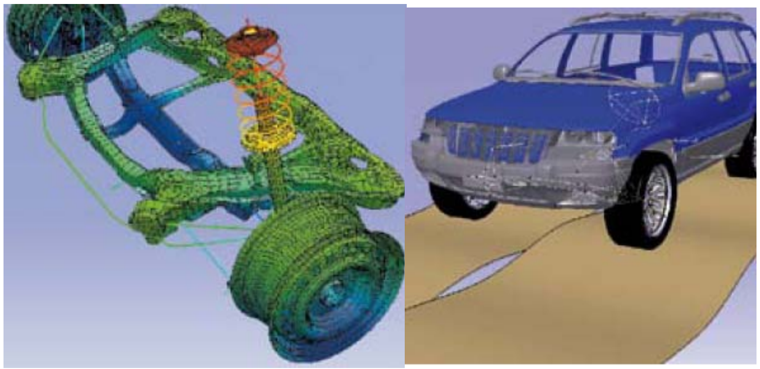
THE CENTER FOR PROFESSIONAL STUDIES



# 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