Types of Computer Simulation

COMPUTER SIMULATIONS include basically everything that mimics or represents real situations. Our world is becoming increasingly reliant on digital information. As this continues, we will rely more heavily on computer simulations to test and display every imaginable aspect of real life, from video games and movies to advanced manufacturing applications and production models. They allow us to study, analyze, and observe possible design solutions.

Objectives:

1. Describe computer simulation.
2. Define types of computer simulation.

Key Terms:

computer model
computer simulation
dynamic system
geometric simulation
mathematical simulation
model analysis
model design
model execution
physical simulation
static system

Understanding Computer Simulation

A **computer simulation** is an example that shows how a system or model will work based on data and constraints. It involves the act of creating a model in the computer, which can range from an actual 3D physical model to a theoretical model that displays how a system works or its result.

COMPUTER MODEL

Although the terms "computer simulation" and "model" are often used interchangeably, there is a slight technical difference. A **computer model** is a virtual representation of a designed object, system, or concept. The model can be abstract, or it may be an accurate physical representation of a design. A computer model is in a virtual environment used to study a system or form. It may include numeric data or physical geometries. The simulation is the process of running, animating, or rendering the model to see the results.

ALTERING VARIABLES

Computer simulation is used to study and learn how objects and systems work. It can simulate a real world environment. In addition, computer simulation can force and display how interactions affect other system or design parts. It can create an environment that allows people to alter variables and adjust designs for varying results. It is, essentially, an artificial world where scenarios are established to study outcomes. A computer simulation can be used to display dynamic and static systems.

Dynamic System

A **dynamic system** is a system that is subject to change through different variables.

Static System

A **static system** is a system that is not subject to change; there are no adjustable variables. The design parameters and data are fixed, and they lead to one final model or result.

FIGURE 1. Video games are a common use of computer simulations. Advanced simulations allow for interactive dynamic environments.

INTERDISCIPLINARY

Computer simulation, which is basically a computer model that gives people different results, is used across all disciplines, including chemistry, economics, physics, architecture, and engineering. It shows how something will look or physically change as well as how a production strategy will work and if it will create a profit.

FURTHER EXPLORATION...

ONLINE CONNECTION:
Computer Simulation of Engineering Structural Study

Computer simulation has become more useful and popular in the past five years. Modern technology allows for a whole series of forces and factors to be numerically input into design software that will graphically simulate the result.

To view a structural computer simulation, visit the following Web site:

http://www.scivee.tv/node/4333

Types of Computer Simulation

Computer simulation types vary greatly. In general, computer simulation falls into one of two categories: a 3D formal (physical) simulation or a mathematical simulation. Within these groups, dynamic and static types of computer simulation exist.

PHYSICAL OR GEOMETRIC SIMULATION

A **physical simulation** (**geometric simulation**) is a visual display of the geometry and physical properties of an object. This type of simulation is used in architecture, physical sciences, health care, motion pictures, and video games. A common type is a 3D formal model, which is concerned with creating a virtual reality or physical world. Essentially, a physical simulation relies on geometries with different properties. A 3D physical simulation relies on mathematical simulations written into the software to create the geometries.

Traditionally, a 3D model was static. However, modern software allows a 3D physical model to become dynamic through external changes or user input (e.g., in video games and movies). Physical simulation is used in engineering and architecture to develop designs that are responsive to environmental changes.

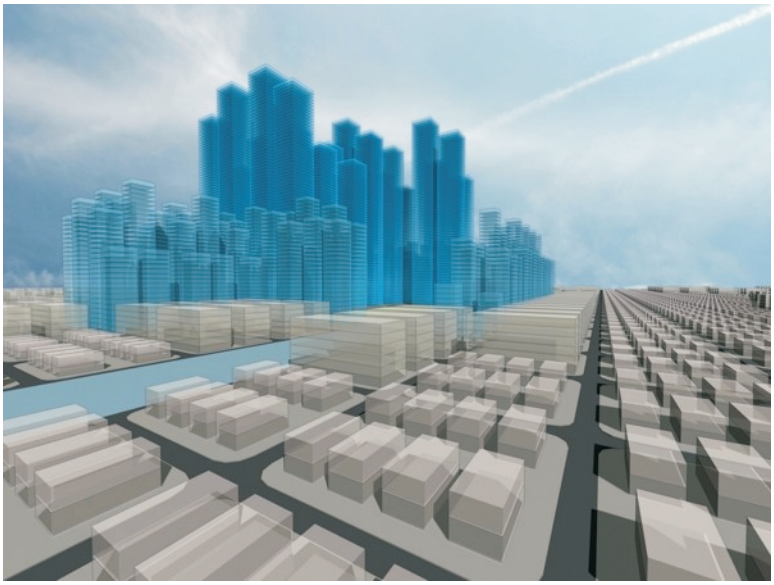

FIGURE 2. Computer simulations can be programmed to display almost anything, including geometric forms and abstract data, as seen in this image.

MATHEMATICAL SIMULATION

A **mathematical simulation** is a display of a sample of outcomes through different situations or a sequence of events. This type of simulation is commonly used in psychology, physics, economics, biology, and chemistry. In general, this model type is non-visual. However, more advanced modern software, using parametric data, can translate a mathematical simulation into a 3D form.

SERIES OF SIMULATIONS

Most software today relies on a series of computer simulations to work, including 3D CAD software. More advanced software will utilize a series of dynamic simulations that allow for interactive design. Many professions use a combination of computer simulation types (e.g., manufacturing and engineering).

THREE STAGES

Computer simulation can be divided into three stages: model design, model execution, and model analysis. The specific development and execution of these stages depend on the final application.

Model Design

Model design is the initial stage of a computer simulation in which the model—a 3D physical model or an abstract system—is organized and constructed. The design may be a simple 3D physical form to study a product design or a complex series of mathematical equations (algorithms), allowing data and variables to be input and adjusted. A model that uses direct mathematical equations and variables would be used in simulating economic strategies or in biological studies.

A wide range of knowledge may be required in professions that use computer simulations. For example, an employee may need knowledge of computer software to create geometries and must know how to write mathematical equations that allow the software to simulate systems. A more complex and very specific model will require software to be written for it. In this case, people across disciplines work together to design the simulation model.

Model Execution

Model execution is the point at which the simulation is run; the process or activity that the model represents is executed. The software and/or mathematical formulas calculate the data and give a result. The result can be executed into a 3D physical model or can be given in statistical data (e.g., numbers). Depending on the complexity of the simulation, this process can take a few seconds or many days. In some cases (e.g., high-end 3D movies, which are a

combination of real images and computer-generated images), the sequences can take thousands of hours. A basic computer simulation can be written in common software (e.g., Microsoft Excel). Microsoft Excel is used for basic spreadsheets. A series of variables (e.g., product costs, materials, production, delivery, overhead, and personnel) can be input and a final cost seen.

Model Analysis

Model analysis is the process of studying the results of the simulation. The data or the results are used for various purposes, depending on the type of simulation or model. An economic model can be studied to see how various approaches may produce different profits. In contrast, an engineering model could be used to study how different structure systems will give proper support.

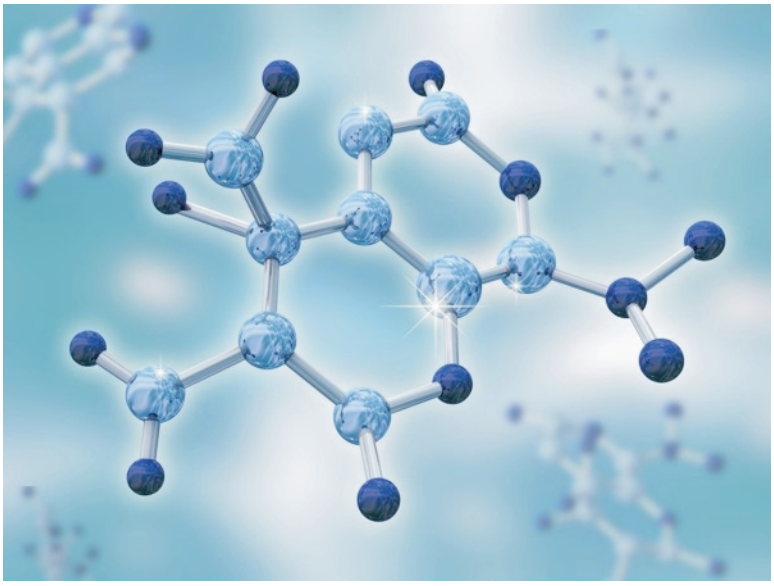

FIGURE 3. Computer simulations are valuable for studying intangible systems and those very small in size, as in this simulation.

Summary:

A computer simulation shows how a system or model will work based on data and constraints. It involves the act of creating a model in the computer. It can range from an actual 3D physical model to a theoretical model. Computer simulations typically include numeric data or physical geometries. They are used to study and learn how objects and systems work. Simulations rely on how the model is created and then simulated through three basic stages: model design, model execution, and model analysis.

Types of computer simulation vary. In general, they are grouped into 3D formal (or physical) simulation or mathematical simulation. They can be used to display dynamic and static systems and models.

Checking Your Knowledge:

1. What is a virtual representation of a designed object, system, or concept?
2. How do model design, model execution, and model analysis compare?
3. What type of simulation system allows variables to change?
4. For what fields are mathematical simulations commonly used?
5. List two fields in which a dynamic computer simulation would be used.

Expanding Your Knowledge:

Computer simulations are used in almost all fields and professions. Plan a trip to a local production company or business to discuss how they use computer simulations. There are also many books in the library on the broad range of computer simulation types, so you can research how computer simulations are used.

Web Links:

Simulation Example
http://www.cise.ufl.edu/~fishwick/introsim/node3.html

Computer Technologies
http://www.learningcity.org/computer_technologies.html

Types of Computer Simulations
http://www.experiencefestival.com/computer_simulation_-_types_of_computer_simulation