A summary of basic simulation concepts

•Simulation is the process of creating a model of an existing or proposed system in order to identify and understand the factors that control the existing system, or to predict the future behavior of the system.

- In a static simulation, the system model does not change with time.
- In a dynamic simulation, the system model changes and evolves with time.
- Deterministic simulation require certain (fixed) input values.
- Probabilistic simulation represents uncertainty and randomness by specifying some inputs as probability distributions or random events.
- Simulation is a powerful and important tool because it provides a way in which alternative designs, plans and/or policies can be evaluated without having to experiment on a real system.

Simulation tools

- It is mostly a program/ software that allow the user to observe an operation through **simulation** without actually performing that operation.

- **Simulation** software is used widely to design equipment so that the final product will be as close to design specs as possible without expensive in process modification.

Applications of simulation

Some of the application areas of simulation are

- Logistics simulation. Optimize complex and dynamic logistics processes with simulation.
- Simulation in production planning.
- Planning of machine scheduling.
- Supply Chain simulation.
- Construction Engineering and project management
- Military application
- Transportation and assignment models
- Analysis of air pollutant dispersion using atmospheric dispersion modeling
- Design of complex systems such as aircraft systems.
- Flight simulators to train pilots
- Drive simulators to train drivers
- Weather forecasting
- Forecasting of prices on financial markets (for example Adaptive Modeler)
- Modeling car crashes to test safety mechanisms in new vehicle models.

SIMULATION OPTIMIZATION:

- Simulation optimization can be defined as the process of finding the best input variable values from among all possibilities.
- The objective of simulation optimization is to minimize the resources spent while maximizing the information obtained in a simulation experiment.
- When the mathematical model of a system is studied using simulation, it is called a *simulation model*. System behavior at specific values of input variables is evaluated by *running* the simulation model for a fixed period of time.
- A *simulation experiment* can be defined as a test or a series of tests in which meaningful changes are made to the input variables of a simulation model so that we may observe and identify the reasons for changes in the output variable(s).

A general simulation model comprises n input variables $(x_1, x_2, \ldots, x_n)$ and m output variables $(f_1(x), f_2(x), \ldots, f_m(x))$ or $(y_1, y_2, \ldots, y_m)$ (Figure 1). Simulation optimization entails finding optimal settings

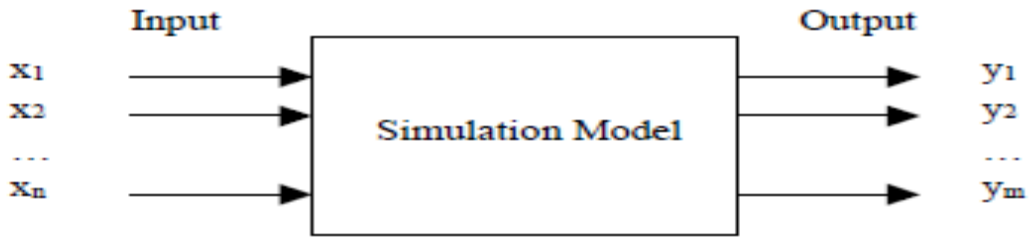

Figure 1: A Simulation Model

of the input variables, i.e. values of $x_1, x_2, \ldots, x_n$, which optimize the output variable(s). Such problems arise frequently in engineering, for instance, in process design, in industrial experimentation, in design optimization, and in reliability optimization. This is the problem we will

- A simulation optimization model is displayed in Figure 2. The output of a simulation model is used by an optimization strategy to provide feedback on progress of the search for the optimal solution. This in turn guides further input to the simulation model.

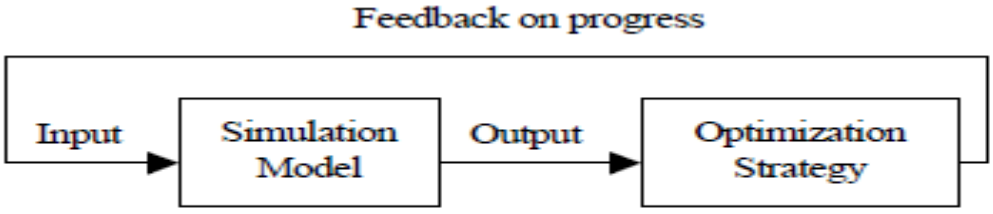

Figure 2: A Simulation Optimization Model