WEEKLY JOURNAL-10

SUMMARY

Introduction to reliability analysis using simulation techniques were discussed. Monte Carlo technique was discussed.

Shanthanam, Sangar

N359Z235

Group partner: Danielle Mouer

Monter Carlo simulation

Week-10

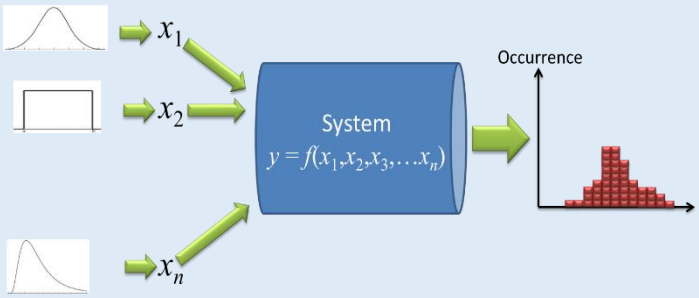
Summary: Introduction to reliability analysis using simulation techniques were discussed. Monte carlo technique was discussed.

Introduction

Reliability analysis of a system is done in two methods, direct mathematical modelling-based analysis or stochastic simulations. Analytical methods often use approximate mathematical models. Where as simulation techniques try to mimic the actual scenario.

The behavior of components of a real-world system shows a stochastic nature. Number of failures, failure rate etc. are random. So these random nature is modelled using probability distributions in simulation environment to estimate the desired parameters.

Following figure shows the simulation concepts.



In the simulation modelling. System parameters will not change only the input parameter change.

Example 1:

Estimating the value of ∏. Following steps will be followed in simulation environment to estimate the ∏.

Step 1: Create a parametric input

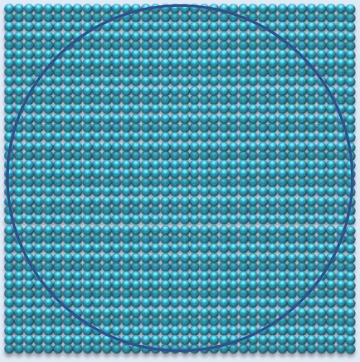
Step 2: Generate set of random inputs

Step 3: Evaluate the model and store the results

Step 4: Repeat steps 2 & 3 for n times

Step 5: Analyze results using statistics, histograms etc.

Following figure shows the pictorial representation of the simulation model.



Let S be a space enclosed by the square and C be a space enclosed by the circle. Any random point in the square is given by

$$r(x, y) \in S$$

If $r(x, y) \in C$

The point is inside the circle

Inside Circle = Inside Circle +1

Else

The point is outside the circle

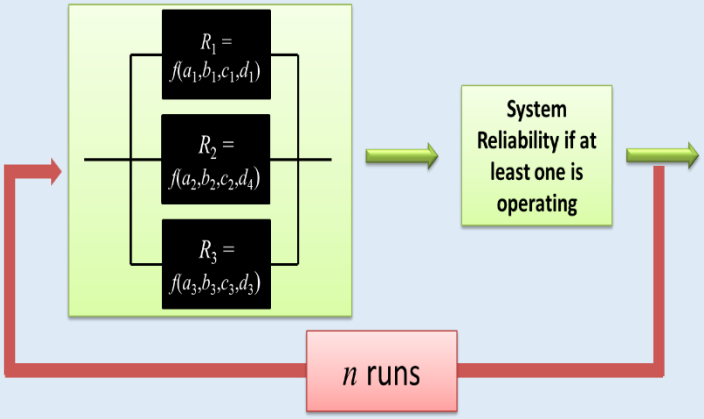
Outside Circle = Outside Circle +1

End

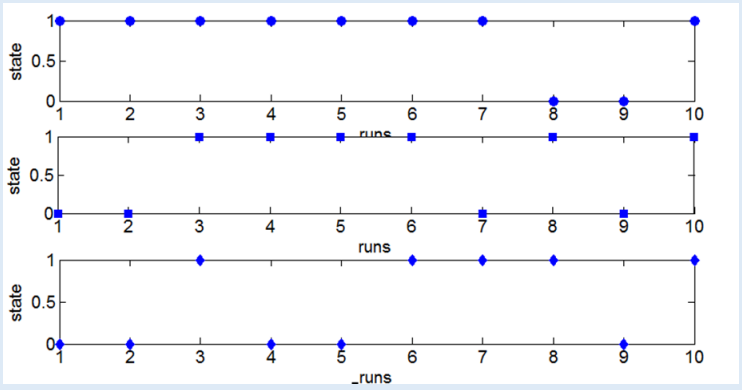
Selecting number of simulations is important in monte Carlo simulations. Following measure (normalized SE) is used to determine the correct number of simulations.

$$SD = \frac{\sigma}{\sqrt{n} \times \bar{x}}$$

Following figure depicts the time independent analysis of 3 components in parallel scenario.



The results after 10 trials are shown in below figure.



Following table shows the results after 100,000 trials.

Run	Reliability
1	0.8202
2	0.8156
3	0.8142
4	0.8200

Mean of the reliability

$$\bar{x} = 0.8175$$

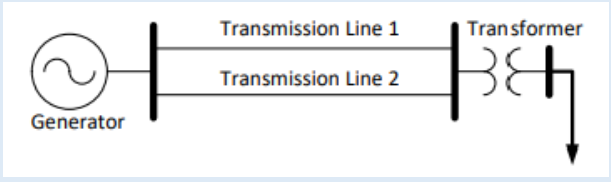
Standard deviation of the reliability

$$\sigma = 0.0031$$

Normalized standard mean of the error

$$SD = 0.0022$$

The system shown in below Figure has the following failure rates generator – 0.01 failures/1000 hours, transmission line 1 – 0.015 failures/1000 hours, transmission line 2 – 0.027 failures/1000 hours and transformer – 0.011 failures/1000 hours. Determine the availability of the system in 1000-hour operating period.



A program was written in MATLAB. Following pseudo code was used to write the program.

Inputs: Failure rates of all the components.

Run: generate the time to failure value for all the components.

Sample the values for system up time.

Output:

Reliability: Reliability of (Generator & (transmission line 1 or transmission line 2) & Transformer)

End