Effect of Reliability Input Value towards Monte Carlo Simulation Convergence

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ABSTRACT: Taking the importance of reliability analysis in current society, it becomes a must to analyse the networks in order to give enough supply towards consumers. The needs for reliability evaluation becomes more essential as time passes since the network becomes more complex and network compound advance together with the number of consumers. Thus, it is important to provide uninterrupted system without any obstacle. As a useful tool to analyse reliability, Monte Carlo will be used in this research. By using the IEEE-14 buses network, two fault rates will be used which are large and small values. In a simulation, a variance reduction method will be applied to MCS in order to watch the effect of fault rates. However, based on the current discovery, the simulation fails to converge due to the size of the fault rate. The simulation with smaller fault rates tends to fail to stop before the decided years, but despite that, the simulation with bigger fault rates able to stop before the decided years. From the evaluation of difference fault rate, reliability indices (SAIFI, SAIDI, and CAIDI) were obtained and analysed. Based on the output, the simulation that applied bigger failure rate and repair time would help to increase the speed of CPU and reduced the time taken to complete a simulation compared when using smaller input data

Keywords: *Distribution System, Time to Fail, Time to Repair, Monte Carlo*

1. INTRODUCTION

Monte Carlo simulation (MCS) is the preferred method for reliability assessment of composite systems [1]. MCS can be divided into Sequential Monte Carlo (SMC) and Non-sequential Monte Carlo (NSMC) [2]. SMC is done in chronological method, where the system and the component will be simulated in order [3]. There are two inputs that will be needed for the simulation which are time to fail (TTF) and time to repair (TTR) [4].

2. NETWORK

The network consists of 17 overhead lines and 3 transformers. Each overhead line represents a different length. These lengths will determine the expected failure rate that should occur on the overhead line. The failure rate is used as an input in MCS to create an interruption based on the network component.

3. INPUT DATA

In this research, the main focus to compare the size of fault rate and repair time of overhead lines. The failure rate for transformer (Tx), has been standardize to 0.002 fault/year. Case 1 and Case 2 are focus on the size of fault rates, while Case 3 and Case 4 are focus on size of repair times. For Case 1 and Case 2, the convergence were set to occur at the time to fail (TTF) only. For Case 3 and Case 4, the convergence were set at time to repair (TTR), and only the TTR for o/l were manipulated in these cases which are 5.7 hours/fault and 6.44 hours/fault.

4. METHODOLOGY

Select the input value of fault rates. After that, random number were generated between 0 and 1. Once done selected the fault rates and generated random number, Time to Repair (TTR) will be calculated after the calculation of Time to Fail (TTF). Then the system will be force fault based on the calculation. Lastly, reliability indices will be calculated to analyze.

5. DATA ANALYSIS

Based on Table 1, it illustrates a new expected interruption. In general, if a convergence occurs in the simulation, it will able to increase the speed of CPU, and decrease the time taken to complete a simulation. By shorten the number of years, it able to reduce the time taken. As the number of years have been reduced, a new expected failure rate will be obtained. Referring to table 1, Case 1. The designed failure rate for 1000 years is 0.252, equal with 252 expected faults. However, due to the convergence effect (at TTF), the number of years had been reduced to 484 years. Since the number of years is 484 years, a new expected interruption also will be updated. For 484 years, and expected interruption should be occurring around 122 interruptions. If referring to the simulated interruptions, there are slightly smaller from the expected with -22% different. However, it is still around the corner.

Case		1	2	3	4
Fault Rates		0.252	0.106	0.106	0.106
Expected Interruptions (Old Years-1000)		252	106	106	106
New Year		484	493	595	492
Interruptions (New Year)	**New Expected**	122	52	63	52
	Simulated	100	52	64	52
Percentage Different (%)		-22	0	2	0

Table 1 New expected and simulation

6. RESULT AND DISCUSSION

Illustrate in Figure 1 and 2 are the interruptions at the component for each type of convergence. As shown in the figure, Case 1 has severe interruptions compared to Case 2. This is because, Case 1 used larger failure rate, while Case 2 smaller failure rate. For Case 1, the exact failure rate used is 0.168 fault/km, while for Case 2, the exact failure rate is 0.0706 fault/km.

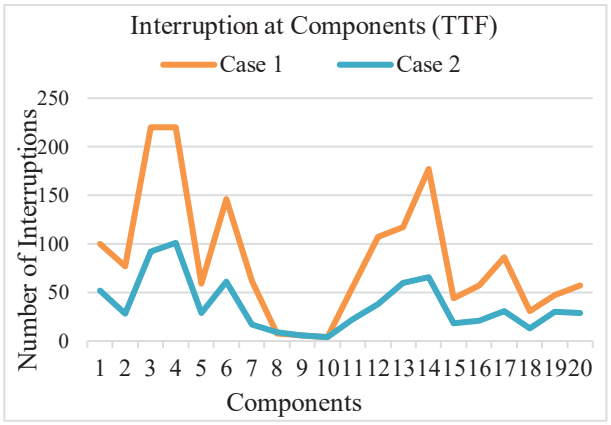

Fig.1 Interruption at Component (TTF)

From Figure 2, another information that can be obtained from the figure is the length of the overhead lines. Except for Components 8, 9, and 10 as these components represent transformers. The rest of the component can determine the length of the overhead line based on the interruptions occur. The more the interruption means that the length of the components is longer. From observations, when the simulation used similar failure rate, it is possible to force fault at the same time. However, the slightly different between both cases is because of the number of years.

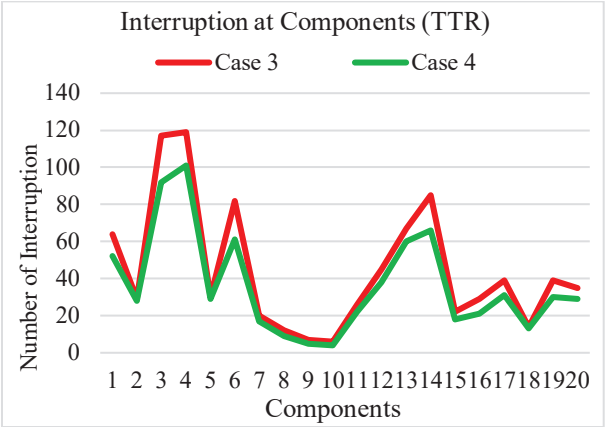

Fig.2 Interruption at Component (TTR)

7. CONCLUSION

Overall conclusion that can be made from the obtained results is, the size of fault rate does give big contribution towards the convergence of simulation. Other than determine the number of fault that should be occurred, it also determine whether the simulation able to converge or not. In order to decrease the number of interruptions, the number of iteration/years should be smaller.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Higher Education for providing financial support under Fundamental Research Grant Scheme (FRGS) No. FRGS/1/2018/TK04/UMP/02/16 (University reference RDU190186).

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