Failure Intensity Determination for Renewal Doubling System with Parallel Redundancy

Orest Lozynsky, Serhiy Shcherbovskykh

Abstract – **The problem of failure intensity determination for renewal doubling system with parallel redundancy is considered.**

Keywords – **Reliability**, **Failure Intensity, Markov Analysis, Parallel Redundancy, Doubling.**

I. INTRODUCTION

The failure intensity is ratio of mean number renewal system failures for infinitesimal life to this life quantity. This index shows system upstate leaving frequency. Both availability and failure intensity are characterized renewal system reliability property.

II. SYSTEM RELIABILITY MODELS

The method for failure intensity calculation for renewal doubling system with parallel redundancy that based on Markov reliability model is suggested.

The system functions by such maintainability algorithm. It's situated in up state S_1 (fig. 1) at the beginning.

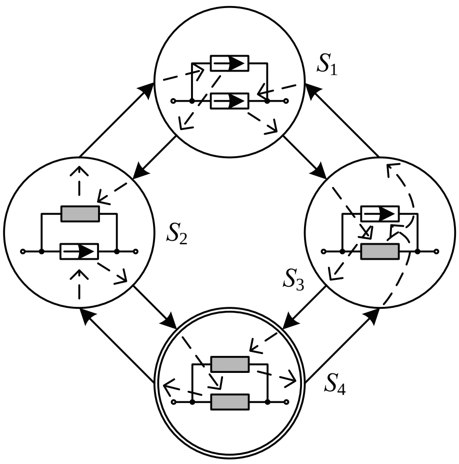

Fig.1. Generalized state space transition diagram for renewal doubling system with parallel redundancy

In this state both components are functioning properly and they life is given by phase-type failure model $R_1(t)$. If one component downs, then system cross to S_3 state, else – cross to S_2 state. It's assumed that technical diagnostics facilitates are ideal. This means that component failure is tested instantaneously. After repair failure component is "as good as new". At S_2 and S_3 up states one component is operable and other – not operable. Such component life is given by phase-type failure model $R_1(t)$ too and time repair is given by exponential maintainability model $M_1(t)$.

Orest Lozynsky, Serhiy Shcherbovskykh — Lviv Polytechnic National University, S. Bandera str., 13, Lviv, 79013, UKRAINE, E-mail: shcherbov@polynet.lviv.ua

If good component downs, then system crosses to S_4 state, and if faulty component ups, then system returns to S_1 state. At S_4 down states both component are not operable and time repair are given by exponential maintainability model $M_1(t)$.
If one component ups, than system return to S_2 or S_3 upstate.

For considered system Markov reliability model was formed using phase-type distributions and state space extending. More about this approach see in [1, 2].

System failure intensity $z_1(t)$, solid bold curve 1 (fig. 2) is determined as sum of product transition intensity, that shift system from up to down state, and such upstate system probability function.

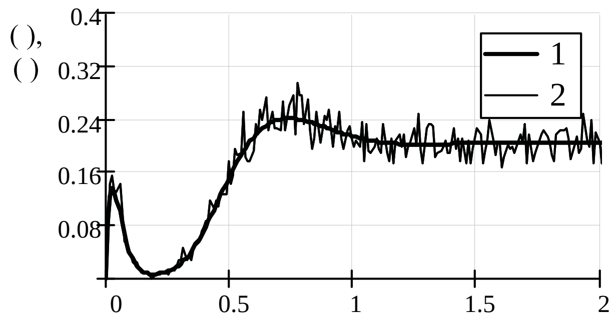

Fig.2. System failure intensity curves

For result accuracy verification system failure intensity $z_2(t)$, solid curve 2 (fig. 2) was determined by Monte-Carlo reliability model.

III. CONCLUSION

Curve 1 is agrees with curve 2 in tolerant limits. Curve 2 is distorted by Monte-Carlo method noise. Integral mean root error between 1 and 2 failure intensity curves for 50000 Monte-Carlo iterations is about 0.02. Simulation duration for extended state space Markov reliability model is less then simulation duration for Monte-Carlo reliability model more than 500 times. Such, using homogeneous extended state space Markov reliability model, failure intensity determination method for renewal doubling system with parallel redundancy is proposed.

REFERENCES

[1] *Lozynsky O., Shcherbovskykh S.* "Electromechanical items reliability models construction on the basis of state space extension", Visnik NTU "KhPI", 45, 2005, pp.74-81.

[2] *Lozynsky O., Shcherbovskykh S.* "Failure Intensity Determination Using Markov Reliability Model for Renewal Non-Redundancy Systems" Przeglad Elektrotechniczny. Vol.85, №4, 2009, pp.89-91.