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Research paper

Analyzing the Improved Software Reliability Based on the Markov Model by Considering Error propagation

Dr. S. Srinivasa Rao, D. Sowjanya, CH. Dileep Chowdary, M. Harika

Department of Computer Science & Engineering, K L E F, Vaddeswaram, Guntur, Andhra Pradesh, India- 522502.
**Corresponding author E-mail: srinu1479cse@kluniversity.in*

Abstract

In the software reliability analysis we proposed an approach, which is named as Model Driven Development method. This is a modelling and model transformation techniques. The Markov model used in reliability fields is modified to adapt to error propagation behaviors of components. The Markov model has been used for results of reliability analysis. Markov model which means that that future or upcoming states depend only on the present state not on the events that occurred before it to ensure high reliability of this software is to estimate reliability accurately in the developing phase. Then a study on the transformation between model based on Architecture & Analysis Design Language (AADL) and Markov model has been done. By considering all these a model based software reliability analysis approach is proposed.

Keywords:*Software Reliability, MDD, Markov model, BW algorithm, AADL Model..*

1. Introduction

Now-a-days there is a development in the today's technology in software engineering. So, the traditional technologies in software engineering or methods are faced up with a lot of problems. The problems which include longer development period or higher development costs. To solve this problem there is an approach, named Model Driven Development (MDD). There are various modelling languages and analysis methods to estimate the reliability of the any software products. Model driven development is faster than all other traditional programming languages similar to C# and Java. Modelling languages mainly include Architecture Analysis and Design Language and Unified Modelling language. In our project we mainly use of the AADL because it is of text-oriented language and UML also has many features but it is of diagrammatic representation. To convert into code it takes much time so we use AADL. This Markov model to characterize the behavior of a component to calculate the reliability of software systems. This model has been used for results of reliability analysis in various systems. All these approaches hardly considered the error propagation. Error propagation is an important reliability related component behavior. By developing any model we have an errors in any model that can be come across by the Markov Model which the upcoming state depend only on the present state only but not on the events that happened before states.

Model driven software development process uses Platform Independent Model (PIM) to build the original software architecture model. Now we have to prove the feasibility of this approach in the speed regulation when establishing the Markov reliability model by considering the three components states, error free, faulty and failed states. By this we can calculate the probability of the reliability analysis that have been considered without loss of accuracy.

2. Literature Survey

In probability distribution, the Markov model is a stochastic model. It is used for the randomly changing the values of the systems. There are four common Markov models which are to be used in different type of situations. One is Markov chain and the other one is Hidden Markov model (HMM) [5].

In these two the system is automatic which is said to be dynamic. And the other two are Markov decision process by which the system is to be controlled. So we are learning Markov model. To know these we have to learn different algorithms in these model such as forward-backward algorithm and Baum-Welch algorithm [7].

In Markov model to get the accurate and optimization values they used those algorithms in Markov model. It is used for estimating the probability values of the starting state and also the transition function among the states. They used those algorithms because we treat with the multiple observations case in different type of systems. Baum-Welch is an iterative procedure for estimating the probability values of that algorithm. It works on maximizing a proxy to the log-likelihood markov model and updating of the present model to be closer to the optimal model. So Markov model depends only on the current state values to get the next state values. In general it is an Expectation-Maximization (EM) algorithm. These model can be used in different applications like speed regulation of car, face recognition, and also weather reporting and also speech coding wave form and also in various applications. We get the probability results of the reliability analysis without loss of any accuracy and it is to be optimized model. We considered Error propagation because the system contain some failure, faulty components to overcome all these we considered this propagation [1].

3. Framework Model Based Analysis

3.1 Software Reliability Analysis

In the MDD and reliability analysis there is a transformation from design phase to analysis Phase. The MDD model is a platform Independent model which can transform to analysis model. In Software Reliability test there is a transformation tools and the analysis tools which will helps us to get the reliability analysis results.

3.2 MDD Model

1. Model-driven development (MDD) is used for implementing computer programs quickly, effectively with minimum cost.
2. Consequently, as we know that model driven development is faster than programming languages like java.
3. Modelling languages mainly include AADL and UML.
4. MDD Model is faster than programing languages like java.

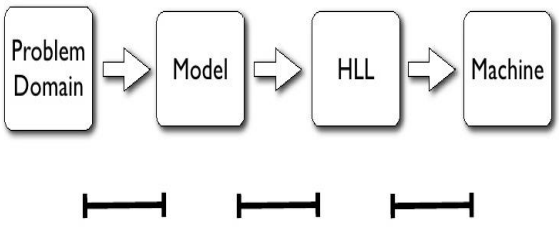

Fig3.2 MDD Model

3.3AADL Model

AADL is a modelling language widely used in embedded systems. There are two kinds of languages, one is UML, and the other one is AADL.

AADL has been applied to several fields such as model-driven top-down and bottom-up approach, real-time and critical distributed systems. AADL has a lot of features when compared to UML when it is applied to the reliability analysis. AADL is text oriented language as UML is an diagrammatic representation language. So we prefer in these we use AADL modelling language.

3.4 Error Propagation

It is the process of determining the uncertainty of an answer obtained from a calculation. Every time when the data is said to be measured, there is an uncertainty values of measurement. There are three components which are error free, faulty and the failed states in the reliability analysis considering error propagation. Suppose there is an fault in an component that causes an error which is an erroneous state. The error that manifests itself as a component failure.

This component failure may affect this probability and also it leads to a system Failure. But the subsequent components may not Propagate the error.

There are two level factors:
1. Component level
    1.1 failure probability
    1.2Error propagation probability
2. Architecture level

Error propagation probability value is always 1.

This depends on both source and the target component. By considering all these error propagation we get the probability results of completing of a given task by the system. Otherwise we can't able to complete the task due to the failures in a component at any state of the system. The failures in a component occur to the whole system or it may be happen at any particular state. So we are considering of the error propagation.

4. Markov Model Considering Error Propagation

Error model when considering in the error propagation there is a lot of component failures.
So, there are various software testing methods for the requirements of the software because they are becoming higher and higher.
Problems like the test case is huge and also the safety testing efficiency is low. In order to solve this problem there is a safety testing method that is to be considered when we go through to get the dynamic results of reliability analysis. To get all this we have to use the Markov model. In these we are having a 4 tuple representation of testing of system.

SCEN = (op, pre, post, Trans).
Op sequence of operations in a certain rule.
Pre precondition of the scene
Post state of the scene that is the state of the system after carrying on the scene.

Transmapping of pre * post [0,1] and trans(s, t) =p represents the possibility that execute the scene and satisfy the system post condition 't' after satisfying the precondition 's' is p. The Markov model consists of 2 sequences one represents the statistical relationship of state transition and the other represents the statics corresponding between the hidden and the observed components. There is a 5 tuple representation:

$\lambda = (S, P, I, J, \Pi)$
S=number of states (s1, s2… Sn)
P=values of every states (v1, v2…. Vn)
I=state transition matrix
J=probability distribution of state values
Π=initial state

5. Detailed Analysis

The approach we are using to analyses the reliability model is Markov model by considering the error propagation. In these we are considering the speed regulation of a car to get the different reliability analysis results. When we are doing we may have a component failures so we are considering the Markov model that it considers the three component states which are of error free, faulty, failed state. We have to check all these to get the reliability analysis of this model.

5.1 Markov Model

Markov model where the systems of future states depend only on the current state, not on the before states of the system.
For example, let us see the stock market which is very stable which means the probability that it "increased," "decreased," or "unchanged."
This has to be same in the regulation of a car in which the results are changes time-to-time. Sometimes the value may be same or it goes high or less.

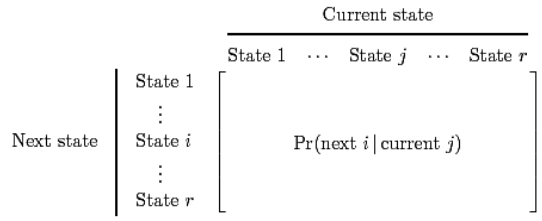

Fig 5.1 Transition Matrix

The Markov process is to be performed at the regular or respective time intervals and have the same type of values(outcomes). This outcomes are called states.

There are two states in Markov model, one is right state and the other is wrong state. Starting of the component in a work process is been translated into the initial state of the Markov model. The first component also has a wrong state in sometimes that is based on the system and the components. Last component which is the end of a work process is a terminal state or final state in Markov model. The outcome of the future state is referred to as present state process. This states are represented as column matrices. For the Markov model we are using the Model-driven development (MDD) which is used for implementing computer programs quickly, at minimum cost, less time. Model driven software development process uses Platform Independent Model (PIM) to build the original software architecture model, and then uses a transformation methods to implement the software codes. Software reliability analysis approaches based on MDD methods usually transform the original software architecture model to analysis model, which can be calculated the reliability results. Model based software reliability analysis is concurrently done with the software development process based on MDD model driven development methods. There are of 3 phases named as m a, m band m c. In m a we add error information to original software architecture model. This is used to analyze the reliability properties. We obtain the intermediate model which named as m b. Later we do the transformation from m b to analysis phase which is m c. In these Markov model we have to know the BW algorithm and forward backward algorithm which on represents the probability values based on the states and the other one is represented as count like how many times the count values are there from one state to another state. The results of original software architecture can be calculated. This can give a feedback to design process of the model which is helpful to improve the reliability of the various software products.

5.2 Case Study

Like, vehicle speed using two sensors and detection of an obstacle using a radar. Finally, it controls the car and warns the driver for an emergency of Activation of the brake or acceleration using a speed controller. Use the transformation rules. The transformation rules states that the number of states in the speed regulation are represented in a matrix form. And we have to check the currently what is good that probability values in the system.
It will be multiplied with the first state of the transition matrix and later on the result will be multiplied with the next state only. The next state doesn't use the starting values to get the future state. We calculate the reliability results of total system without loss of any accuracy.

5.3 Observation

To calculate the probability values of at different aspects we are using the eclipse software for the Markov model analysis to get the reliability results by considering of the error propagation.

In these we have to see how many number of states we want as it is dynamic system we can change the states whenever we want as per our system. We have to see how many steps are to be required from initial sate to final state. Based on those steps and values present at each state we have to show a graph which indicates which states have the better values like without any errors and without loss of any accuracy.

6. Conclusion

In these paper we implemented the probability results of the reliability analysis using Markov model to prove the feasibility of this approach when establishing the Markov reliability model only three components states, error free, faulty and failed states have been considered without loss of
any accuracy. We get the results of the speed regulation of a car by the usage of Markov model and of BW algorithm.

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