Software Reliability Assessment Under Soft Computing Environment

Software reliability measures the chance of failure-free operation of software for a specified period of time in a specified environment. In this thesis, several new types of software reliability models have been developed considering more practical situations that arise during testing and we derive novel soft computing techniques to predict reliability of software more justifiably.

Initially, the following statistical parametric software reliability growth models (SRGMs) are presented with some new practical development assumptions.

- Original Jelinski and Moranda model is modified assuming imperfect debugging process in fault removal activity during testing.
- SRGM based on non-homogeneous Poisson process (NHPP) imperfect debugging with error generation is presented. We modify the fault content function by taking into account the increased skill of testing team.
- NHPP based s-shaped SRGM is presented with imperfect debugging and we present fault content and fault detection rate functions by considering the increasing efficiency of testing team.

Besides the following robust soft computing-based nonparametric software reliability models are presented.

- Multi-layer feedforward artificial neural network (ANN) based logistic growth curve model is presented for software reliability prediction. We present a neuro-genetic approach by optimizing the weights of the network using proposed genetic algorithm (GA).
- We develop feedforward and recurrent neural network based dynamic weighted combination models to improve software reliability prediction accuracy. Traditional SRGMs are combined based on dynamically evaluated weights determined by learning algorithm of the networks. We present a real-coded GA based learning algorithm to train the ANNs.
- We also present an efficient neighborhood based adaptive particle swarm optimization (PSO) algorithm to train the proposed dynamic weighted combination model for improvement of software reliability prediction accuracy.
- ANN based software reliability model is developed considering the effect of fault generation with different levels of fault complexity. We present a neighborhood based fuzzy PSO algorithm for learning of the proposed network.

Each of these proposed models are validated using real software failure data sets. Software reliability prediction capability of these models are much superior than established models and application of soft computing methodologies enables us to develop models with great prediction accuracy than traditional parametric models. Presented models can be cordially accepted by testing engineers to assess software reliability precisely during testing phase of software development.