Abstract

The higher software development technology is, the more important early development phases such as analysis and design are. Design metrics that quantify design phase play an important role in reducing system development cost. Also prediction models that predict quality factors of code at design phase are very important because the problems in early phases largely affect the quality of the late products. Real-time systems such as telecommunication systems are so large that design quantification and early quality prediction are very important in real-time system design.

In this paper, I propose design metrics set for SDL, Specification and Description Language, and criticality prediction models using the defined metrics set. SDL is a formal, graphical, Object-Oriented real-time specification language. SDL is a widely recognized international standard, maintained by ITU-T (Z.100).

I define SDL metrics set as basic metrics set and complexity metrics set. Also I define a framework for construction of hybrid complexity metrics. SDL complexity metrics set is composed of three metrics subsets classified according to two design phases and entity types. Each set is composed of basic complexity metrics and internal complexity, external complexity and hybrid complexity metrics. SDL complexity metrics can be used by two forms, metric vectors (basic complexity metrics) and scalar metrics (hybrid complexity metrics). I validate SDL metrics by an axiomatic approach and a dimensional analysis. And I show the correlation between two hybrid metric forms by a simulation study.

Criticality of a design entity is fault-proneness of the entity when it is implemented. And criticality prediction model determines whether a design
entity is fault-prone or non-fault-prone. In this paper, I classify prediction models into four types according to the input metric forms and the necessity of past project data. Many prediction models for identifying fault-prone modules using complexity metrics have been suggested. But most of them are \textit{VI-SL} model type that needs a training data set. Unfortunately very few organizations have their own training data. To solve this problem, I built four prediction models. Each model stands for each model type: \textit{BPM} using backpropagation neural net as \textit{VI-SL} model, \textit{KSM} using Kohonen SOM neural net as \textit{VI-UL} model, \textit{HMM-AC} and \textit{HMM-HC} using defined SDL hybrid metrics as \textit{SI-AC} and \textit{SI-HC} model. I compare and evaluate these models considering internal characteristics, utilization cost and accuracy of prediction. As a result I showed that some proposed models not using training data have similar performance with the \textit{VI-SL} model.

\textbf{Keyword}: Object-Oriented real-time system, Specification language, SDL, Design complexity metrics, Hybrid complexity, Criticality prediction model

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