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Software Defect Prediction Techniques in Automotive Domain: Evaluation, Selection and Adoption

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Abstract

Software is becoming an increasingly important part of automotive product development. While software in automotive domain enables important functionality and innovations, it also requires significant effort for its verification & validation to meet the demands of safety, high quality and reliability. To ensure that the safety and quality demands are meet within the available resource and time - requires efficient planning and control of test resources and continuous reliability assessment. By forecasting the expected number of defects and likely defect inflow profile over software life cycle, defect prediction techniques can be used for effective allocation of limited test resources. These techniques can also help with the assessment of maturity of software before release.

This thesis presents research aimed at improving the use of software defect prediction techniques within the automotive domain. Through a series of empirical studies, different software defect prediction techniques are evaluated for their applicability in this context. The focus of the assessment have been on evaluation of these techniques, how to select the appropriate software reliability growth models and the factors that play important role in their adoption in industry.

The results show that - defect prediction techniques (i) can be effectively used to forecast the expected defect inflow profile (shape and the asymptote); (ii) they are also useful for assessment of the maturity of software before release; (iii) executable models can be used for early reliability assessment by combining fault injection with mutation testing approach; and (iv) a number of factors beyond predictive accuracy such as setup, running, and maintenance costs are important for industrial adoption of machine learning based software defect prediction techniques.

The effective use of software defect prediction techniques and doing early reliability assessment on executable models would allow (i) early planning and efficient use of limited test resources; (ii) reduced development time/ market lead time; and (iii) more robust software in automobiles which make them more intelligent, safe and also highly reliable.