Design for Availability – Flexible System Evaluation with a Model Library of Generic RAMST Blocks

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ABSTRACT

Tailoring a complex system to meet given availability requirements is a challenging task in the design process. Besides compiling the applicable *mtbf* and *mttr* figures of the required components, the specific set of algebraic rules has to be identified and applied to compute the overall predicted availability of the designated system functions for the individual architecture and for individual usage profiles.

While on the other hand model based methods have meanwhile become established in the system development process, such time- and effort-saving simulation-based approaches are by far not so common in the field of RAMST-analyses.

This contribution reports about an approach of amending a reusable library of functional component models - originally designed to explore the effect of assumed failures in complex networks by simulation - and applying it to compute the availability of a generic launcher system. Here the design engineer is faced with the complex task to find an architecture to guarantee a specified availability of the firing function with the given resource items onboard.

Developed within the tool environment RODON, the developed prototypical library enables a quick evaluation of structural design alternatives of the selected launcher application. On top it supports the full range of RAMST-analyses - like computation of cause-effect-relationships for FMEA, automatic drawing of FTAs for hazards of loosing designated system functions or systematic evaluation of the Diagnostic Coverage resp. potentially monitor or reconfiguration strat[1]egies - based on the same single model. Further generalization activities are going on.

Since the model is composed of generic qualitative building blocks, it took much less time to develop than full quantitative or physical model descriptions usually need. Although this qualitative representation implies certain limitations, as the authors experienced this is compensated by the advantage of an easier understanding by the modeler and quick adaption and to new principal architectures, while still providing sufficient system insight and result.

Driven by requirements from the industrial application, ideas for further library extension are being discussed to support also questions regarding repair procedures and time, resource allocation or cover even economical aspects.

The paper sections focus on the description of the launcher design task, a short introduction to the applied tool, the library development and application and finally the results and outlook.

BIOGRAPHIES

Dieter Fasol, born in Vienna May 3rd 1960 studied Mechanical Engineering at the Ruhr University of Bochum. He started his professional career at Messerschmitt-Bölkow-Blohm GmbH in Ottobrunn near Munich. His fields of work were designing Flight State Control and Guidance Algorithms for various guided missile systems as well as developing simulation environments to serve as a design and test bed for algorithm development. Since 2007 he is working in the field of safety engineering at LFK-Lenkflugkörpersysteme GmbH and started to apply the tool RODON for model based safety analysis.

Burkhard Münker, born Dec 21st 1965, studied Mechanical Engineering at the University of Siegen, Germany, where he also started his scientific career with a focus in simulation and fault analyses. Continuing at Technical University of Berlin, Germany, he developed a tool for automated generation of state space models and filters for early detection of hazardous situations in chemical reaction

systems and got his doctoral degree in engineering in 2001. For many years he has been working as senior consultant and project manager for the vendor of the model based reasoning tool RODON, developing and applying new advanced approaches to the full range of diagnostic and RAMS activities for industrial and academic customers. Since 2010 working as independent technology consultant and analyst he is still interested in tasks to support classical RAMST-analyses by advanced failure mode modeling techniques and esp. to adopt model based ideas to non-technical applications. He is also a lecturer for the topics Physical System Modeling and Model based Safety Assessment at University of Siegen. See his LinkedIn-profile for details.