ITEA 3

Project Results

ModelWriter

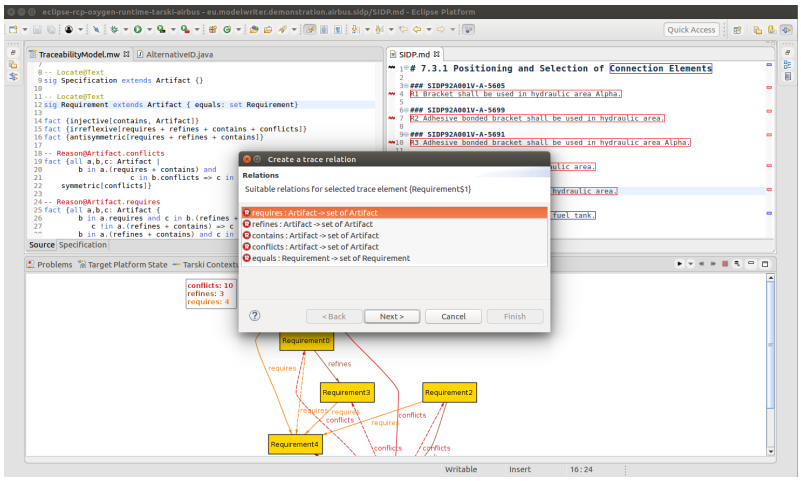
A quantum leap for technical authors

EXECUTIVE SUMMARY

ModelWriter is a text and model-synchronised document engineering platform. It provides a generic framework for automated traceability analysis that allows the integration of two types of reasoning: about the meaning of text and about document structure. By improving the quality (consistency, completeness) of documents produced by technical authors (such as software or systems engineers), the quality of companies' products is enhanced.

PROJECT ORIGINS

The lack of tooling available to enable technical authors to (semi-)automatically transform 'words' into exploitable and ambiguity-free 'pieces of knowledge' lays at the heart of the ITEA project ModelWriter. The need was to create an integrated authoring environment in which a Semantic Word Processor (the 'Writer') and a Knowledge Capture Tool (the 'Model') are combined to reduce authoring effort by 20%. Text-model synchronisation does not only generate huge gains in documentation maintainability and reduce the product defect costs caused by inconsistent or even obsolete knowledge, but it also brings a quantum leap in the productivity of technical document authors.



ModelWriter running on Eclipse Integrated Development Environment

During the development of complex and safety-critical systems, the consistent and complete systematic synchronisation of different kinds of artefacts is essential. In the domains targeted by the project – aerospace, automotive and defence – traceability is an important ingredient of the certification processes. A further challenge is presented by the need to take account of the meaning of natural language. To address these requirements, the project developed a platform comprised of three main components: 1) a semantic parser, which formalises the textual requirements, 2) a so-called Tarski, which derives formal models from structured documents such as Source Code files, Architectural or Design Models and Test Cases, and 3) configurable formal semantics to synchronise those artefacts.

TECHNOLOGY APPLIED

Semantic parsing techniques enable formal meaning representations to be assigned to natural language (NL) text; theorem proving and model building enable traceability relationships to be inferred between text fragments so as to check consistency and to ensure completeness. The capability to maintain a readable textual document (using an editor) and relate its content to existing elements of models are realised through a model/text synchronisation engine. This engine, which has iterative and interactive matching synchronisation, allows the formal specification and verification of semantic relationships between software and system artefacts as well as the semantic annotation of text with model elements.

A key element in the ModelWriter platform is synchronising model and requirement, a job for the semantic parser that has to understand natural text and create this text's mathematical representation. When components understand the meaning of sentences (to some degree), conclusions can be drawn about the extent to which a model satisfies a particular requirement. In other words, it can check for consistency and completeness. For example, in the Airbus use case, a set of System Installation Design Principles (SIDP) was used to ensure the correctness of aircraft design. First, the SIDPs were parsed and assigned Description Logic (DL) formulae representing their meaning. Then traces were either manually specified by the end user or inferred using semantic parsing and

DL theorem proving, and new trace links inferred from existing ones using Relational Logic (RL) and Model Finding. Importantly, this enabled missing or inconsistent SIDPs to be detected. Such as the DL formulae obtained by parsing sentences that conflict with each other because the underlying ontology, to which these axioms are added, specifies e.g. that the concepts “hydraulic area” and “fuel tank” are disjointed.

MAKING THE DIFFERENCE

The project generated some significant and innovative technology results; it is now a matter of applying them. Collaboration among the partners continues after the end of the project and interest has been shown by companies like Ericsson. In the meantime, OBEO is in the process of integrating some of the ModelWriter tools into its better-known products while post-project agreements have been made between UNIT, Ford-Otosan, Airbus and Havelsan to continue exploitation of the ModelWriter approaches and tools internally. Furthermore, using the results of the project, UNIT and Ford-Otosan are collaborating on a system that directly links requirements, models, test cases and source code, handles more than 10,000 artefacts and compiles the results within seconds. UNIT and KoçSistem aim to embed relational logic into MOF-based models using the knowledge in ModelWriter in a project called AlloyInEcore for automated model reasoning to target impact on the model-driven engineering community. The semantic parser and the text generator developed by CNRS/LORIA have been made available on GitHub as open source code for researchers and tool providers.

There is real market potential for the ModelWriter solution since not only does it increase the dependability of software-intensive system of systems (SiSoS) and cyber-physical systems (CPS) but it also enhances the production of safe and reliable systems. ModelWriter also allows companies to further exploit, recycle and valorise their own internal knowledge, which is currently left unexploited in technical documents that are seen as a sequence of words only.

MAJOR PROJECT OUTCOMES

Dissemination

- Publications in prestigious venues such as ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE), IEEE/ACM International Conference on Automated Software Engineering (ASE), ACM Symposium on Applied Computing (SAC), and European Semantic Web Conference (ESWC)
- Presentations at the workshops of European Cooperation in Science and Technology (COST) Actions, Multi-Paradigm Modeling for Cyber-Physical Systems (MPM4CPS) and Runtime Verification beyond Monitoring (ARVI)

Exploitation (so far)

New products:

- The M2Doc technology enables the generation of Office Open XML documents from models (http://obeonetwork.github.io/M2Doc/)
- T-Solver is a high-performance traceability solver to perform scalable-deductive reasoning on trace-links (https://modelwriter.github.io/Tarski)
- Eclipse Intent Project: The synchronization engine of ModelWriter is transferred to Eclipse Intent Project becoming a de facto-industry standard (https://www.eclipse.org/intent/) for the synchronization model

New services:

- Automated Traceability Analysis of OMG® SysML® models on system engineering processes

New systems:

- New feature for Obeo SmartEA to synchronize Enterprise Architect models with strategic documents

Standardisation

- AlloyInEcore conforms to OMG® Meta-Object Facility (MOF)® standard
- Eclipse Intent, M2Doc and AlloyInEcore are compatible with Eclipse Modeling Framework (EMF)
- High-Performance Traceability Solver (T-Solver) can perform automated analysis on models that conform to OMG® SysML® standard

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KoçSistem

Mantis Software

UNIT Information Technologies R&D Ltd.

Project start

October 2014

Project end

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Project leader

Ferhat Erata, UNIT Information Technologies R&D Ltd.

Project email

project@modelwriter.eu

Project website

https://github.com/ModelWriter/