FAMOUS Improvement
transfer of academic knowledge to Semantic Interoperability

Management Summary

The space industry and allied agencies have long acknowledged the interest and added value of Model-Based System Engineering in expediting the design, development, deployment, and verification of space systems. The definition of models and equipment that can serve the diverse objectives of the system engineering process has been the focus of numerous initiatives over the past few decades. The next stage is to employ MBSE broadly throughout the system life cycle across disciplines and the supply chain.

The Fact Modelling Unifying System (FAMOUS) combines a methodology for information modelling with a generic language based on first-order logic to convey the semantics of a «world of speech». FAMOUS uses a controlled natural language to ensure effective communication with all parties.

FAMOUS results from an effort of experts in fact-based modelling acting in transferring decades of academic knowledge on semantic modelling to industry. FAMOUS reuses some of the best of semantic modelling using NIAM, CogNIAM, ORM, DOGMA and FCO-IM. The logic-based graphical notation used by FAMOUS is ORM object role modelling.

Models created using FAMOUS can be expressed verbally in a controlled natural language and graphically, allowing each stakeholder to thoroughly check the semantics contained in the models. FAMOUS enables semantic modelling, which purpose is to capture the WHAT-making abstraction of any implementation specifics.

Applying FAMOUS to the development of Space Products means ensuring that each product specification is established thoroughly and explicitly before any development by some suppliers is initiated. Information modelling using FAMOUS searches to ensure the completeness of the system requirements specifications, eliminating any risk of ambiguities.

This OSIP has produced the following results.

Extending FAMOUS and Prototyping its development

In previous projects, a formal specification of the FAMOUS language has been drafted and some keys elements of that specification have been prototyped using the NORMA (Natural Object Role Modeling Architect) tool.

The first output of this OSIP contract has been to demonstrate the feasibility of developing the FAMOUS tool.

For that purpose:

- the FAMOUS meta-model has been extended to permit a roundtrip from/to NORMA with no loss of any semantics during that roundtrip. This implied extending the FAMOUS

conceptual model with NORMA common features such as those required to support graphically conceptual modelling using ORM graphical notation, organising the conceptual modelling in groups, managing custom properties, but also extending to support the FAMOUS specific features, prototyped in NORMA, such as, enabling modelling at global level, i.e. modelling ontologies and creating partial models for stakeholders' needs, enabling the creation of hierarchical views of the by nature flat, network like conceptual definitions.

- the NORMA tool has been extended to (semi-) automatically generate the FAMOUS tool. For that purpose, the JFE (JavaScript Fact Engine) tool has been developed that takes as inputs an ORM conceptual, the corresponding logical and physical (relational, hierarchical, object) models produced by NORMA and generates as outputs the main elements of the FAMOUS client/server database system, a rich data environment with rules engine transactions, states changes, undo/redo, JSON serialisation, data-bound user interface, ready for beginning used to develop e.g. a web application making calls to the generated input/output service.
- the JFE has been used to generate the prototype version of the FAMOUS client/server database server.
- A web application has been developed to permit the visualisation of the conceptual models produced with FAMOUS.
- An import/export facility has been developed to permit exporting the models from NORMA and importing them into FAMOUS.

The demonstration of developing the FAMOUS tool has been successful. The prototype generated exposes a fully documented FAMOUS data model. It can be used by those participating in the OSMoSE initiative and preparing contributions for the Space System Ontology, refer mb4se.esa.int.

The FAMOUS tool is currently limited to the management of conceptual models. Additional effort is required to extend the FAMOUS tool to support managing the logical and physical models supported by NORMA and others e.g. UML, ECORE, to automate the production of additional software components (complex constraints, derivations, local models, importers/exporters, …).

Verbalising the FAMOUS conceptual models

A conceptual model consists of concepts (object types, fact types and constraints) that describe the Universe of Discourse of interest. Each concept can be associated with some descriptive material, such as a free text that defines that concept. Glossaries of terms can be then generated, but they alone do not produce a formal specification of these terms of the Universe of Discourse.

The second output of this contract has been to demonstrate how to document a conceptual model, producing a formal rule-based model specification in English, using a controlled natural language.

A FAMOUS document generator has been prototyped in NORMA and is now available as a NORMA extension for those modelling with NORMA.

In September 2022, the FAMOUS document generator was tested by OSMoSE. The first version of the OSMoSE MBSE conceptual model documentation has been sent for public review. The main output of that review has been some concerns raised by the reviewers about the difficulty of understanding the (logic-based) formalism used.

Additional effort is required to augment the quality of the generated documents, e.g., capturing informative material related to the Universe of Discourse and using that informative material to facilitate the understanding of the model, using requirement-like language instead of rule-based language.