ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

eurosyslib

INNOVATION REPORT

Driving interoperability in model-based systems engineering

EUREKA

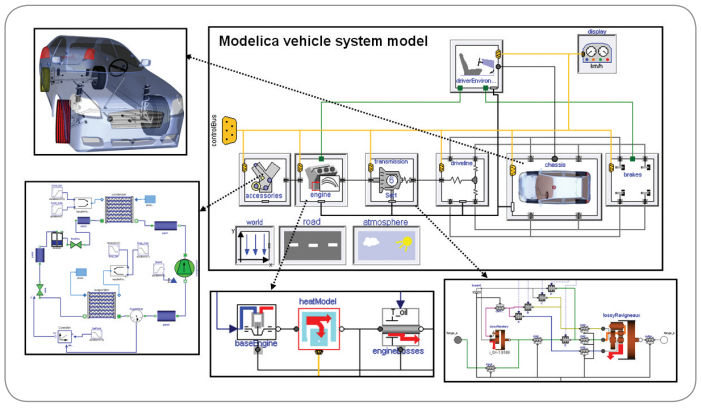
Piero Brozzu and Francois Bichet, Dassault Systèmes,
Martin Otter, DLR

The ITEA 2 EUROSYSLIB project has dramatically reinforced European leadership in the field of systems modelling and simulation through enhancement of the free Modelica modelling language, its accompanying Modelica libraries and infractructure. The project developed support for multi-domain applications in aircraft systems, power plants, conventional and electric vehicles with interoperability between tool boxes and a huge extension of the Modelica libraries which encapsulate know-how of experienced engineers. The results are available both through the Modelica Association and commercial tool suppliers.

There is a crucial need to manage increasing complexity in embedded software while reducing time to market and improving product quality for future products and systems. EUROSYSLIB proposed to tackle this by designing, optimising and checking the behaviour of future products as early as possible in a virtual environment with a multidisciplinary team.

The objective was to reduce cost and increase productivity while meeting the relevant specifications and user expectations. This could be achieved by optimising product dynamic behaviour and geometric constraints concurrently in the same framework – offering a digital mock-up of a system with view on its behaviour.

EUROSYSLIB, initaited and lead by Dassault Systèmes, focused on the field of embedded systems modelling and simulation through further development of Modelica – a free standardised language for modelling and simulation – and its accompanying libraries and infrastructure.



Systems modelling involves the behavioural and dynamic modelling of systems in any engineering domain including control systems, such as the overall model of a vehicle consisting of vehicle dynamics, combustion engine, transmission, drive line, brake and control systems.

Solving difficult engineering problems

Modelica is a powerful, open, modelling language which supports integrated modelling over all systems and physical domains.

This language is designed to solve the most difficult system engineering problems,
in particular:

- Multidisciplinary problems involving simultaneously technologies from multiple domains such as: mechanics, hydraulics, pneumatics, thermodynamics, flow dynamics, electrical and software;
- Problems involving highly coupled components, where traditional hierarchical design does not work or does not make it possible to reach optimal designs;
- Problems involving hybrid mathematical resolutions such as continuous-discrete modelling and simulation; and
- Discontinuous and variable structure systems.

Key to Modelica is that it structures models in the way engineers think: with Modelica the problem is described rather than the way to a given solution. This power of Modelica makes it possible to design very complex systems by assembling components in much the same way as engineers operate. Such an approach makes it possible to model and simulate complex, continuous-discrete, discontinuous and variable structure systems very quickly by just connecting such components together.

The result can be a major gain in productivity with the ability to solve many of the multidisciplinary problems that were not addressed before.

However, more work was required on Modelica to widen its application. The language itself needed to be enhanced and expanded to ensure full coverage of market requirements. Modelica users also needed to have access to a sufficiently large

INNOVATION REPORT

number of libraries comprising off-the-shelf design components. This required large-scale co-operation.

EUROSYSLIB therefore set out to create a rich, inter-related network of 19 European companies developing new innovative Modelica libraries. This will ensure that Modelica adopters benefit from the richest and most innovative off-the-shelf library contents in the market.

Seven areas treated

Work in the ITEA project focused on seven areas:

1. ***Library infrastructure*** with significant improvements to the infrastructure for Modelica by integrating the language in CATIA, ENOVIA, AMESim and CFD, and by improving Modelica and Modelica tools to fulfil the needs of EUROSYSLIB libraries;
2. ***Mechanical systems*** with enhancements to the modelling of mechanical systems in Modelica, in particular to interface Modelica multi-body models with CATIA and to utilize finite element models from SIMULIA in Modelica;
3. ***Electrical and electronic systems*** with enhancements to electronic Modelica standard libraries, controlled electrical machines modelling, advances in electronic circuit simulation and increased application of Modelica to electromagnetic and electromechanical modelling;
4. ***Thermo-fluid systems*** with provision of libraries covering the whole range of operational domains of the modelled systems;
5. ***Control systems*** with provision of Modelica libraries for safe embedded control systems;
6. ***Properties and safety modelling*** where EUROSYSLIB made it possible to express and model properties required of a system. These properties may be associated with a systems behaviour and be validated by simulation. The project also supported risk analysis by introducing specific safety-oriented concepts such as events, transitions and synchronisations; and
7. ***Vehicle systems*** with enhancements for detailed and real-time vehicle system models. This work included libraries for vehicle interfaces, alternative vehicles, engines, free piston linear alternators, tyres, mechatronics openings, heat exchanger stack and under-bonnet, and vehicle controls.

Working with Modelica Association

Major outcomes of EUROSYSLIB include extensions of the Modelica language and a large set of high-value, innovative modelling and simulation libraries. Modelica was also integrated into Dassault Systèmes CATIA and ENOVIA tools and the LMS Imagine AMESim tool. Improvements were made to the Dynasim Dymola tool and the INRIA Scicos tool. And an interface was developed between the Dassault Systèmes SIMULIA tool and the Modelica FlexibleBodies library.

The ITEA 2 project also investigated topics such as:

- Data persistence;
- Multi-target platforms;
- Hybrid systems;
- Library protection; and
- Dysfunctional/safety analysis and Modelica.

Overall, EUROSYSLIB developed 13 open-source libraries, 18 commercial libraries and 13 software enhancements covering electrical and electronics systems, thermo-fluid systems, control systems and vehicle systems.

Standardisation of EUROSYSLIB language developments was carried out through the international non-profit Modelica Association, founded in 2000, which has adopted 10 major extensions. Guidelines were also produced for future library development and have been proposed to Modelica.

Exploitation underway

Exploitation for most of the results is underway. Open-source libraries are distributed via the Modelica Association (www.modelica.org/libraries), while commercial libraries are distributed by Dassault Systèmes, LMS International, Bausch-Gall and Claytex.

Commercial software enhancements developed in EUROSYSLIB are included in the products of Dassault Systèmes and of LMS International.

Extensive dissemination of the results was carried out during the ITEA project. Dassault Systèmes also plans to host an open Modelica community platform to continue the work.

More information:
www.eurosyslib.com