# FORM-L: A MODELICA Extension for Properties Modelling Illustrated on a Practical Example

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Systems engineering methodologies for complex systems increasingly rely on, or could benefit from, modelling and simulation. For MODELICA to support activities such as functional validation of system requirements, design verification against requirements, testing, dysfunctional analyses and verification of operational procedures, the ITEA2 MODRIO project is developing extensions to the language. One of them concerns formal requirements and properties modelling, and is called FORM-L (FOrmal Requirements Modelling Language). This paper presents the main concepts underlying FORM-L, and illustrates them with examples taken from a MODRIO case study, the Backup Poser Supply (BPS) system.

Section 2 presents the main objectives assigned to FORM-L. Section 3 introduces briefly the BPS case study in oder to provide a background context for the examples given in the floowing sections. Section 4 presents how FORM-L considers *functions*, *constants* and *fixed* variables. Section 5 introduces the notions of *condition* and *event*. Section 6 presents the notions of *properties*, *requirements*, *assumptions* and *guards*. Section 7 presents the notion of *time locator*, continuous or discrete. Section 8 presents how FORM-L views *sets* and *arrays*. Lastly, Section 9 presents how *actions* are modelled in FORM-L.

*Keywords: physical modelling; requirements modelling; systems engineering*

## References

[1] Schamai W., Buffoni L., Bouskela D., Fritzson P., 'Automatic Model Composition using Bindings in Modelica', Modelica 2014 conference proceedings, Lund, 2014.

[2] Bouskela D., El Hefni B., 'A physical solution for solving the zero-flow singularity in static thermalhydraulics mixing models', Modelica 2014 conference proceedings, Lund, 2014.

[3] Bouskela D., Jardin A., Nguyen T. 'Innovative Modelling Architecture for Design Verification against System requirements', , Modelica 2014 conference proceedings, Lund, 2014.

[4] Bouskela Daniel, MODRIO Toolset architecture

[5] Fritzson P., Principles of object-oriented modelling and simulation with MODELICA

[6] Harel David, Statecharts: a visual formalism for complex systems, In Science of Computer Programming, vol. 8, pp. 231-274, 1987

[7] Jardin A., EuroSysLib - Properties modelling

[8] Marcon F., EuroSysLib – Synthesis of needs within EDF, EDF technical report, 2009

[9] Nguyen Thuy, MODRIO - FORM-L, 2013

[10] Nguyen Thuy, MODRIO - Methodology, 2014

[11] Nguyen Thuy, MODRIO - The Backup Power Supply (BPS) case study, 2013

[12] Rapin Nicolas, ARTiMon: outil de monotoring de propriétés

[13] Schamai W., Model-based verification of dynamic system behavior against requirements

[14] Thomas E., Chastanet L., EuroSysLib - Dysfunctional: use cases and user requirements, Dassault Aviation technical report, DGT116083B, June 2009

[15] Vered Gafni, SPEEDS: Contract Specification Language (CSL)