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To cite this version:

Idir Ait-Sadoune. OntoEventB: A Generator of Event-B contexts from Ontologies. 9th Rodin User and Developer Workshop, Jun 2021, Ulm, Germany. hal-03265730

HAL Id: hal-03265730

https://hal.science/hal-03265730v1

Submitted on 21 Jun 2021

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OntoEventB: A Generator of Event-B contexts from Ontologies

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1 Introduction

When designing hardware or software system, the integration of domain constraints becomes a determining factor to ensure a great match with the system requirements. This domain knowledge is most often modelled using ontologies that allow the expression of the domain properties. In the IMPEX project[1], we propose an approach to integrate domain ontologies into a system development process based on Event-B. It consists to annotate Event-B models using the ontology concepts, this assumes a formalization of the domain ontology in the Event-B method. Therefore, we propose an extensible generic transformation approach that develops an Event-B specification based on an ontology described in an ontological language. The integration of the domain ontology allows to constrain the system under design with the domain ontology and to validate domain properties.

In this paper, we present a generic approach to integrate domain description formalized by ontologies (OWL, OntoML, ...) into an Event-B formal development process. The proposed approach is conducted by transformation rules that define each ontological concept, the corresponding Event-B formalisation leading to build Event-B contexts expressing ontology concepts. This approach is implemented by the OntoEventB plug-in that has been developed to automatically support the formalisation of ontologies using the Event-B method.

2 Domain constraints integration approach

In order to integrate domain ontologies in the Event-B development process, we propose to formalize the ontology as a system data model within a context component. Thus, the machine variables take their values in ontology concepts and inherit domain constraints. The proposed integration approach is operated in a three steps process:

[1] This work was supported by a grant from the French national research agency ANR ANR-13-INSE-0001 (IMPEX Project http://impex.loria.fr).

1. *Formalization step.* The first step in the development process consists to formalize the system in the Event-B method. This leads to developing the machine component modelling the system behaviour using variables and events.
2. *Transformation step.* During this step, the domain ontology is translated into Event-B formalism. An ontology is translated into an Event-B context using sets, constants and axioms.
3. *Annotation step.* Once the context describing the ontology obtained, the integration of domain constraints is carried out by annotating machine variables by ontology context entities.

3 Ontology transformation : The *OntoEventB* plugin

The development of a transformation approach emerges as a natural choice for the expression of an ontology description in the Event-B language. This approach allows the transformation of an ontology described into an ontology language into an Event-B specification. It takes as inputs the constructs used to describe an ontology in the different ontology languages and as outputs Event-B language constructions. The transformation approach is based on correspondences between ontology languages and the Event-B language semantics.

The proposed ontology transformation approach in Event-B, detailed in [2,1], is fully supported by the *OntoEventB* RODIN plug-in[2] that automatically produces the Event-B formalization related to an ontology (OWL or Plib). The *OntoEventB* plugin takes as input an ontology description file and generates the corresponding Event-B Context.

4 Conclusion

Our results show that it is possible to handle formally domain knowledge in formal system developments with Event-B and the Rodin platform. Ontologies have been formalized within Event-B as contexts and a Rodin plug-in has been developed for this purpose. The proposed approach consists of defining models allowing to handle formal verification techniques and make it possible to handle explicit domain knowledge in such formal models.

References

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2. Mohand-Oussaïd, L., Aït-Sadoune, I.: Formal modelling of domain constraints in Event-B. In: Model and Data Engineering - 7th International Conference, MEDI 2017, Barcelona, Spain, October 4-6, 2017, Proceedings. pp. 153–166 (2017)

[2] OntoEventB : https://wdi.supelec.fr/software/OntoEventB/