A Method Fragment for Transforming Gaia or ASEME Liveness Formulas to BPMN Models for Simulation

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This work shows how an engineer can use Liveness formulas for modeling the dynamic behavior of an agent role and then transform the formulas to a process model compliant to the modern Business Process Modeling Notation (BPMN). The Agent Systems Engineering Methodology (ASEME) employs this text to model (T2M) transformation for being able to simulate the system models even after just the analysis phase. However, a Gaia Methodology fragment could be integrated with this process as well. This transformation is useful as a number of tools allow for simulating process models, even optimizing them. Thus, a number of the system's (non-functional) requirements can be evaluated. This helps an engineer to build a better system capturing its requirements but also a project manager to select the appropriate resources based on the performance of the technologies proposed in an analysis phase iteration.

There are situations, when modeling multi-agent systems (MAS), in which the designer wants to simulate the system model even as early as just after the analysis phase. Moreover, there exist situations in massive multi-agent systems (MMAS) where the number of executing agents is very important for measuring future system stability and performance. Simulation can aid in the early verification of some of the system's properties (even the satisfaction of non-functional requirements such as the timely response to a situation). Furthermore, through simulation, a system's capability to scale can be determined by defining and executing different scenarios. Process modeling tools provide engineers with the ability to model their system's processes, to implement and execute them. Modeling and simulation functionality allows for pre-execution "what-if" modeling and simulation. Post-execution optimization may also be available.

This work presents the method fragment that uses the result of the ASEME ([3], [4]) analysis phase, which is the Systems-Roles Model (SRM), and transforms it to a process model compliant with the modern Business Process Model Notation (BPMN [2]) standard (see Figure 1). The capability of such process models to be used for verification and simulation of system properties but also for evaluating the scalability of the systems has been demonstrated through a case study [5]. Method fragments are reusable methodological parts that can be used by engineers in order to produce a new design process for a specific situation [1]. Since the Gaia methodology also produces the dynamic behavior of the roles in the form of liveness formulas, the method fragment presented herein can be combined with Gaia-based [6] system development.

For transforming the liveness formula of the SRM model to a BPMN model, we need to transform it to a valid BPMN graph. After this process the software engineer

has a ready BPMN model for each role presented in the SRM model. The next step is to use this model to simulate the system. If it is a single-agent system it can immediately be used as is for simulation, verification and optimization. Considering a multi-agent system design, however, the individual process models must be combined into a functional eco-system (the Integrated MAS model shown in Figure 1). This fact raises some additional transformation requirements and the needed information exists in the ASEME Agent Interaction Protocols model (AIP). The details for the transformations are provided in [5].

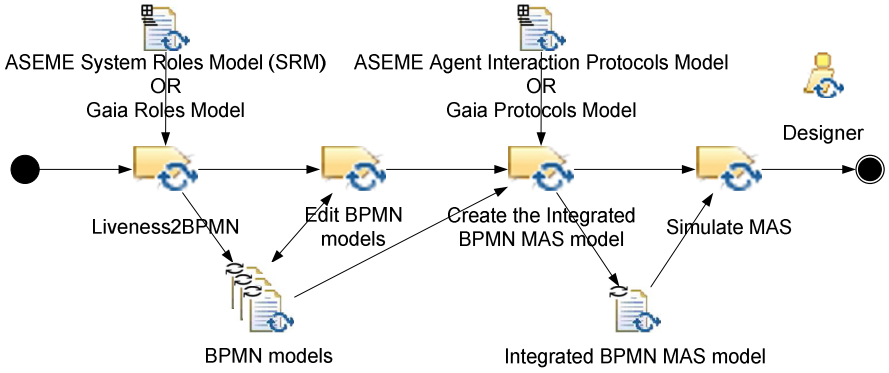

Fig. 1. The method fragment for simulating MAS models based on BPMN.

The final product of our method fragment is a process model which is available for simulation, which allows the designer to a) determine if the system meets its requirements, b) determine how the system would scale, c) identify errors in system conception and propose strategies for resolving them either through a next development iteration (including risks calculation and different technology use) or by directly returning to the phase that introduced the error and restarting from there (useful in agile development), and, d) optimize the system regarding resource allocation and utilization. All these issues are rarely tackled by existing AOSE methodologies.

References

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