Modelling of Change Response in Interweaving Systems as Ontology Alignment Adaption

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Interweaving Systems [TRBW16] are usually defined as systems that have not been designed to cooperate at runtime, but can influence each other at runtime by interacting through a shared environment. Interweaving systems usually work under conditions that require some kind of soft or hard real-time constraints. Therefore, they are first and foremost optimized to hold these constraints. Optimization for domain-specific goals of the system are usually regarded as less important. However, deliberate cooperation between interweaving systems can potentially improve these soft aspects without touching the real-time/safety critical part.

Wether a shared view on the environments of Interweaving Systems can improve cooperation and performance regarding domain-specific goals is still an open question. A first step to address this question consists in designing and evaluating respective approaches. As the typical environments of Interweaving Systems are prone to changes and as parts of such systems can fail, appropriate approaches have to particularly consider these issues, too.

In this work, we present a general approach to support Interweaving Systems in creating a shared view on their environment. The general approach is based on knowledge based techniques such as ontologies and inference. To allow systems to access this shared view, a modification of these systems is required. What kind of information systems can gather about the environment (e.g., what sensors they can use to observe it) is modeled via a global ontology. Each system can view this global ontology and use it to request more information regarding specific aspects of the environment. In this way, systems will only receive data on the environment that is relevant to them. What kind of information is relevant to a system is modeled in a local ontology that is connected to the global ontology using ontology alignments. Changes in the environment and system failures require that this alignment is constantly adapted. This issue is addressed with a technique called Ontology Mapping Adaption [GDRH$^+$13].

In our previous work, we presented a domain-specific approach to this problem for interweaving systems in the domain of autonomous traffic-control [JI17]. The main contribution of this paper is twofold: (1) We present an abstract approach, that shows how our approach can be applied to interweaving systems in general. (2) We show how the case study of [JI17] fits into the application of the abstract approach. This includes an evaluation of how the approach needs to be tailored to the specific use case and which model transformations need to be implemented. We also demonstrate, how autonomous systems can use this data and how the shared view on the environment can be useful.

References

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