Spider Diagrams for Policy Modelling

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General Goal

In the context of safety and security of dynamic systems, policies propose a natural way to frame a system’s behaviour.

Here, we propose a formal modelling framework for specifying policies and reasoning about policy conformance. We aim at both:
(i) a rigorous formal underpinning for reasoning and (ii) an “intuitive” visual front end for the domain expert.

Timed MSDs

Goal: Express policies with temporal constraints.

Step 1: Adapting Spider Diagrams to OO Modelling leads to two classes of Modelling Spider Diagrams (MSDs)

Type-MSD

Instance-MSD

conformance

confirms

does not confirm

Step 2: Embed notion of Timed MS in policy framework

A Policy is a triple
• validity
• trigger
• set of constraints

validity(time,Event, policyChange)

trigger(Time)

Type graph of Car Parking MSGs

Annotating spiders with expressions over interval algebra permits the description of permissible states of objects in time.

Results: Full featured formalism to specify and reason on policies based on novel Modelling Spider Diagrams enhanced with interval annotations.

References:

Coloured (M)SDs

Goal: Distinguish different types of annotations in MSD via their colour to aid the policy modeller.

Idea: Represent different orthogonal annotation layers with the help of colouring.

Complex constraint on the evolution of the system

Annotation sets:
• Car states (Running, PremiumParking)
• Parking place states (allocated or not)
• Being a member (e.g., having a membership card)
• Length of both car and parking place

Results: Enlarged visual depth for MSDs.

References:

Ongoing

• Different modes of interactions of different policies.
• Proposing generic policy specification and reasoning framework.
• Specification of constraints by adding temporal logic operators.
• Tool support.

Parking Domain

Parking places: P P

tall parking (toll free parking)

Vehicle states: running

tall parking

free parking

Example policy rules:
• Ambulances cannot be in toll parking.
• If a Car is in free parking, it is occupying a free parking space.
• A Car can stay at most 60 min in free parking, and before returning, it must be either running or stay in toll parking for at least 120 min.

Policies with Resources

Goal: Express dependency of evolution of elements under a policy from additional resources (e.g., right type of parking place available).

Step 1: From MSDs to Modelling Spider Graphs (MSGs)

Step 2: Synchronisation of evolution via grammar rules

Results: Proper foundation of policy reasoning (including resource annotations) via graph-transformation rules.

Extends:

Annotated MSDs

Goal: Express annotations, e.g., the relation of domain elements to resource elements, directly in MSD while remaining in a subset of Ss that can be handled by existing SD-reasoning techniques.

Step 1: Introduce Annotated SDs (ASDs)

Enhance SD with annotation “arrows” that define directed relations between elements of a hierarchy of domains.

Step 2: Express constraints with Modelling ASDs

Directly represent negative application conditions in diagrammatical setting.

Results: Lift foundation in graph transformation rules back to Spider Diagrams via novel notion of Annotated (Modelling) Spider Diagrams.

References:

Collaboration

Principal researchers are Paolo Bottoni (Sapienza University of Rome) and Andrew Fish (University of Brighton) joined by Alexander Heußner (University of Bamberg) and Francesco Parisi Presicce (also Sapienza University of Rome).