An Ontology of Environments, Events, and Happenings

Vadim Ermolayev, Natalya Keberle  Knowledge representation
Zaporozhye National University

Wolf-Ekkehard Matzke  Agents, domain expertise
Cadence Design Systems GmbH

July 28, 2008, Turku, Finland
Outline

• Material that is important, but not in the paper …
  – Space constraints, or some progress beyond the CR
• Why do we need E2H in Performance Simulation Initiative?
• What is the place of E2H ontology in our KR framework?
• What are the (reasons for) our ontological choices? With examples …
  – Environments; Time; Events versus Actions; Events Versus Happenings
• Implementation and Use
Performance Simulation Initiative

- R&D project of Cadence Design Systems GmbH
  - 2005 - ongoing
  - Goal: Assess and Manage Performance in Engineering Design
  - Domain: Microelectronics and Integrated Circuits
  - Method: knowledge-intensive, agent-based simulation of:
    - A Design System and
    - A Dynamic Engineering Design Process

- A “horizontal” framework:
  - Plugged-in focused activities
  - Cooperation with other projects
    - PRODUKTIV+ (BMBF, http://www.edacentrum.de/produktivplus/)
    - ACTIVE IP (EC FP7, http://active-project.eu/)

Peter van Staa, Inv. talk at HoloMAS’2007
Performance Assessment and Management
Engineering Design Processes, Microelectronics and IC

“Design productivity breakthroughs [are] mandatory to win the design race!”
Peter van Staa, Bosch Automotive Electronics
Inv. talk at HoloMAS’2007
Environments, Events, Happenings and Observers

- **Event**: a manifestation of a **Phenomenon** which can be sensed (and measured)
  - **Phenomenon**: season change
  - **Event**: Spring

- **Happening**: an act of **Event** sensing by a particular **Observer**
  - in different **Environments**:
    - I sensed Spring in Australia (take-off), but Autumn in Europe (landing)
  - By different **Observers**:
    - I sensed a flight attendant passing by
    - But my buddy - a rabbit crossing the runway

- **Environment**: a temporal aggregation of **Objects** which surround the **Object** or the **Process**
  - **Object**: *Me* or **Process**: *Take-off*
  - **Environment**: The aircraft, the crew, the other passengers, the runways, the control tower, the rabbits and the seagulls around, …
Environments, Events, and Happenings in PSI

• Agent-based simulation:
  – Nested, dynamic, stochastically influenced Environments
  – Collaborative, loosely defined, ramified, “stochastic” Processes
  – Actors playing different Roles in different Processes
Engineering Design or Another World of “Death March Projects”*

* Coined by Edward Yourdon, Death March, Prentice Hall, 2003

Faster! Cheaper! Smaller!
Environments, Events, and Happenings in PSI
Examples in Microelectronics and IC Design

• Environments:
  – Of an Engineering Design Process:
    • A Design System
  – Of a Designer – previous slide

• Events:
  – Internal to a Design System: Netlist Design Artifact representation for the designed chip has met quality requirement
  – External: Spec change by a customer

• Happenings:
  – I found out that the Netlist provided by my fellow college is crap
  – My fellow college found the bug in my GDS II layout
  – I noticed that the block design provided by ABC does not fit the interface
  – …
PSI Environment-Event-Happening Ontology
PSI Time

- Linear, anisotropic, discrete (Time Crisp)
- Time intervals are fuzzy (Time Fuzzy)
  - “Springing” schedules
  - Accounting for stochastic appearance
  - …
Time Fuzzy: Extension of Time Crisp (Allen)

- Fuzzy time interval:
  \( I = \{T^b, T^i, T^e, f\} \)
- \( T^i \)- the Core – inner instants
- Beginning and Ending sets:
  - Beginning \( (T^b = \{t^b\}) \): \( \forall t_j^b : t_j^b > t^b \rightarrow t_j^b \in T^i \)
  - Ending \( (T^e = \{t^e\}) \): \( \forall t_j^e : t_j^e < t^e \rightarrow t_j^e \in T^i \)
- Discrete membership function: \( f : Z \rightarrow [0,1] \) - individual for Agents
- Thresholds: reputation and confidence
- Rich set of axioms extending Allen’s time interval logic
- More details in our UNISCON 2008 paper
Event vs Action

• Occasionality vs pro-activity

• Event:
  – Objective manifestation of a tangible change in an Environment

• Action:
  – A kind of an Event
  – Performed by Agent
  – Who has a goal to be reached
  – Decision
Event vs Action

- **Occasionality vs pro-activity**
- **Event:**
  - Objective manifestation of a tangible change in an Environment
- **Action:**
  - A kind of an Event
  - Performed by Agent
  - Who has a goal to be reached
Event vs Action

- **Occasionality vs pro-activity**
- **Event:**
  - Objective manifestation of a tangible change in an Environment
- **Action:**
  - A kind of an Event
  - Performed by Agent
  - Who has a goal to be reached
Event vs Happening

- **A Happening** is the perception of the **Event** by the **Observer** situated in the **Environment**
  - Happening → PSI-META:AtomicAction
  - Happening is instant (no duration)
  - Happening is performed by an Observer
  - Observer → PSI-META:Agent

- **Event**: Petrol retail price change

- **Happening**: I got the receipt with the new petrol price
Simulation Tool: WBS generation
Simulation Tool: Design Process Simulation
Summary and Outlook

• E2H ontology provides new modeling features for open, dynamic and semantically rich domains  
  – e.g. Engineering Design
• E2H has been implemented (OWL-DL) a part of the Core of PSI Suite of ontologies v.2.2
• E2H has been evaluated (as part of PSI Core) using Shaker Modeling Methodology for Ontology Refinement  
  – More details in our ER 2008 paper
• E2H is used (as part of PSI Core, Crisp Time) in Cadence Process Planning Expert System
• Future work:  
  – Time Fuzzy enhancement used in Cadence Software  
  – E2H refinement to model context sensitivity (e.g. for FP7 ACTIVE IP)
Questions Please