

Simulation of Model Execution for Embedded Systems

MLE 2019, Munich

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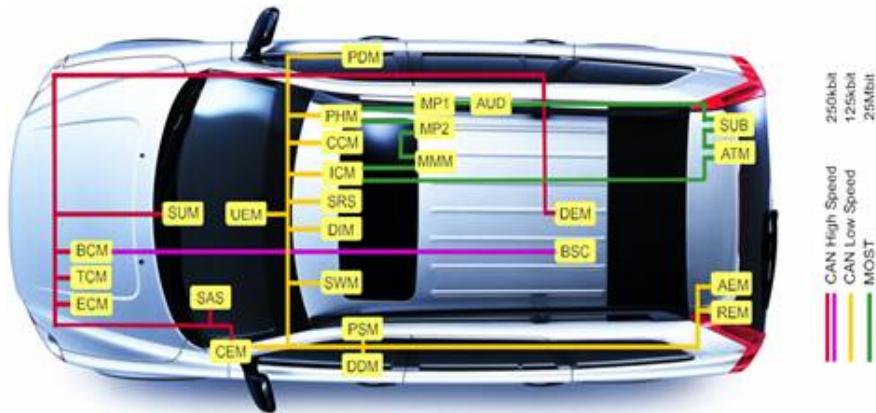
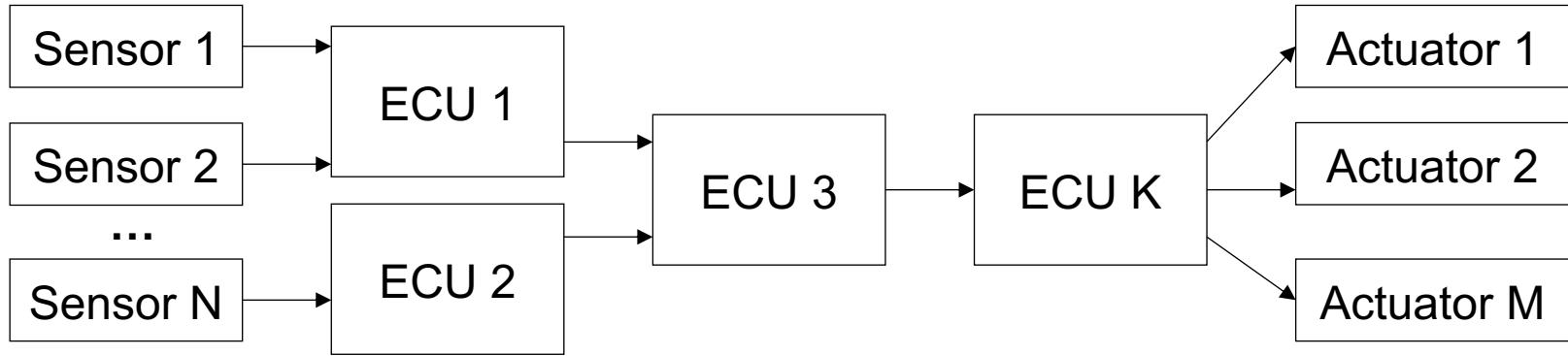
Software Engineering

RWTH Aachen

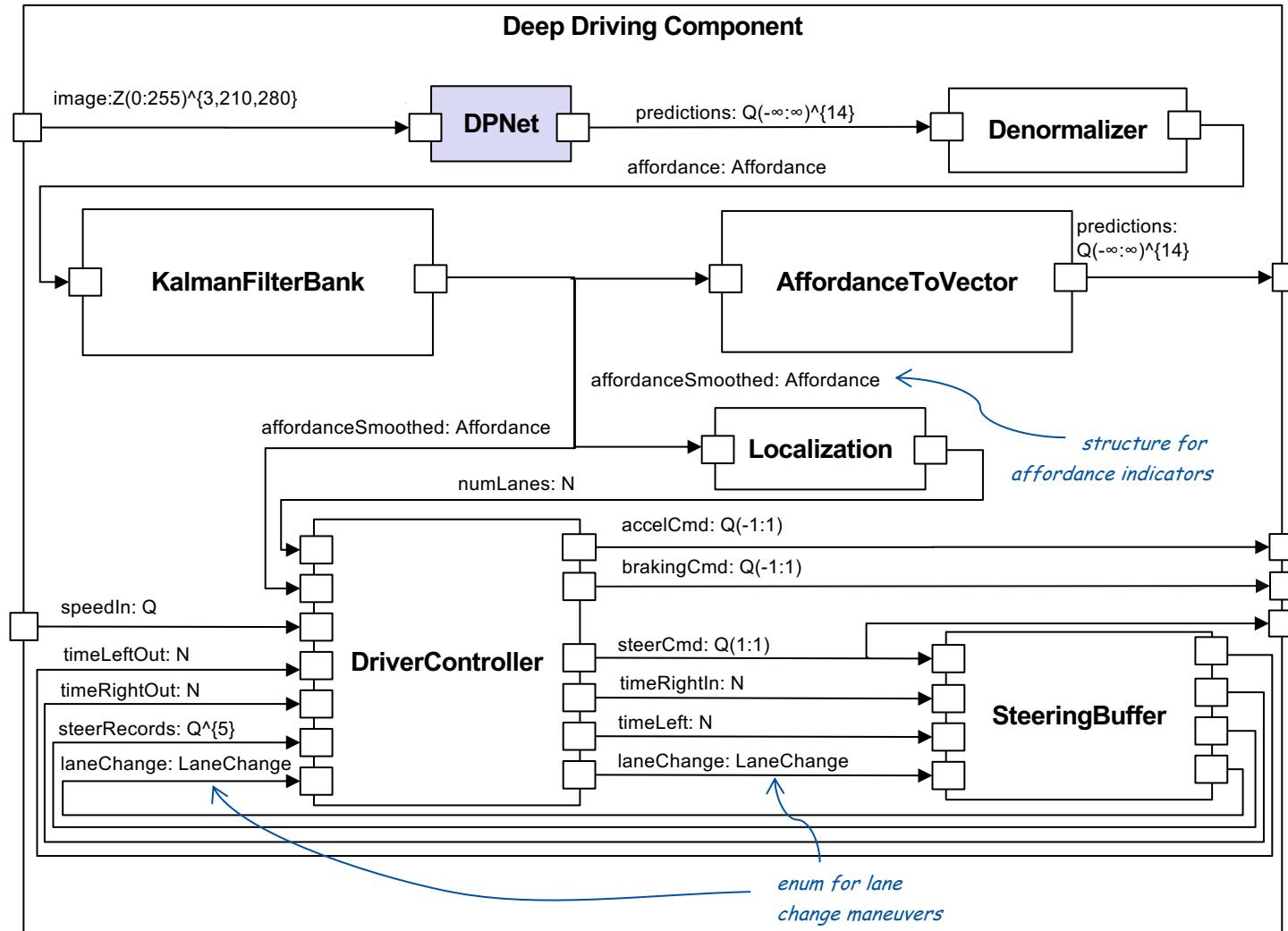
<http://www.se-rwth.de/>

Motivation

- Our mission: provide MBSE methodologies for the automotive domain
 - EmbeddedMontiArc: Modeling language for automotive systems

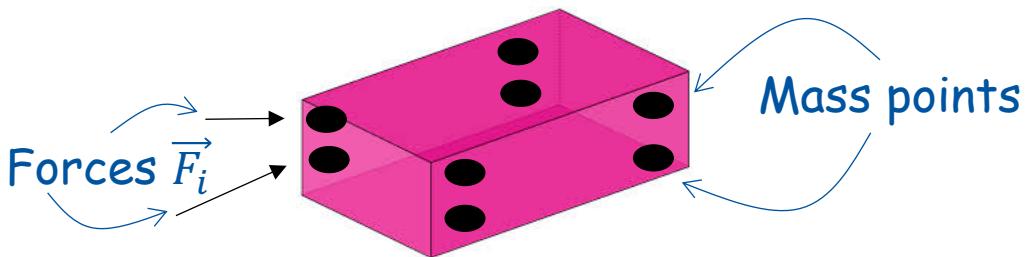
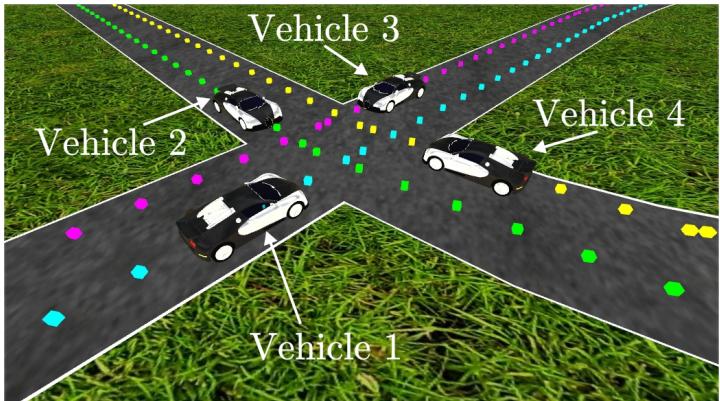


EmbeddedMontiArc



MontiSim

- Browser based 3D visualization
 - Simulator: Java
 - Visualization: JavaScript / ThreeJS
 - Enables CV + ML capabilities
- Environment model
 - OpenStreetMap
 - Probabilistic models for pedestrian behavior
 - Weather effects (e.g. changing the friction coefficient)
- Physics engine
 - Discrete time
 - Rigid body based (Euler loop)
 - Collision detection



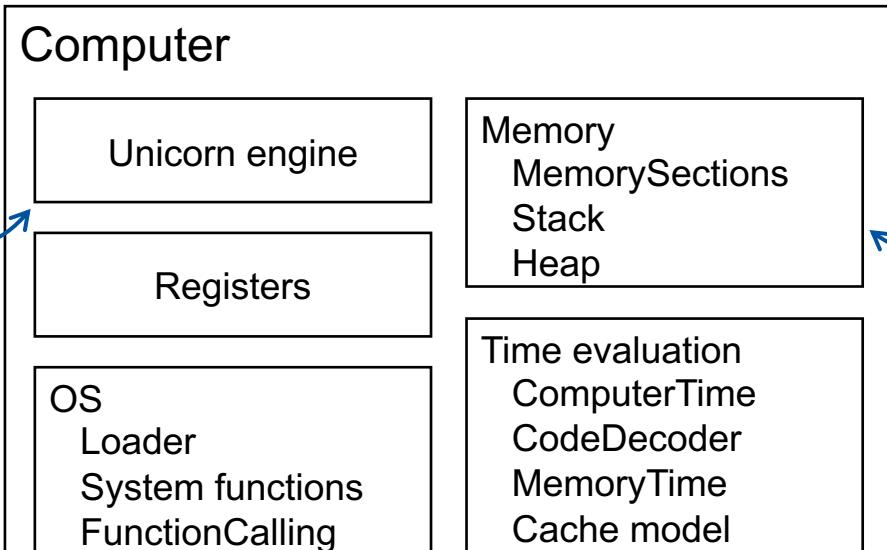
Requirements

- **R1** The emulator must reproduce the real logic behavior of the emulated software
- **R2** Evaluate the execution time of the emulated software
- **R3** Reproducibility of the simulations (independently of the platform and hardware used)
- **R4** Allow the emulation of software compiled for other platforms
- **R5** Variability of the hardware models
- **R6** The hardware emulator can be used to emulate any program and evaluate their execution time

Concept

Emulate execution on hardware

Abstract from OS-specific functionalities



1	os	= windows	Hardware
2	cpu_frequency	= 1500000	
3	memory_frequency	= 150000	
4	cache_DL1	= 128, 1, 2	
5	cache_IL1	= 128, 1, 2	
6	cache_L2	= 1024,10,15	

Abstract from low-level C memory interface of the Unicorn engine

Connect to monitoring hooks of Unicorn engine and calculate needed time, based on hardware parameters

Defines parameters of the hardware

UNIX vs. Windows

Identification header

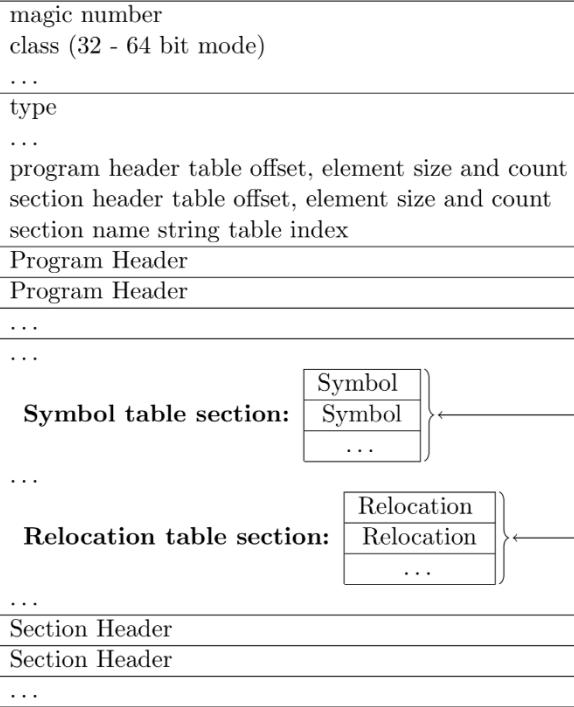
ELF header

Program Header table

Sections

Section Header table

ELF File:



PE File:

DOS

COFF

Optional header:

- Entry point
- Base address
- Image size
- Section alignment
- ...

Data directories:

- Export Table
- Import Table
- ...

Section Table

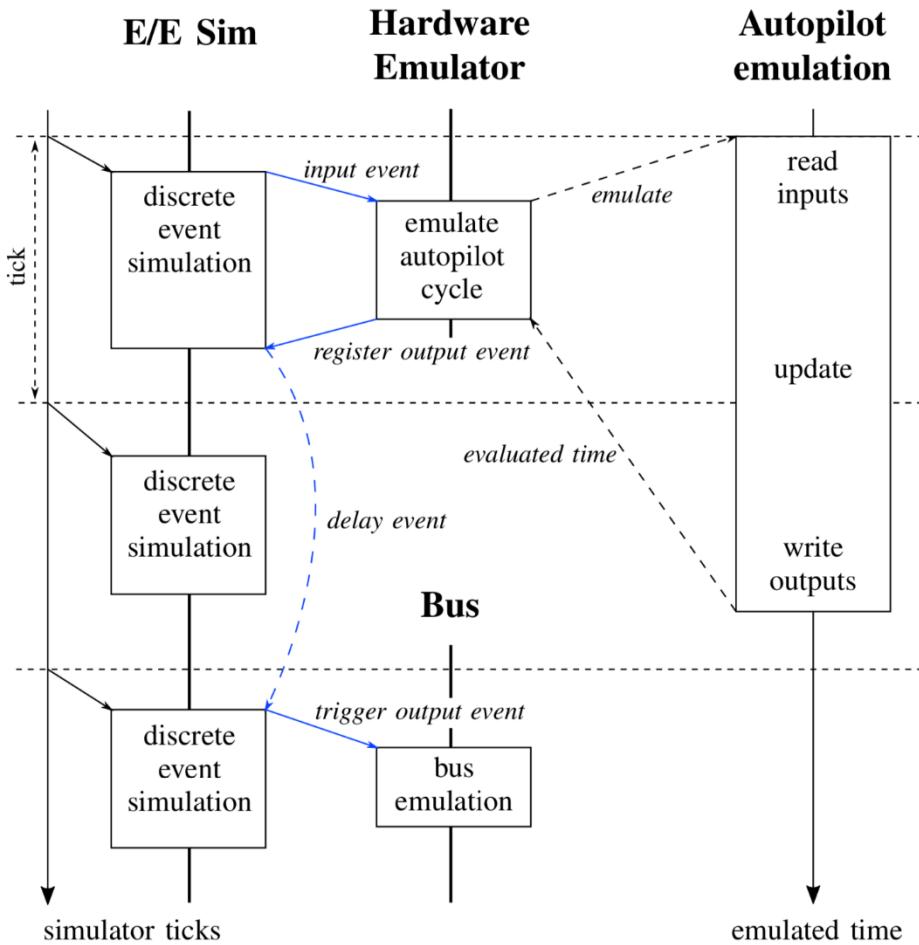
Sections

*Executable and Linking Format
(UNIX)*

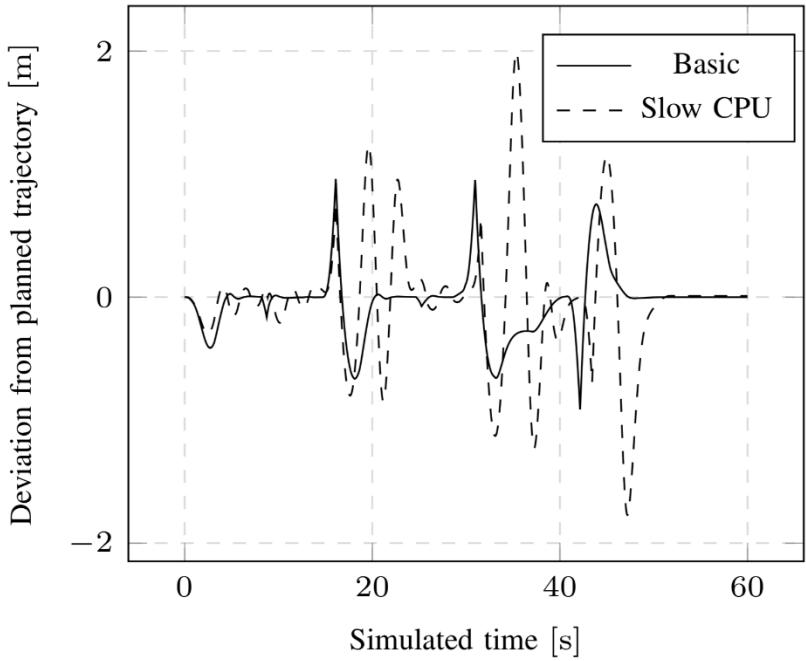
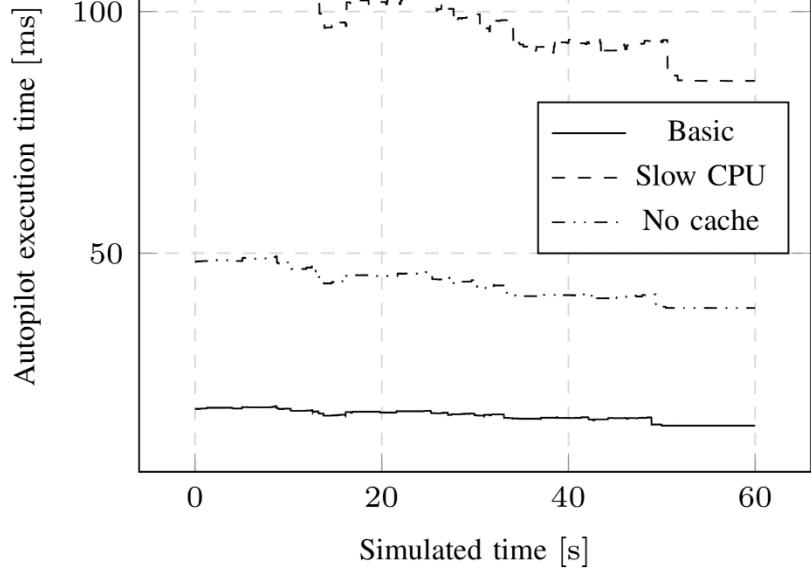
*Portable Executable
(Windows)*

EmbeddedMontiArc Integration

1. Discrete event simulator calls hardware emulator
2. Hardware emulator calculates outputs and time needed on real hardware
3. Discrete event simulator delays the output event according to the time estimation of the hardware emulator



Evaluation



Conclusion

