

Parallelisation of Construction Machinery Control Code

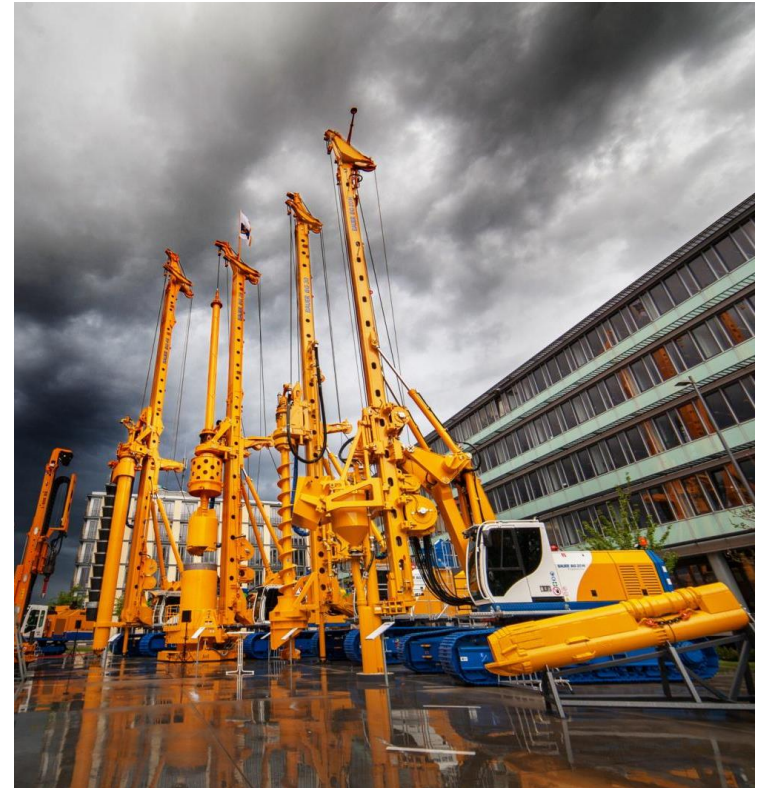
Andreas Hugl
BAUER Maschinen GmbH

Construction Machinery Domain

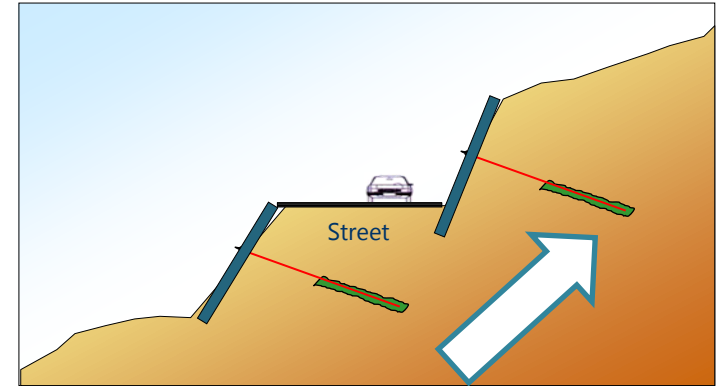
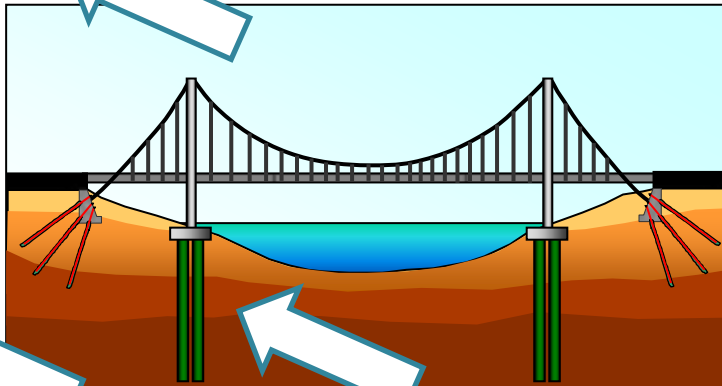
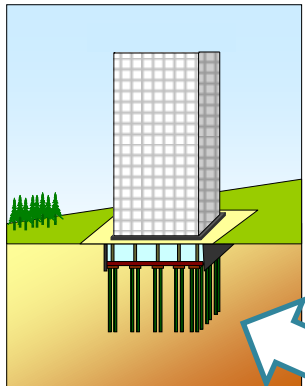
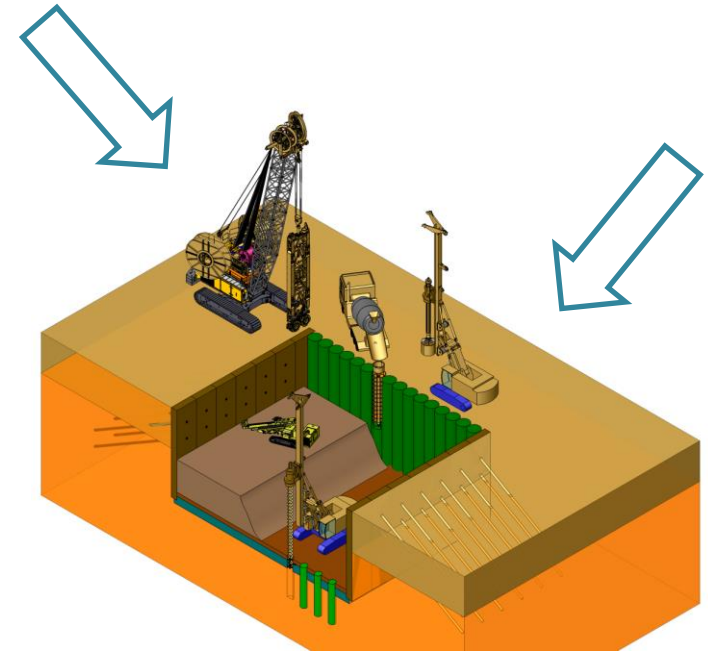
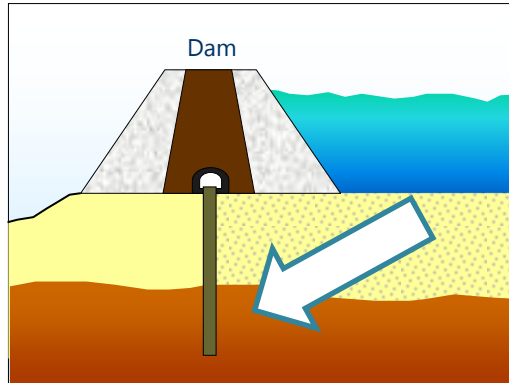
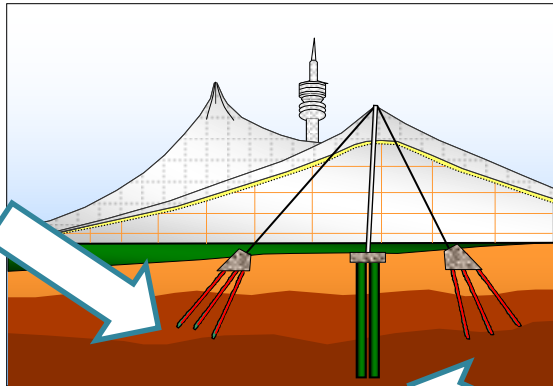
Andreas Hugel

- Introducing BAUER
- Our application: Dynamic Compaction
- Simulation on parMerasa-Simulator
- Results

- Specialist foundation engineering equipment
- For exploration, mining and safeguarding of valuable natural resources
- Research, Development and Manufacturing
- 2,500 employees
- production plants and construction projects all over the world
- Revenue of 390 Mio € in 2013
- Market leader since the late 1960s
- Based in Schrobenhausen, Germany



What is specialist foundation engineering?



Dubai Juharai Palm Island



Burj Khalifa (828 m) Kingdom Tower (1001 m)



Rotary Drilling Rig

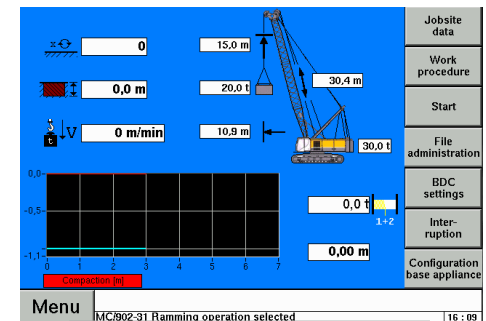
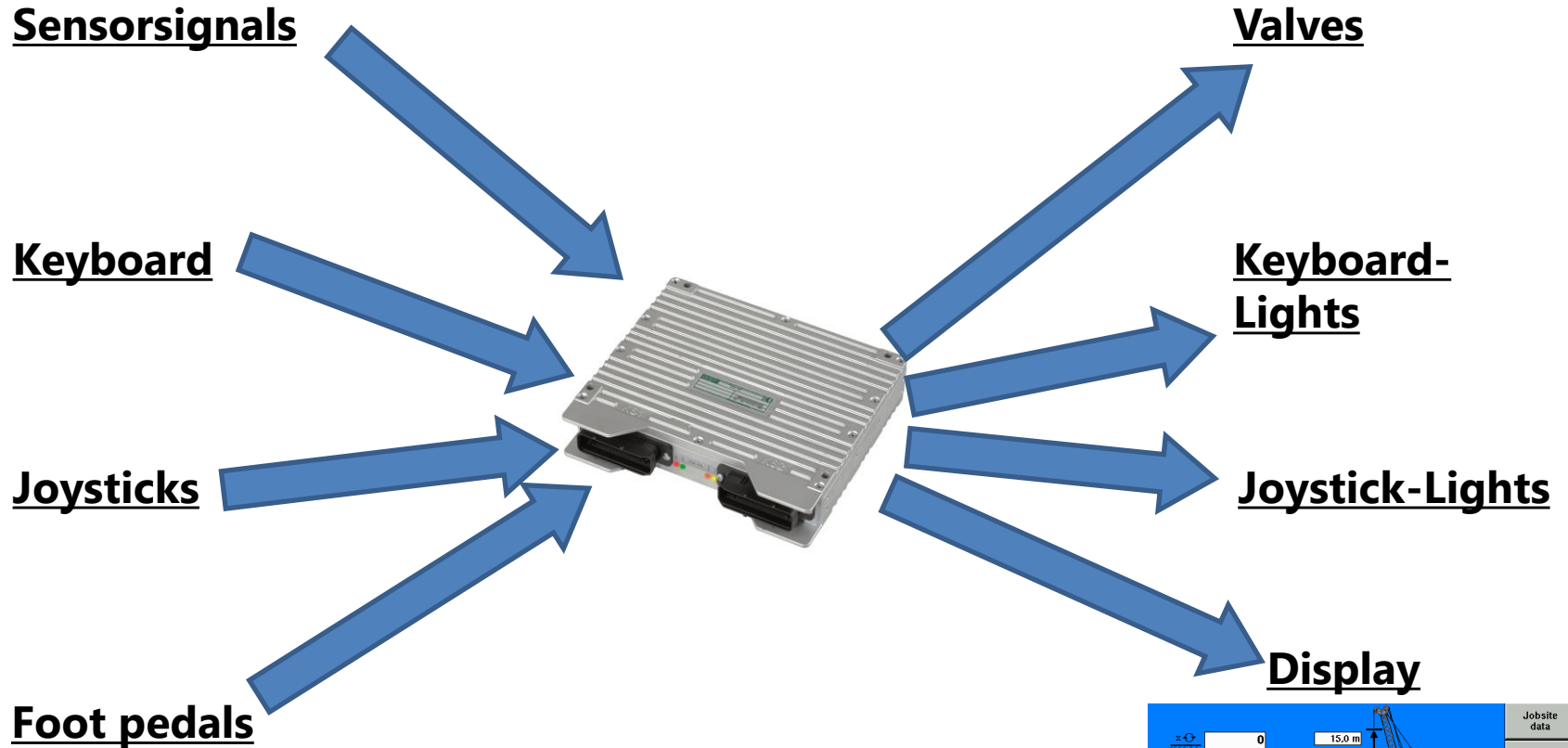


Pile Drivers



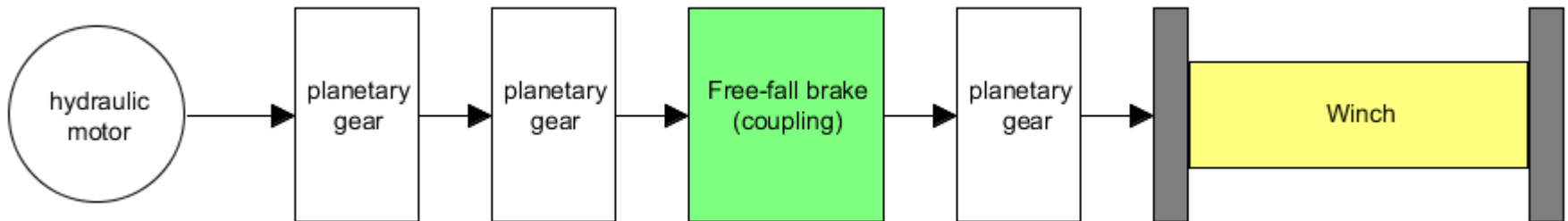
Foundation Cranes



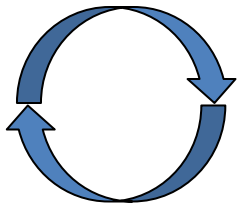
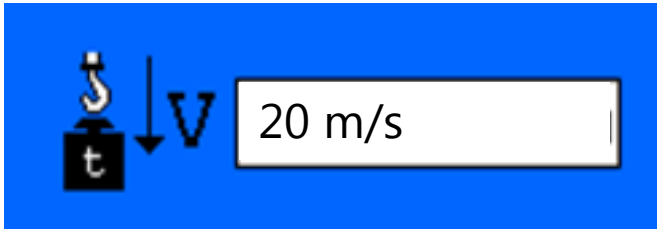


BAUER Dynamic Compaction

- Fully automatic control of winch function during working cycle
- Step 1: Lift the pounder on drop height
- Step 2: Drop pounder
- Step 3: Stop the winch at the right moment

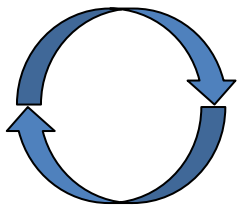


Some facts about our application:

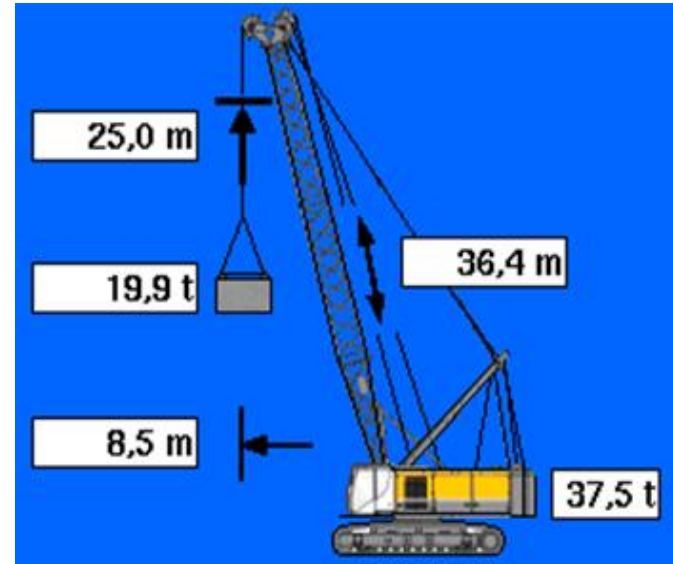


100 ms => 2 m

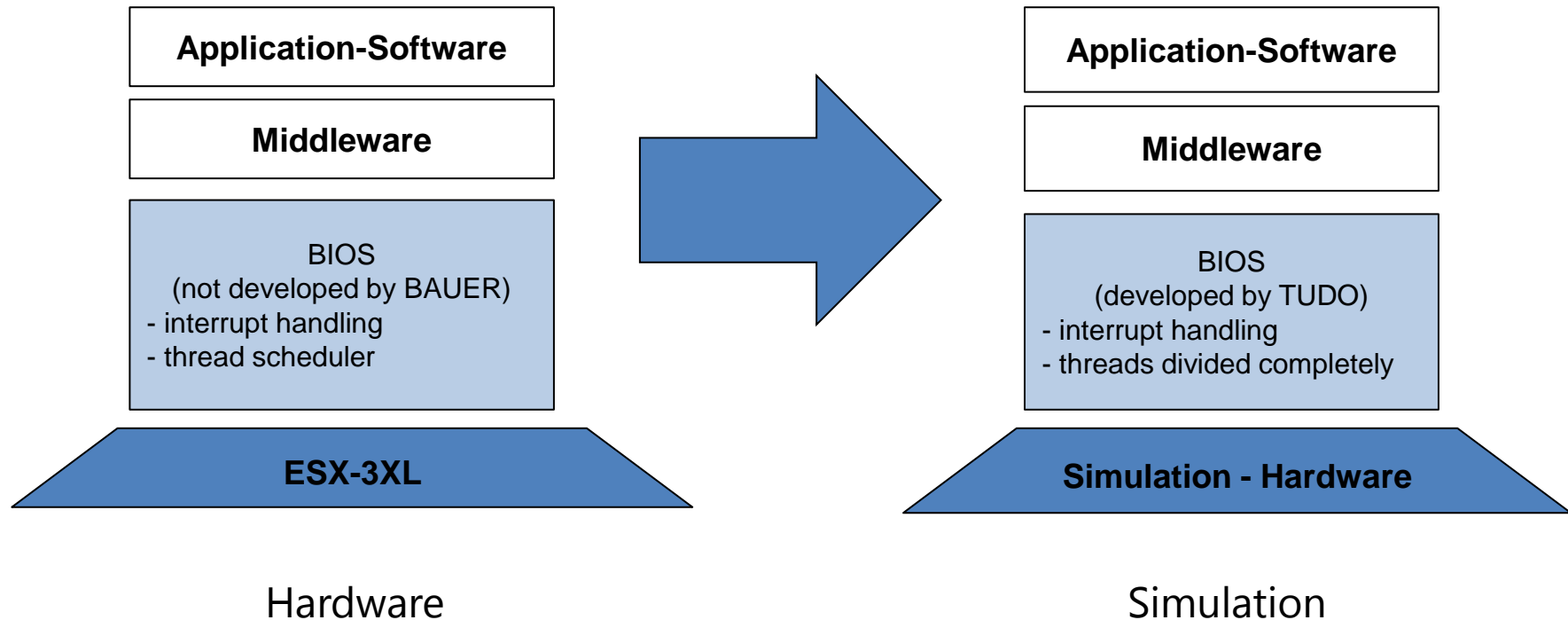
period duration of the control algorithms



20 ms => 0,4 m

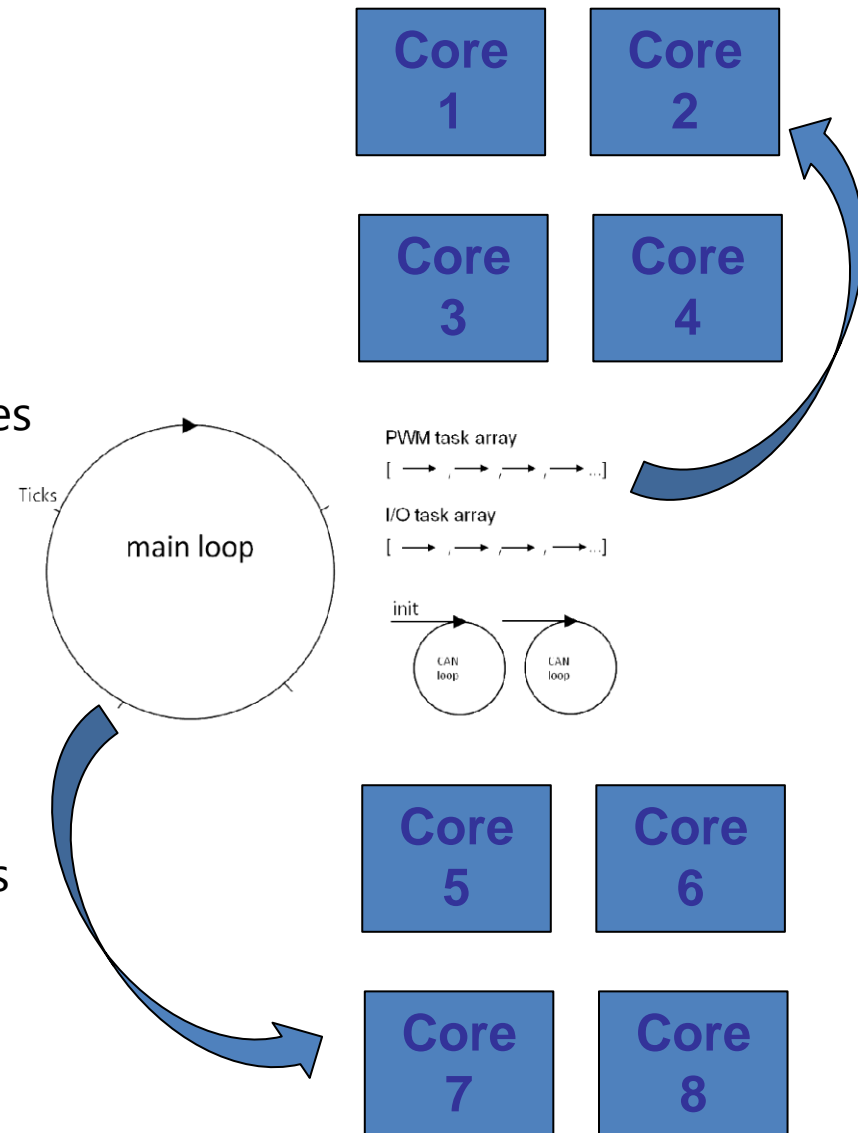


How can our application run on the simulator?

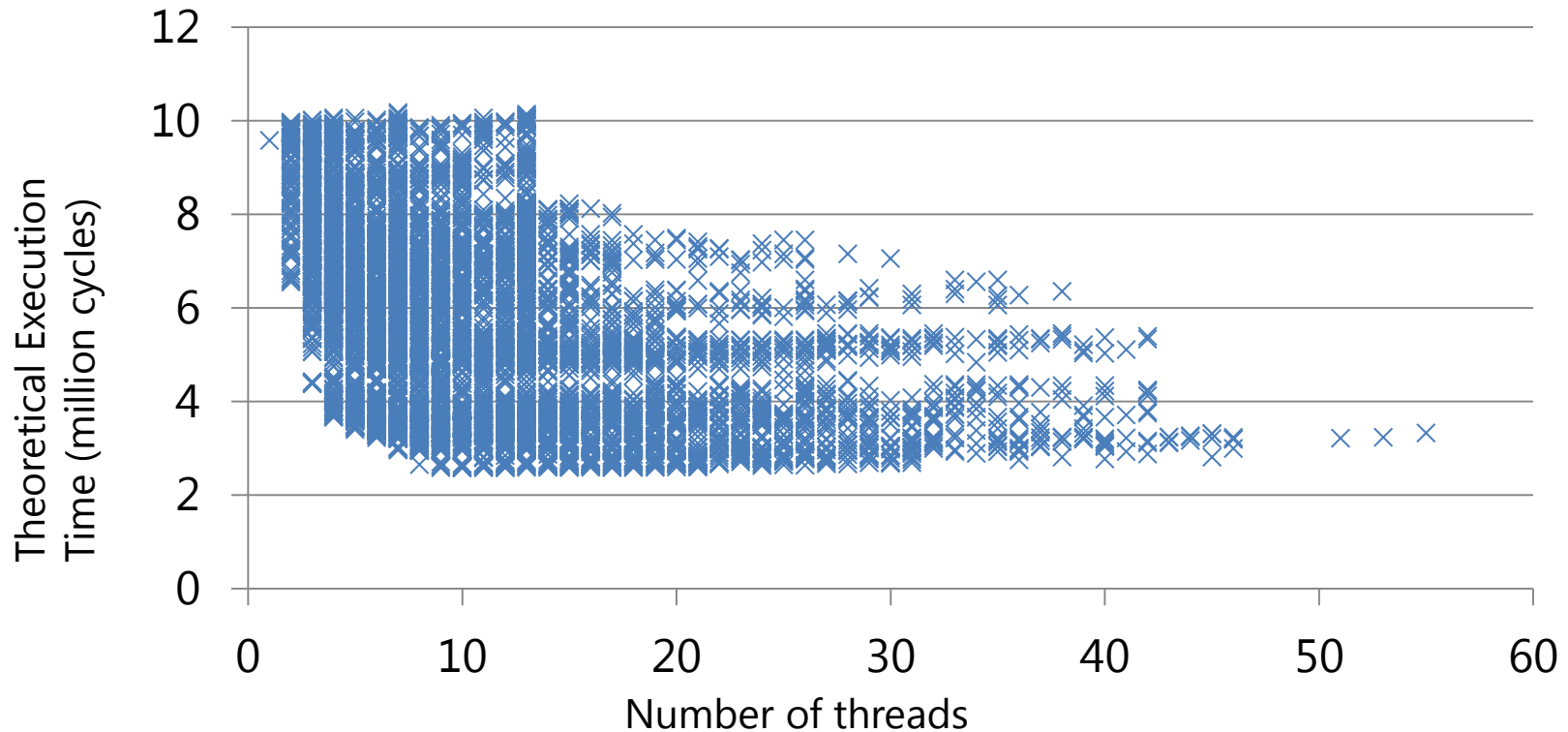


Multicore simulation step

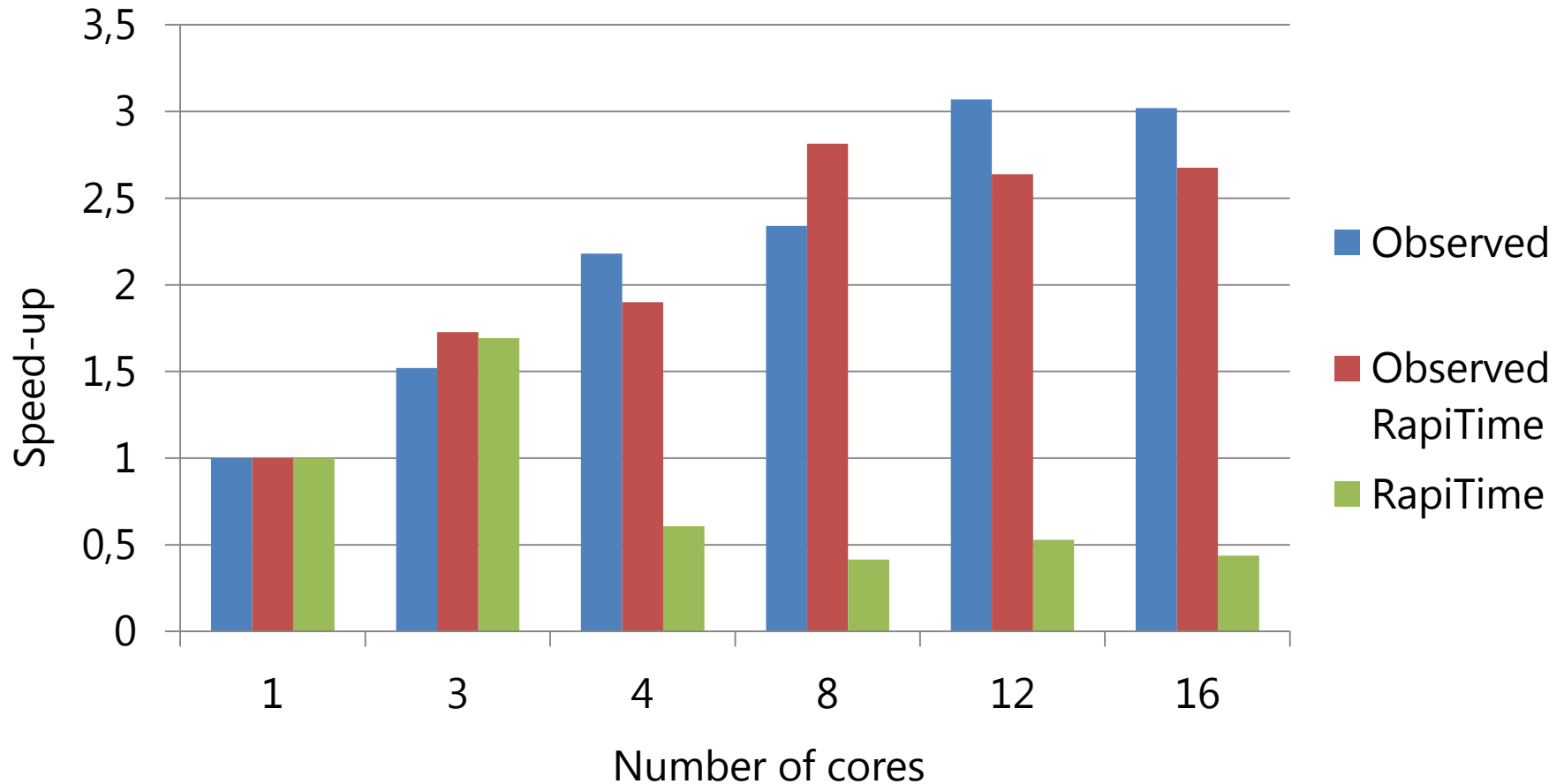
- Divide the code into:
 - periodic tasks
 - non-periodic tasks
- Periodic tasks should run on dedicated cores
→ no scheduler needed
- Using Timing-Analyzable Algorithmic Skeletons for the non-periodic tasks
- Result:
 - 2 Cores for periodic Tasks
 - 1 up to 14 cores for non-periodic Tasks

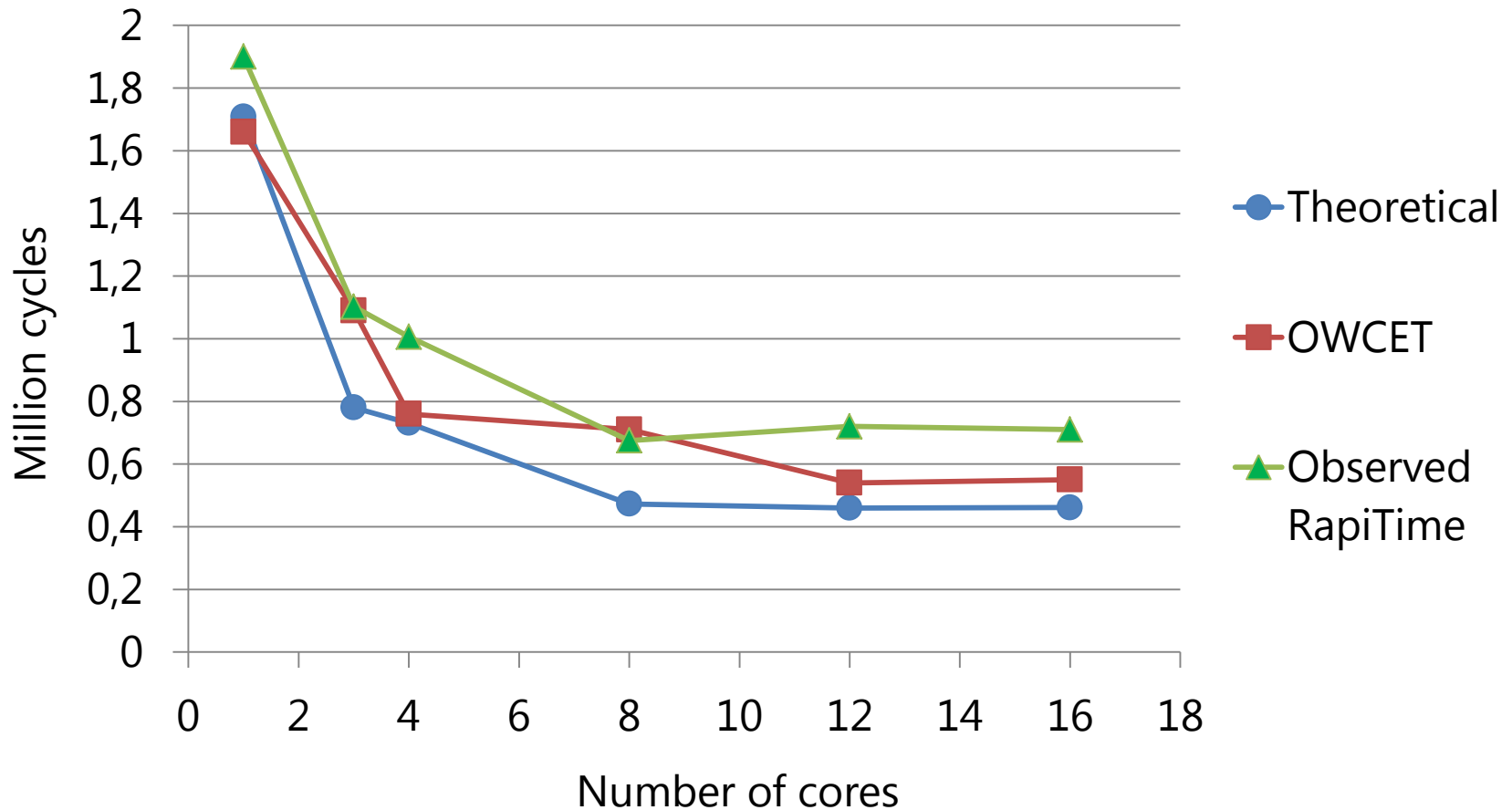


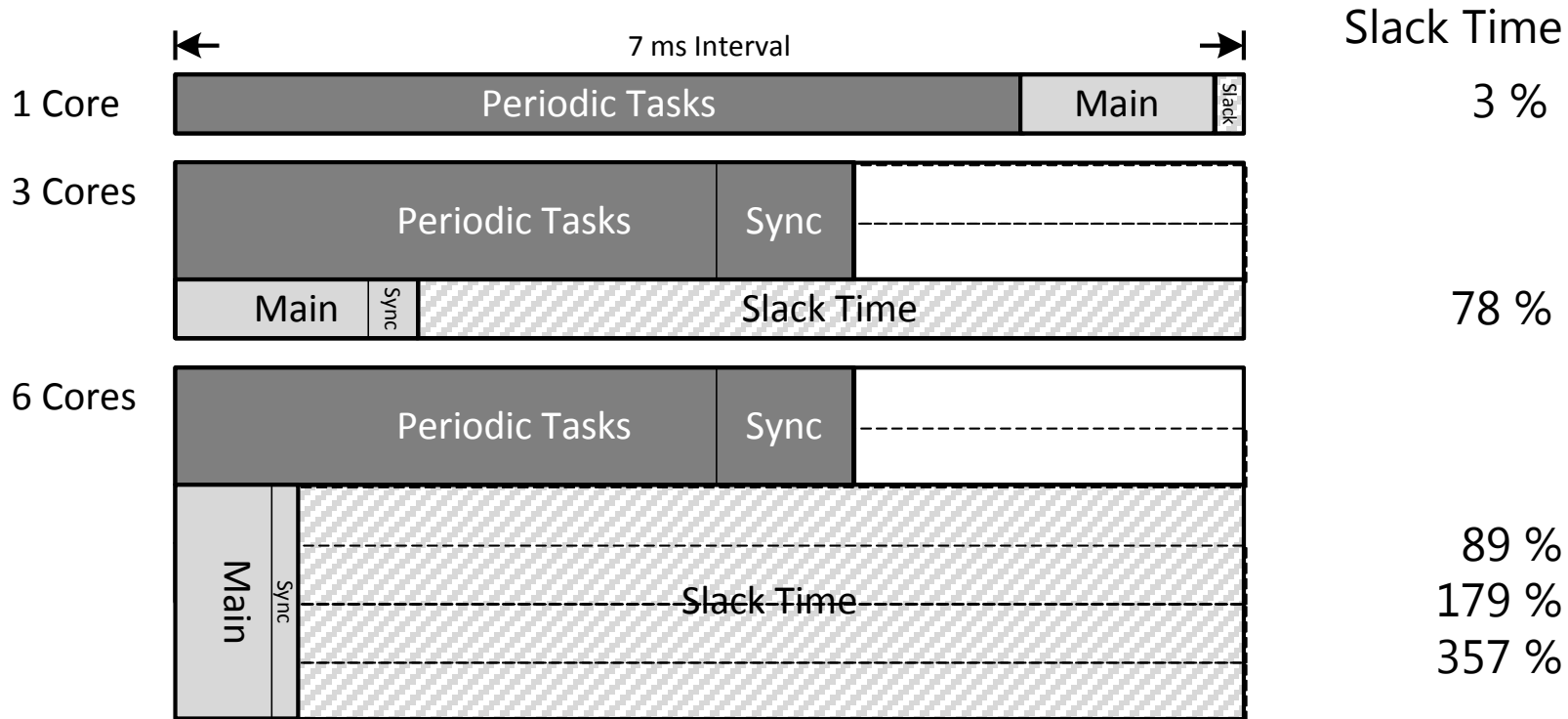
Genetic algorithm to explore configurations assigning N cores to each pattern.



Assumption: implementation with skeletons.







- Negative factor: additional synchronization effort (here: 25%)
- Speedup for sequential code parts increases slack time
- Unknown: use of slack time on multiple cores

Summary

- High number of cores does not lead to high speed-up
- Moderate number of cores leads to small speed-up
- Problems with WCET have to be solved

Outlook

- Additional cores could be used for additional tasks such as complex calculations
- For mixed critical systems: separation of time-critical and other tasks could lead to higher speed-up



Thank You!

BAUER Maschinen GmbH