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# Virtual Prototyping of Automotive Systems: Towards Multi-level Design Space Exploration

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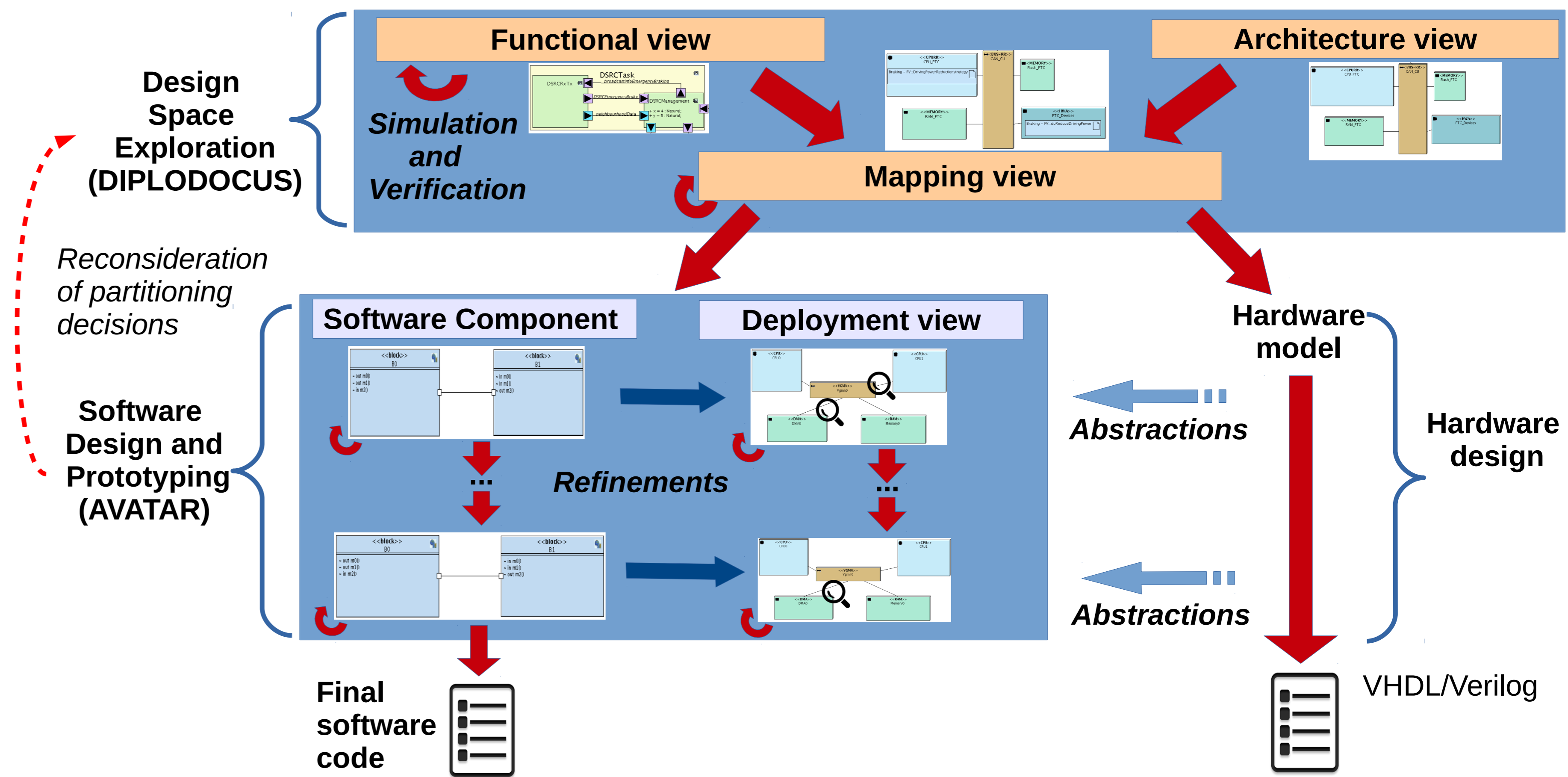
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## Methodology

- ▶ Design Space Exploration integrated with software development
- ▶ Supporting toolkit TTool
- ▶ Formal verification and simulation at the push of a button

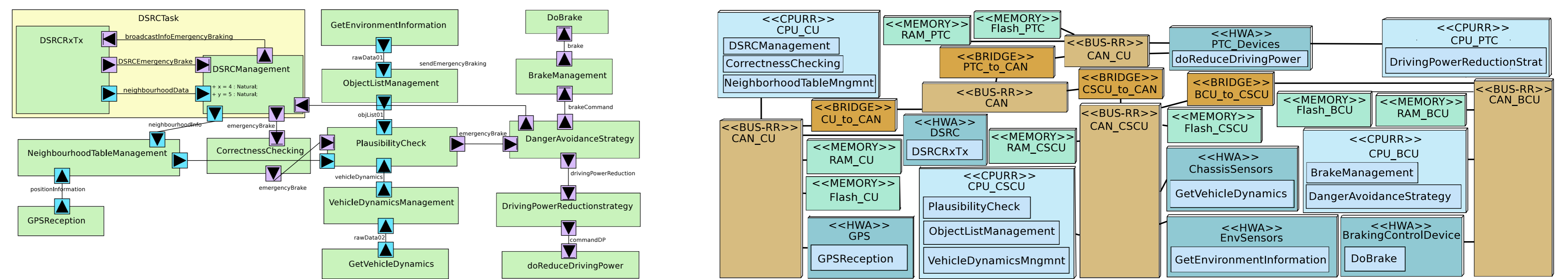
[1]D. Knorreck, L. Apvrille, and R. Pacalet. Formal System-level Design Space Exploration. *Concurrency and Computation: Practice and Experience*, 25(2): 250–264, 2013.

[2]D. Genius and L. Apvrille. Virtual yet precise prototyping: An automotive case study. In *ERTSS'2016*, Toulouse, Jan. 2016.

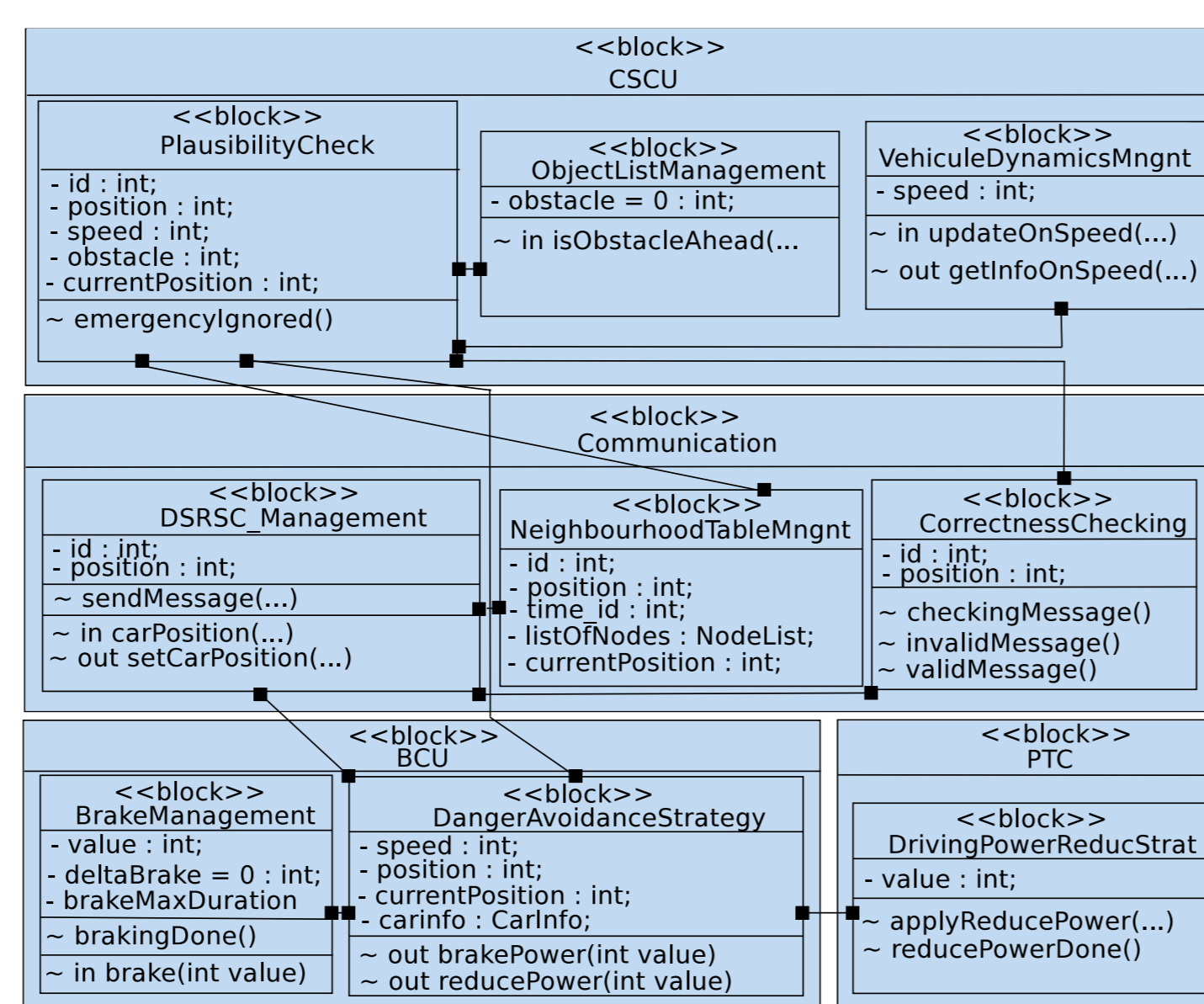


## Automatic Braking Model

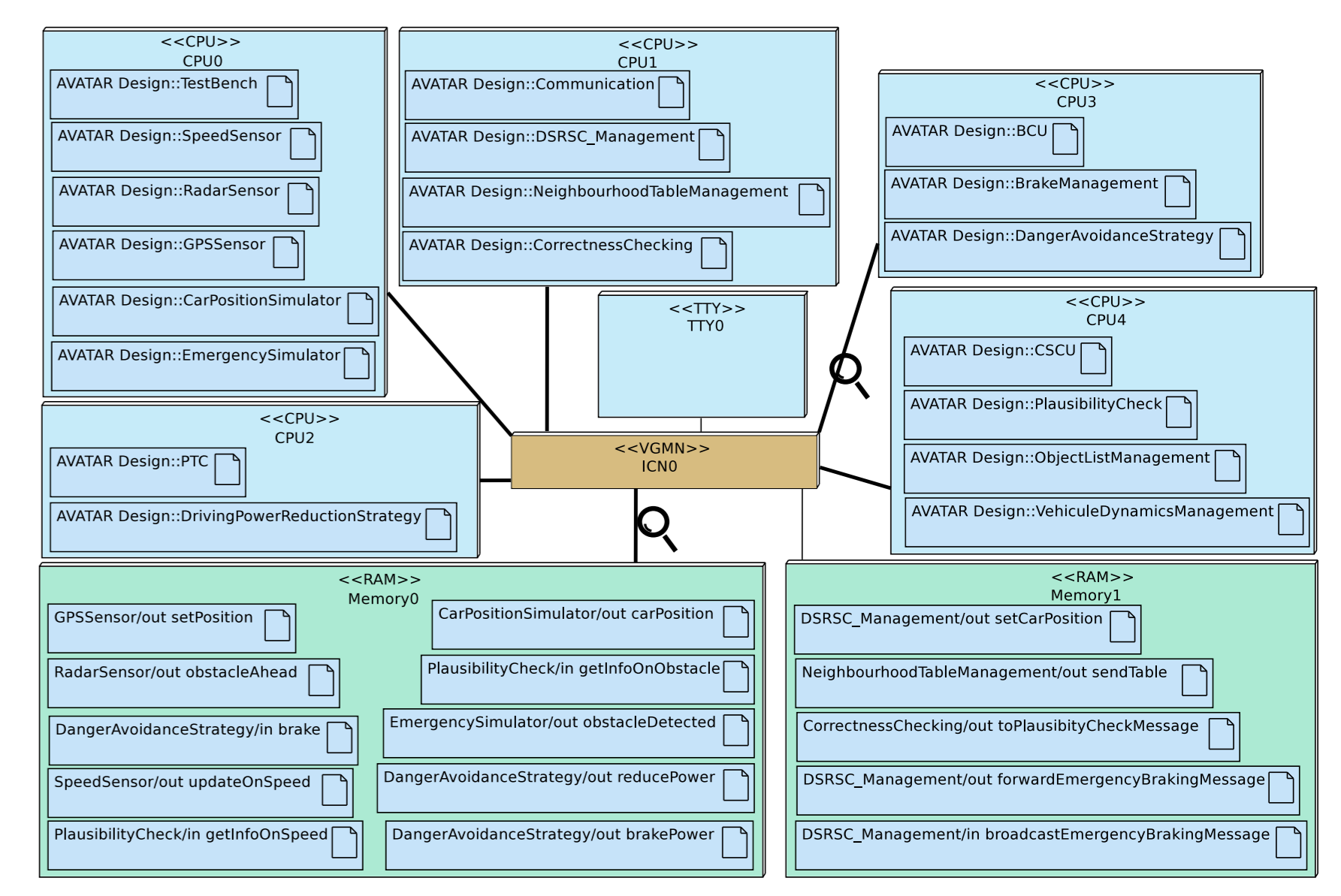
**Design Space Exploration:**  
Modeling of function and architecture separately



**Software Design:**  
SysML Block Diagrams with support for automatic conversion to formal verification, simulation, and C language

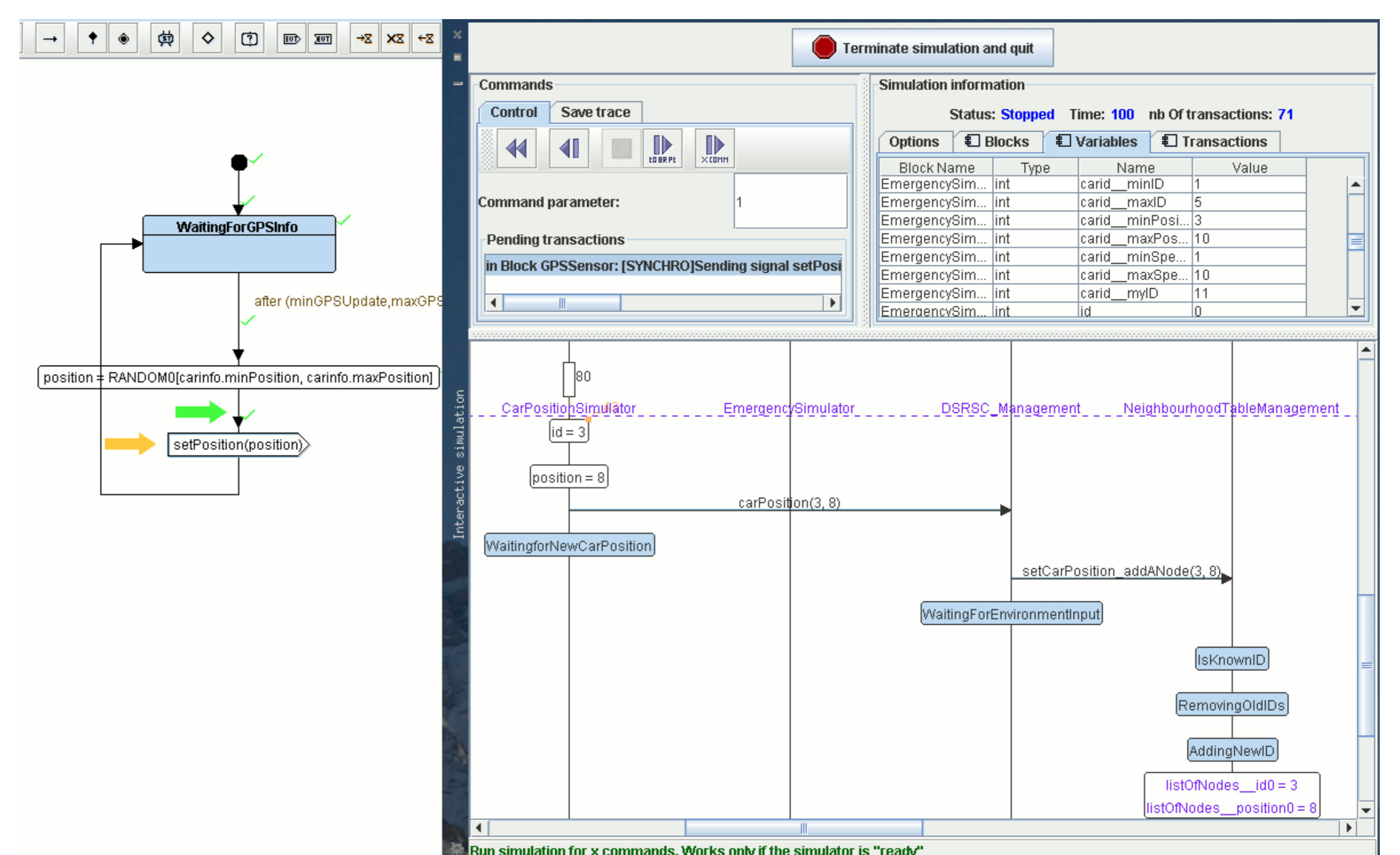
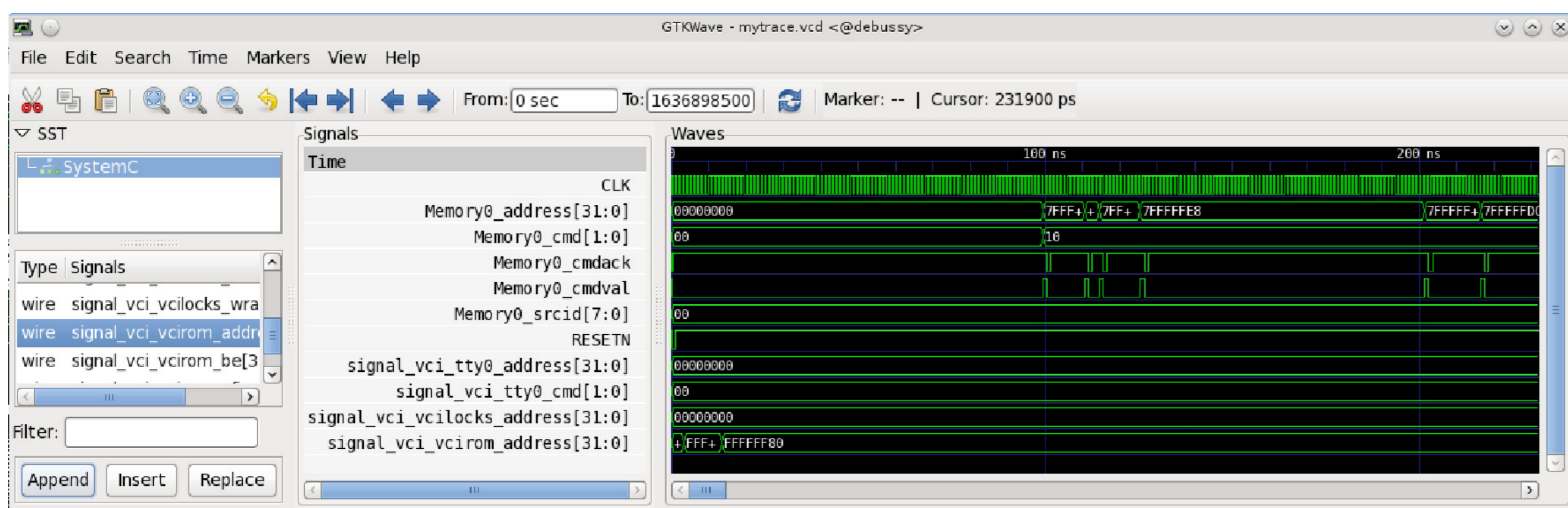


**Prototyping:**  
Software model on destination platform with AVATAR deployment diagram



## Cycle-Accurate Simulation at Prototyping Level

- ▶ An **executable implementation** of the application is **automatically generated** for rapid prototyping on a cycle accurate bit-accurate simulator of the real hardware (SoCLib)
- ▶ Memory allocation indicated in the Deployment Diagram
- ▶ Data-block addresses automatically calculated



## Conclusion

- ▶ Integration of system-level design space exploration and prototyping in the same toolkit
- ▶ Push-button approach to verification and simulation
- ▶ Deployment diagram : (in)validation of partitioning choices

## Future Work

- ▶ Detailed performance profiles (cache misses, buffer fill state etc.) can be determined
- ▶ Full Design Space Exploration, with automatically suggested modifications

