Including HW-SW Co-Design in the ASSERT Model Driven Engineering Process

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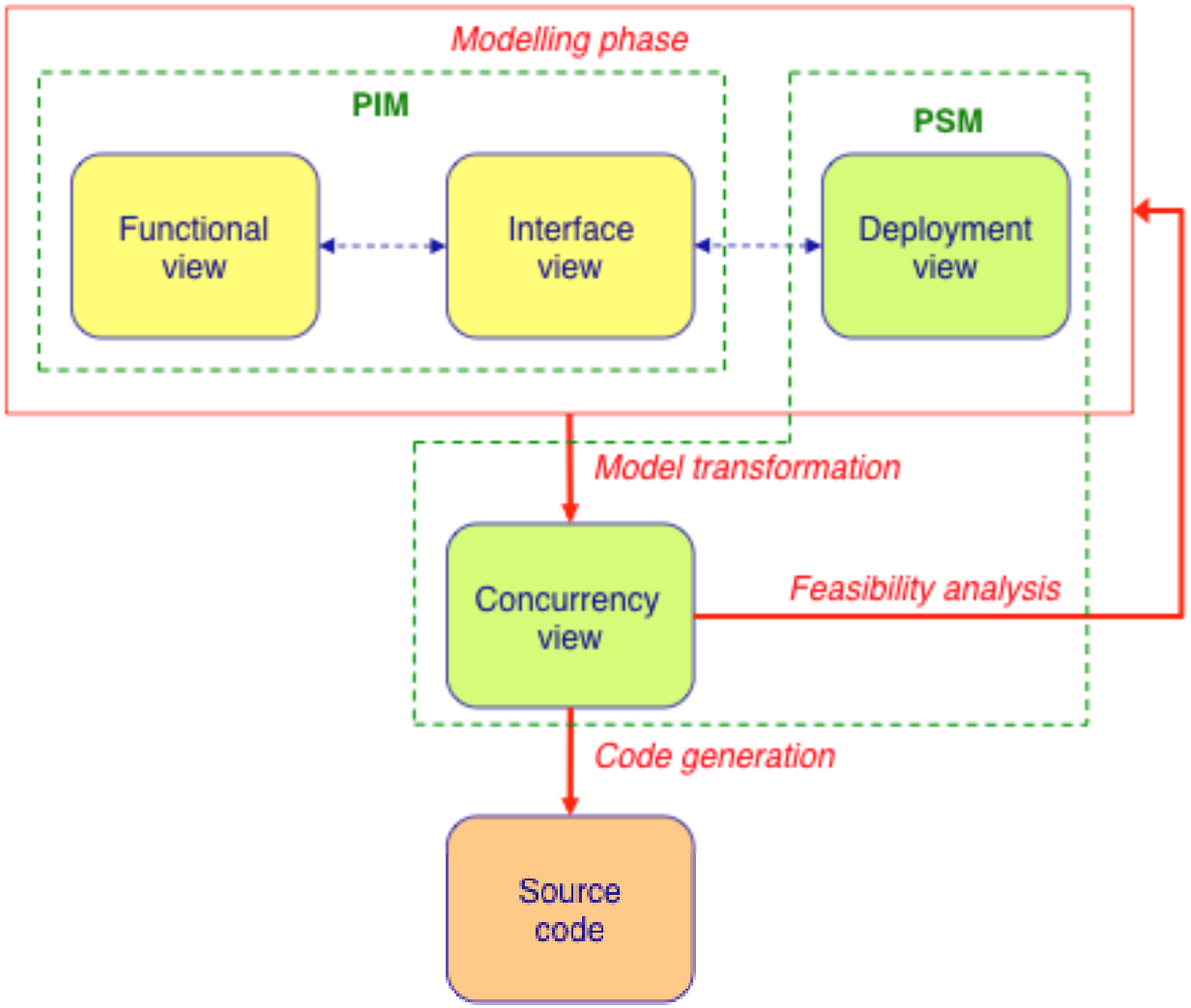
Aims

- Add HW-SW co-design to ASSERT process:
  - model-driven approach to software development
  - definition of co-design methodology supported by tools
- Case study
  - on-board image processing system

- HWSWCO study funded by ESA/ESTEC
  - GMV, U Cantabria, UP Madrid

The original ASSERT software process

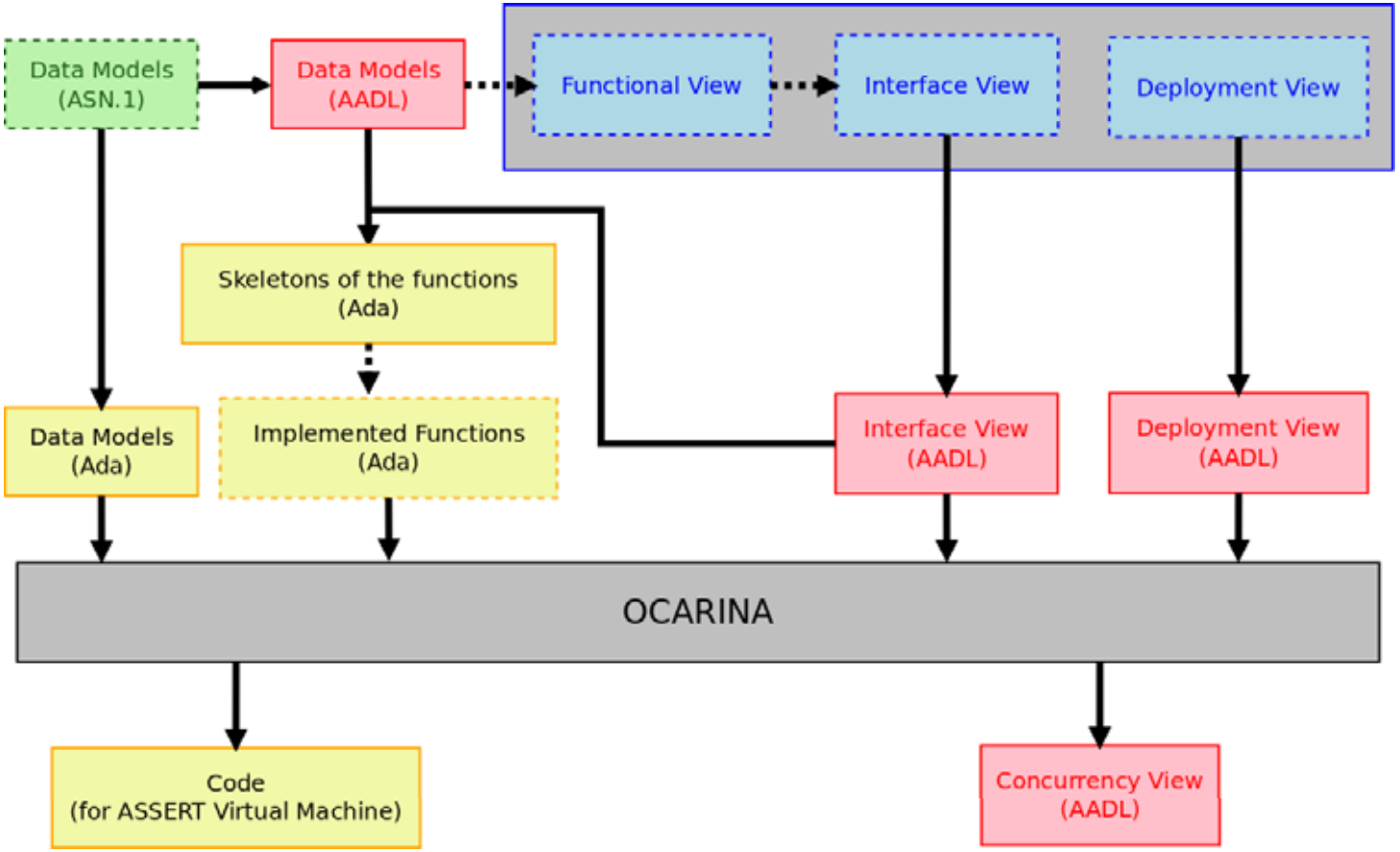


Key elements

- Property preserving model transformations
  - especially real-time properties
  - implemented by common meta-model
    - based on Ravenscar Computational Model
- Separation of concerns
  - data, functional, interface and deployment
- Automatic code generation
  - for specialized execution platform (virtual machine)
    - based on ORK+ and PolyORB-HI-Ada
  - automatic synthesis of SW interfaces

The TASTE toolset

- Based on the ASSERT process
- Uses AADL as a common language
  - meta-model enforced by means of templates

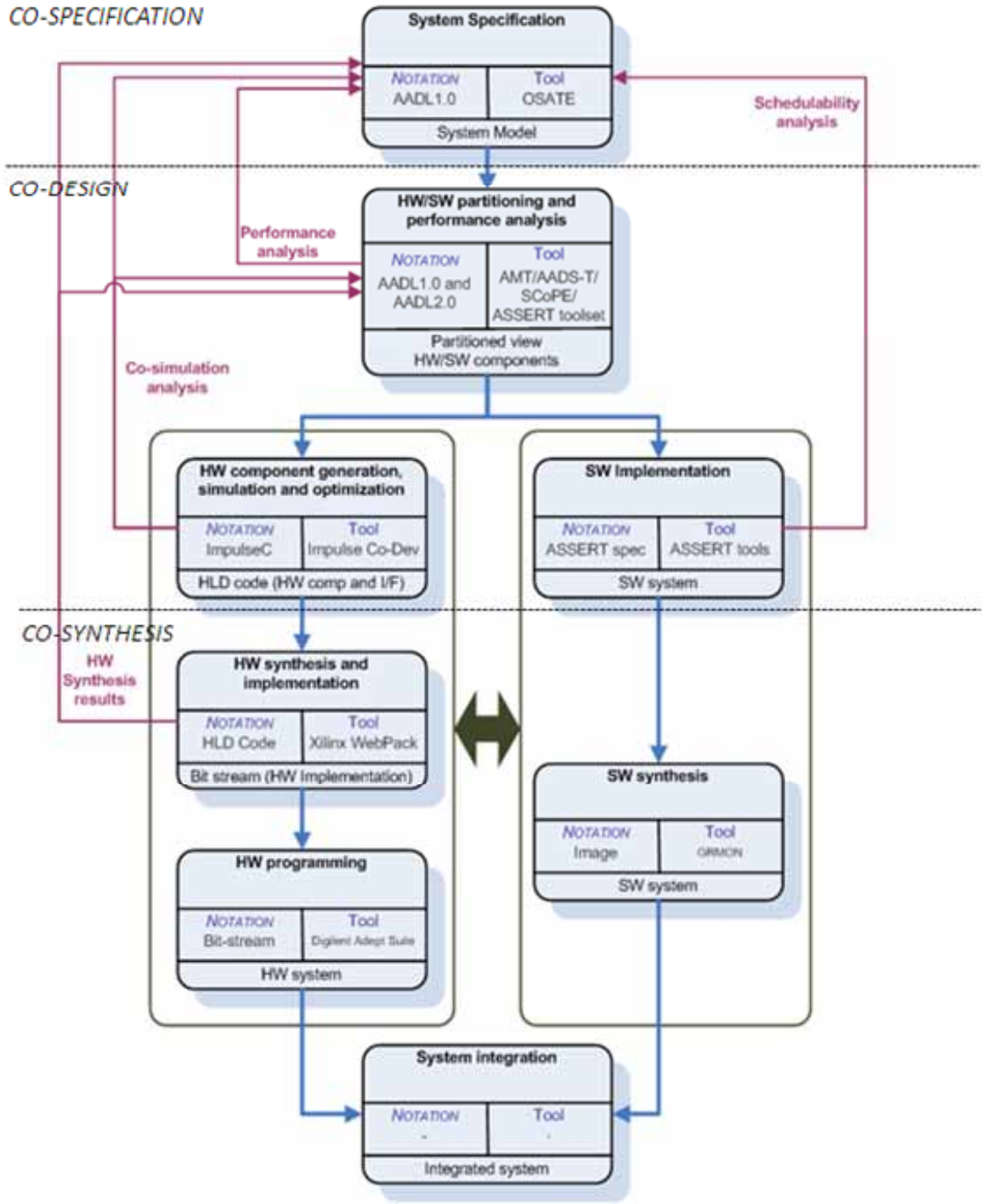


HW-SW Co-design

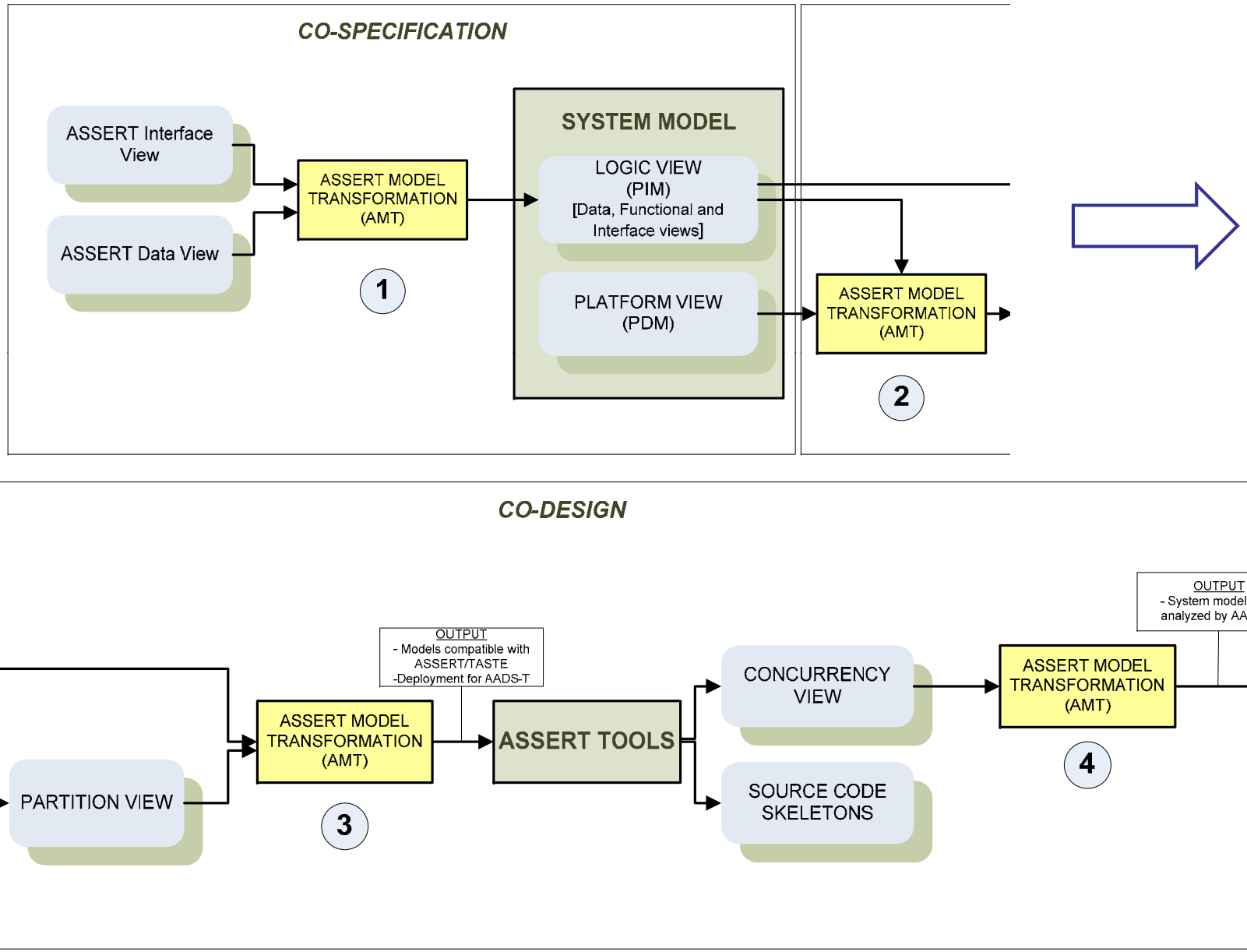
- Concurrent development of HW and SW systems
- Integrated design flow:
  - abstract specification: **common component model**
  - HW-SW partitioning
    - Based on **high-level software estimation** (SCoPE): assesses performance and power-related metrics (trade-off speed-accuracy)
    - Allocation of system functions to processing resources to fulfill performance and power-related requirements
  - **parallel** implementation of HW and SW
  - system integration: minimization of integration issues

HWSWCO methodology

- Co-Specification
  - abstract view of system
- Co-Design
  - map to processing resources
  - feasibility analysis
- Co-Synthesis
  - implement HW and SW in parallel paths
  - synthesis of HW and SW interfaces
  - integration of HW and SW systems



ASSERT model transformation tool



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Case study: image processing

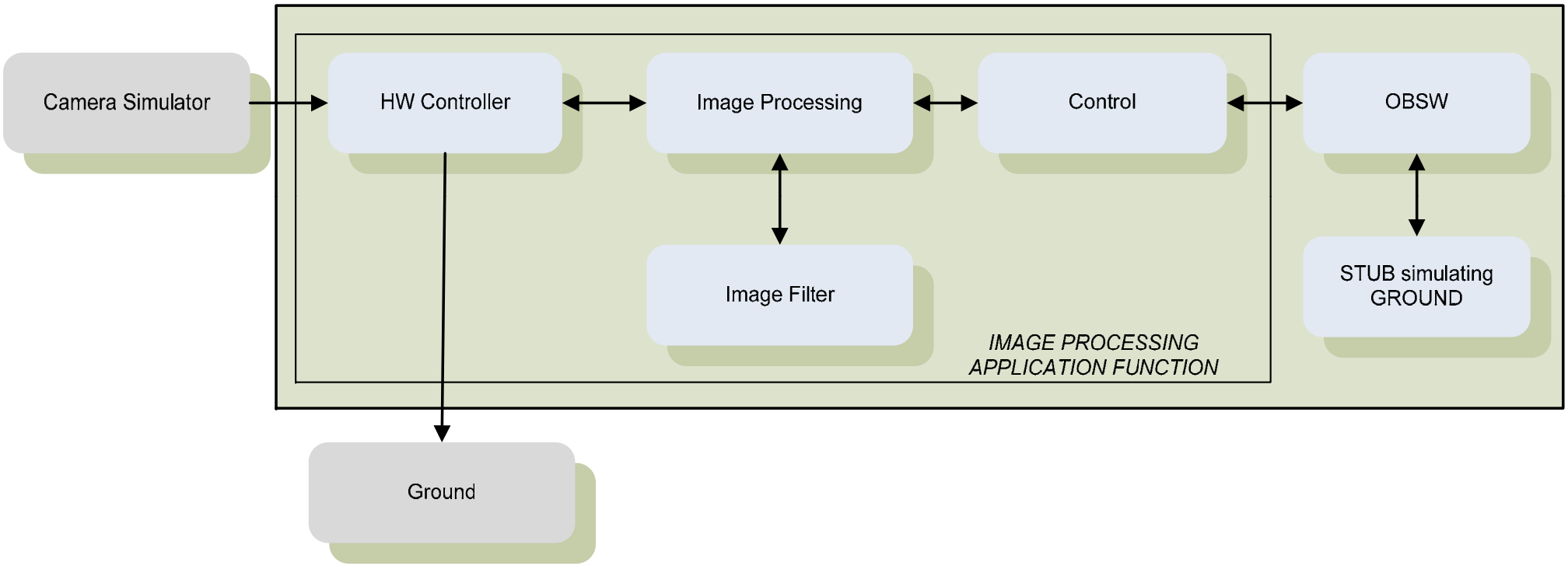
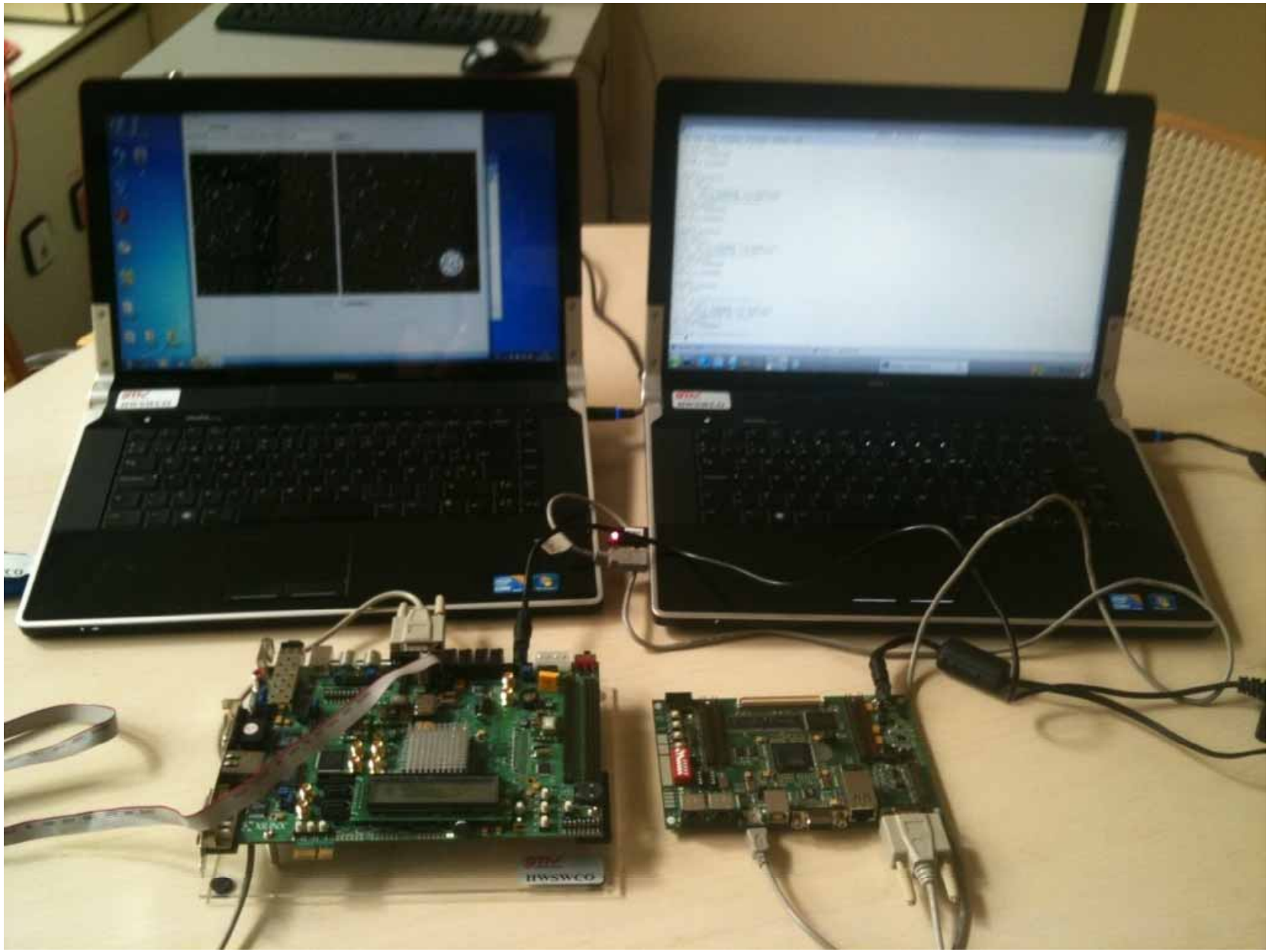


Image processing testbed



Conclusions

- Key points in HW-SW co-design
  - Unified representation of HW-SW components
  - HW system component model compatible with ASSERT component model
  - HW data model compatible with ASSERT data model
  - Similar programming language for HW and SW systems: ANSI C
- Future work
  - Exploration HW issues in relation to RCM
  - Automatic design space exploration (DSE)