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Making Modeling Assumptions an Explicit Part of Real-Time Systems Models

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Outline

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Rationale

- A model abstracts a system
  - Mastering the complexity of real-time systems
- A model is valid for a precise set of assumptions about the system and the system's environment
- A model should always be associated with the assumptions the designer has made to build up it
  - When the model evolves, the assumptions should evolve accordingly
  - And reciprocally

Our contribution

Making the modeling assumptions a full part of the model

Our Contribution

Objectives

- Solution not restricted to one modeling language
- Supports incremental modeling methods and versioning
- **Language**, **method**, **tool**

Our solution

- A new diagram: Modeling Assumption Diagram (MAD) added to SysML-Sec
- Assumptions attributes
- Relations between modeling assumptions
- Supported by a free and open-source tool (TTool)
  - http://ttool.telecom-paristech.fr
- Case study: a UAV

MAD: Assumption Stereotype

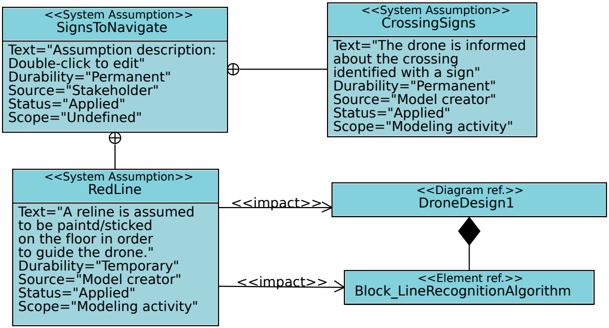
- **Stereotype** = system, environment
- **Durability** = temporary, permanent
- **Status** = applied, alleviated
- **Source** = end-user, stakeholder, creator of the model
- **Scope** = language, tool, modeling activity, verification

<<System Assumption>>
CrossingSigns

Text="The drone is informed about the crossing identified with a sign"
Durability="Permanent"
Source="Model creator"
Status="Applied"
Scope="Modeling activity"

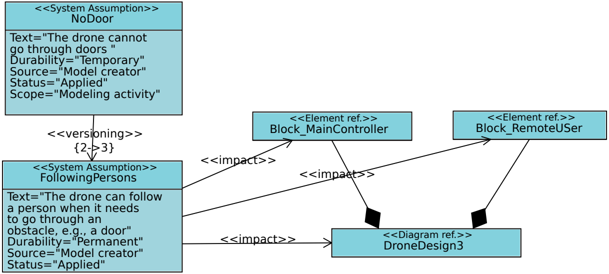
MAD: Relations

- **Containment**: a high-level assumption split up into elementary ones
- **Impact**: model elements impacted by a given assumption



MAD: Relations (Cont.)

- Modification of assumptions → Modification of the system model
- Tracing (i) the versions of assumptions, and (ii) how the versions impact the system model
- **Versioning** relation: a applies until version x and becomes b at version y



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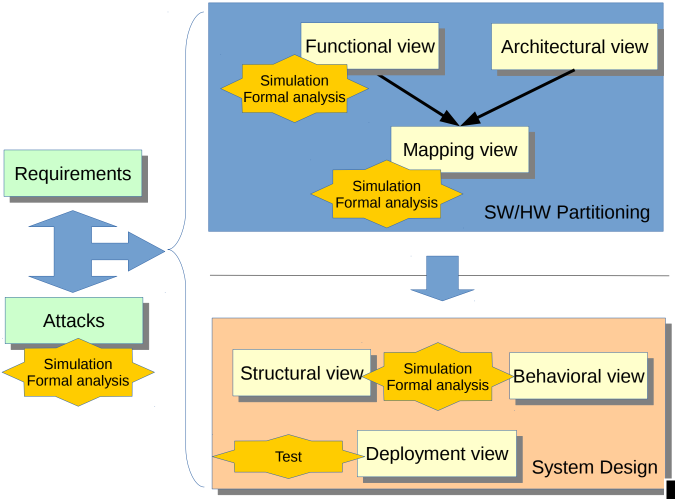
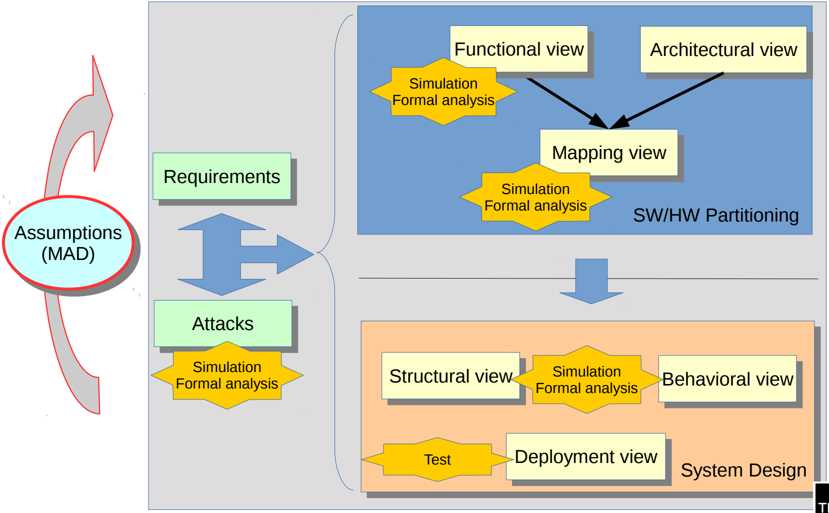
Method


Functional view
Architectural view
Simulation
Formal analysis
Mapping view
Simulation
Formal analysis
SW/HW Partitioning
Requirements
Attacks
Simulation
Formal analysis
Structural view
Simulation
Formal analysis
Behavioral view
Test
Deployment view
System Design

Method


Assumptions (MAD)
Requirements
Attacks
Simulation Formal analysis
Functional view
Architectural view
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Mapping view
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SW/HW Partitioning
Structural view
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Test
Deployment view
System Design

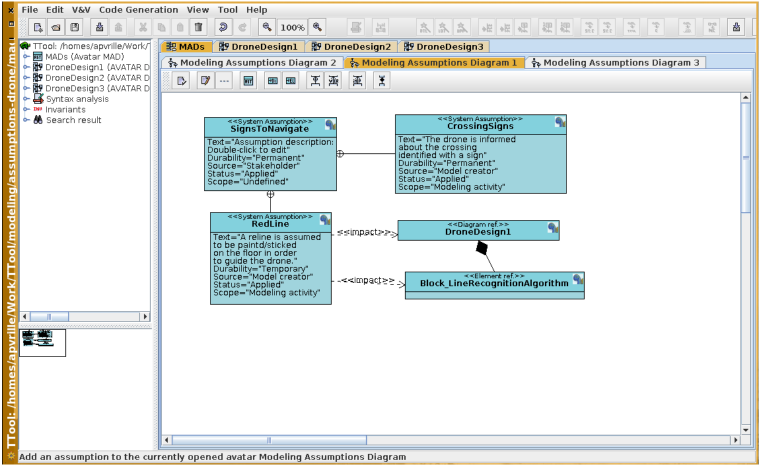
An Autonomous UAV

Autonomous drone navigation in harsh conditions, in particular inside buildings

3 scenarios (with different assumptions)

1. **Understanding marks**, e.g., a red line located on the floor
2. **Analyzing the environment** (obstacles, etc.) with image-based processing techniques (3D reconstruction).
3. **Going through obstacles with human assistance**
   - Entering in a room when the entrance door is closed.

TTool: MAD Scenario #1



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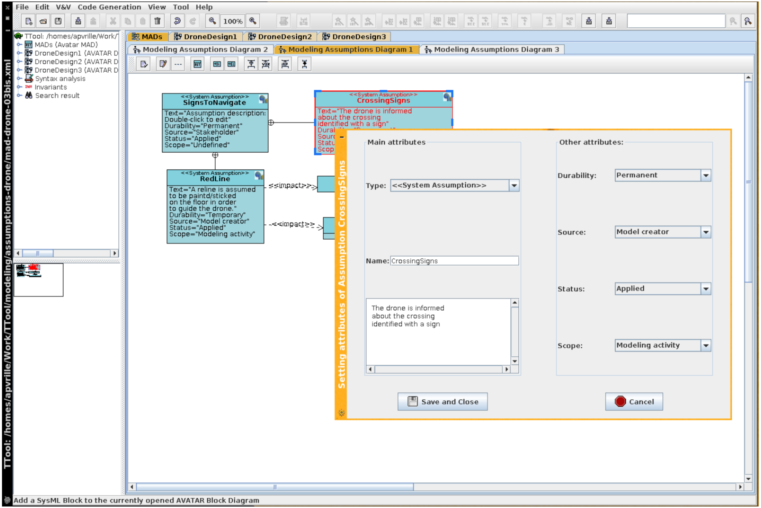
TTool: Editing an assumption



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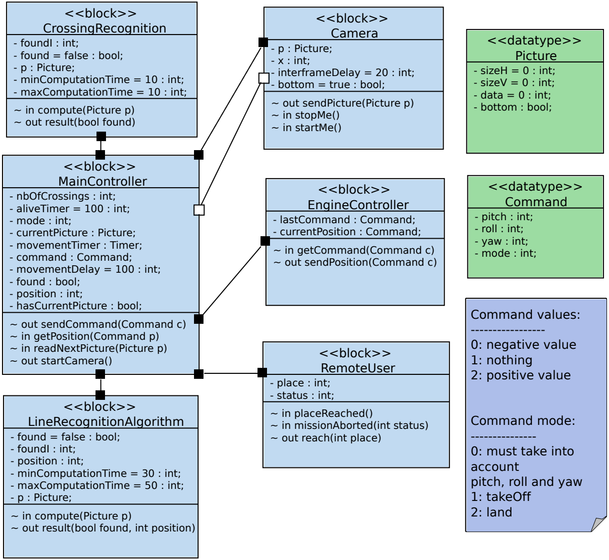
TTool: Design #1



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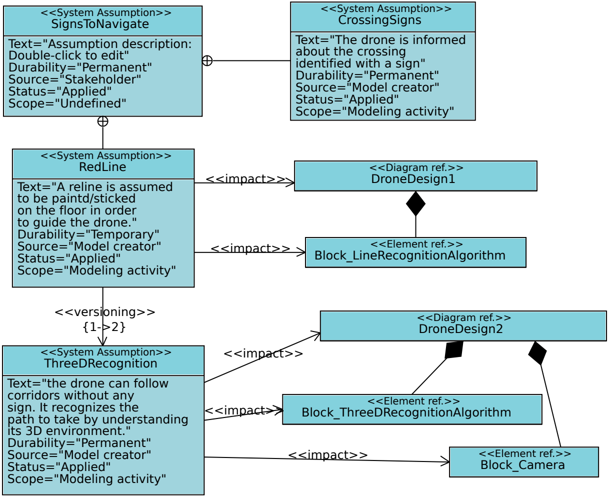
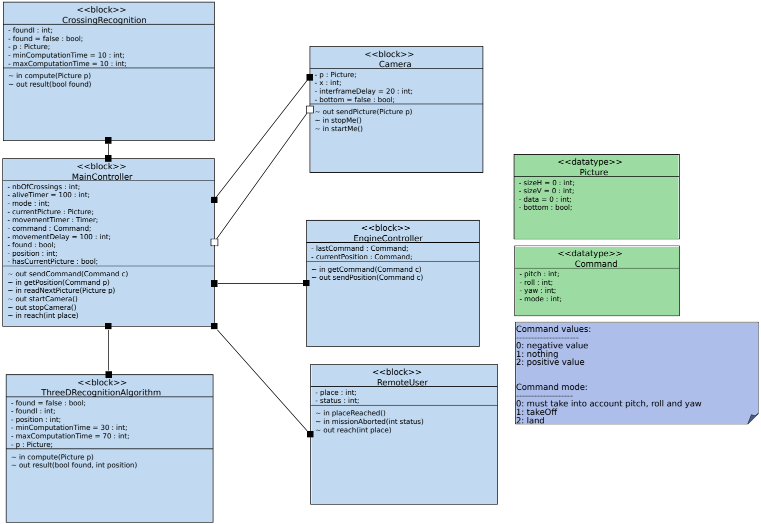
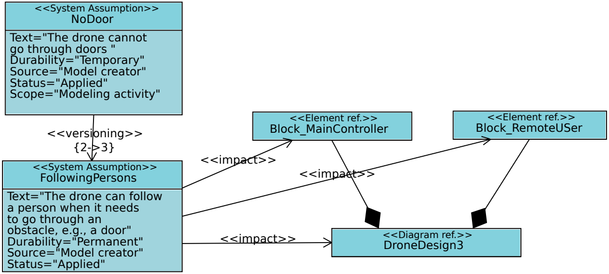
TTool: MAD Scenario #1 → #2



TTool: Design #2



TTool: MAD Scenario #2 → #3



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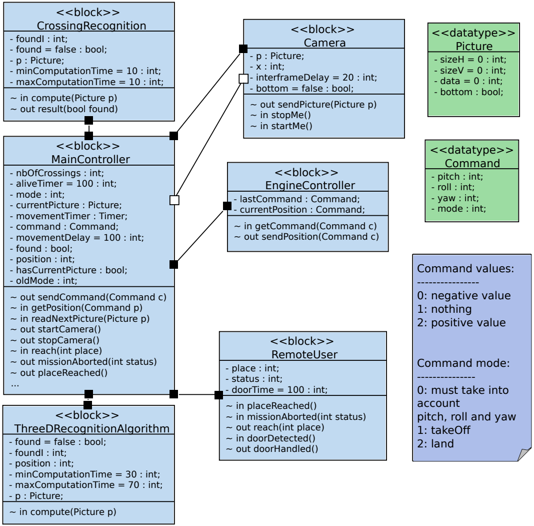
TTool: Design #3



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Conclusion

Objective

Making modeling assumptions a part of every real-time system model

Contributions

- Model Assumption Diagram (MAD), attributes, relations
- Included into SysML-Sec, supported by TTool

Future work

- Optimizing simulation and verification with regards to versioning

To Go Further ...

- **TTool**: http://ttool.telecom-paristech.fr
- **SysML-Sec**: http://sysml-sec.telecom-paristech.fr

- **Drone4u** project: http://drone4u.telecom-paristech.fr
  - Several videos of the UAV in action!