Simulink integration

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Rationale

- **Different approachs, common goals**
  - AADL models system architecture
  - Simulink models software
  - Common goal: design, validate and implement real-time systems

- **Purpose: integrate Simulink in AADL models**
  - Full MBE approach, no code is required !
  - Deploy Simulink code according to AADL models

Integrating Simulink & AADL

- **Separates software in software blocks**
  - Recursively, blocks can contain other blocks
  - Blocks communicate with signals/parameters
  - #1: Mapping of Simulink blocks into AADL components
- **Defines its own types**
  - #2: Integration of these types into AADL models

Integration challenge

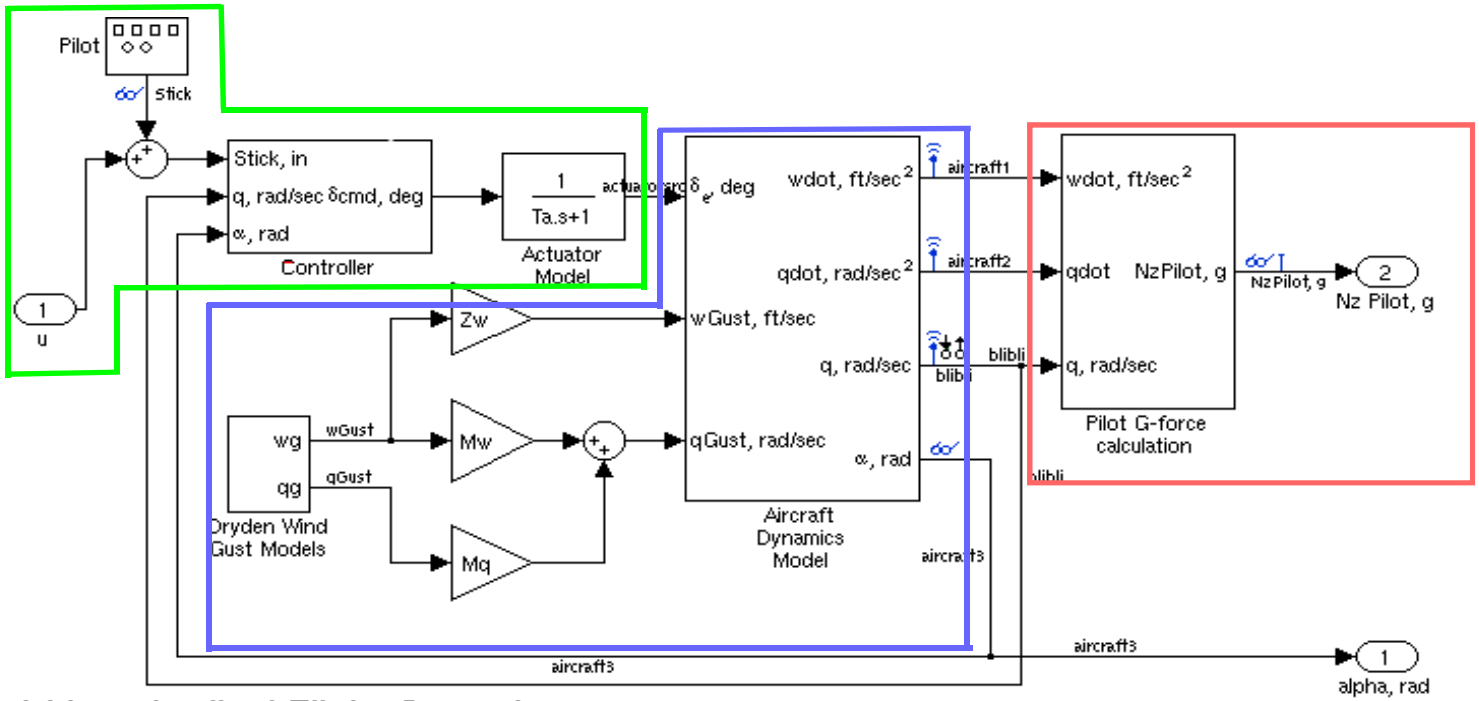
- **Simulink blocks mapping**
  - How to map Simulink blocks in AADL ?
- **Simulink types mapping**
  - Integration of Simulink types in AADL ?
- **Code generation approach**
  - Combine AADL and Simulink generated code together ?

Use case

- **Use the F14 example from Simulink**
  - Aircraft guidance system
- **Map it in a distributed system designed with AADL**
  - Three processes, inter-process communications
- **Integrate Simulink and AADL generated code**
  - Implement complex systems without writing any line of code !

Use case

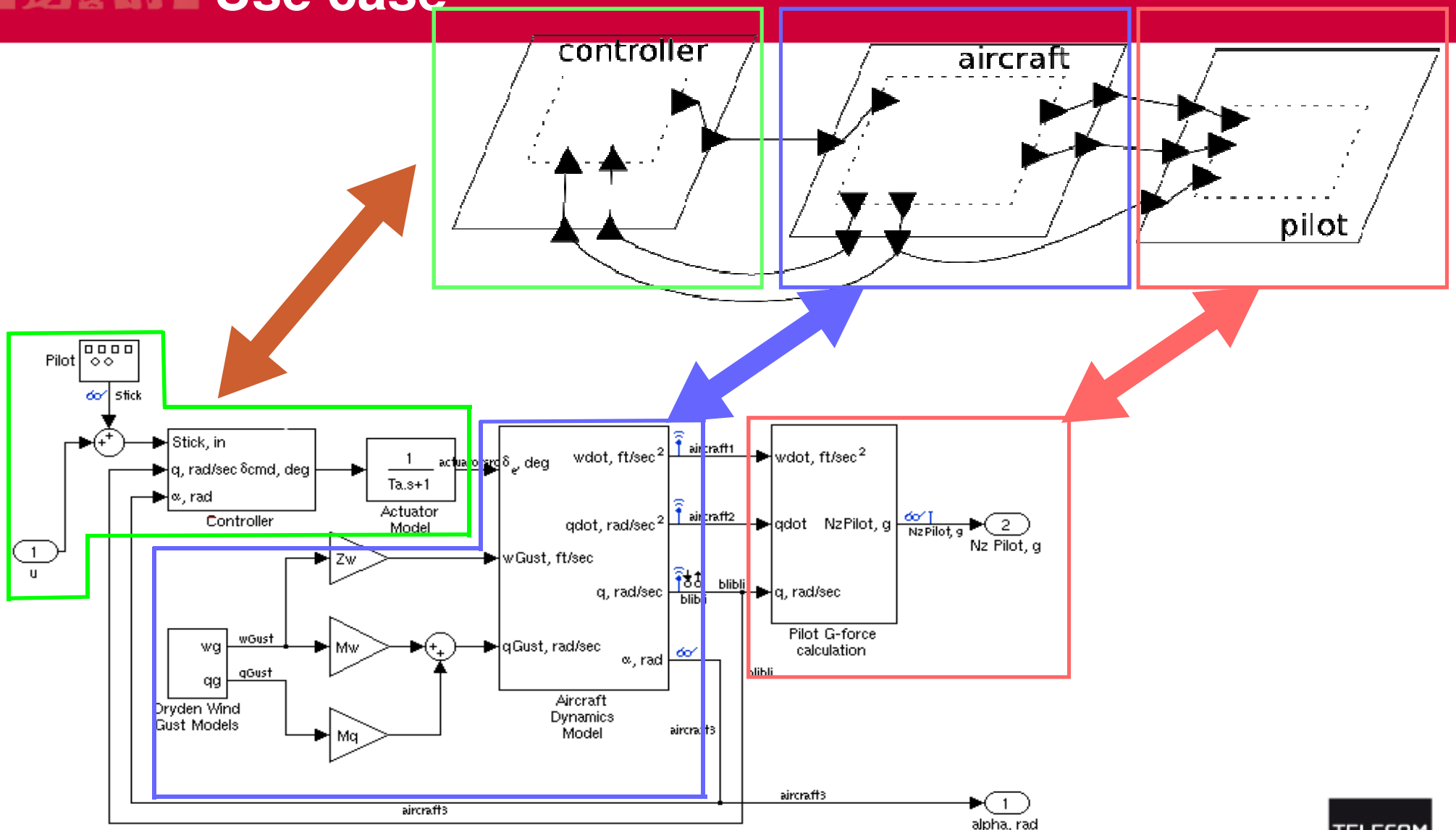
- Map each block to a thread, add relevant ports
- Map data types in an AADL data component



F-14 Longitudinal Flight Control

This demonstration models a flight control for the longitudinal motion of a Grumman Aerospace F-14.

Use case



F-14 Longitudinal Flight Control

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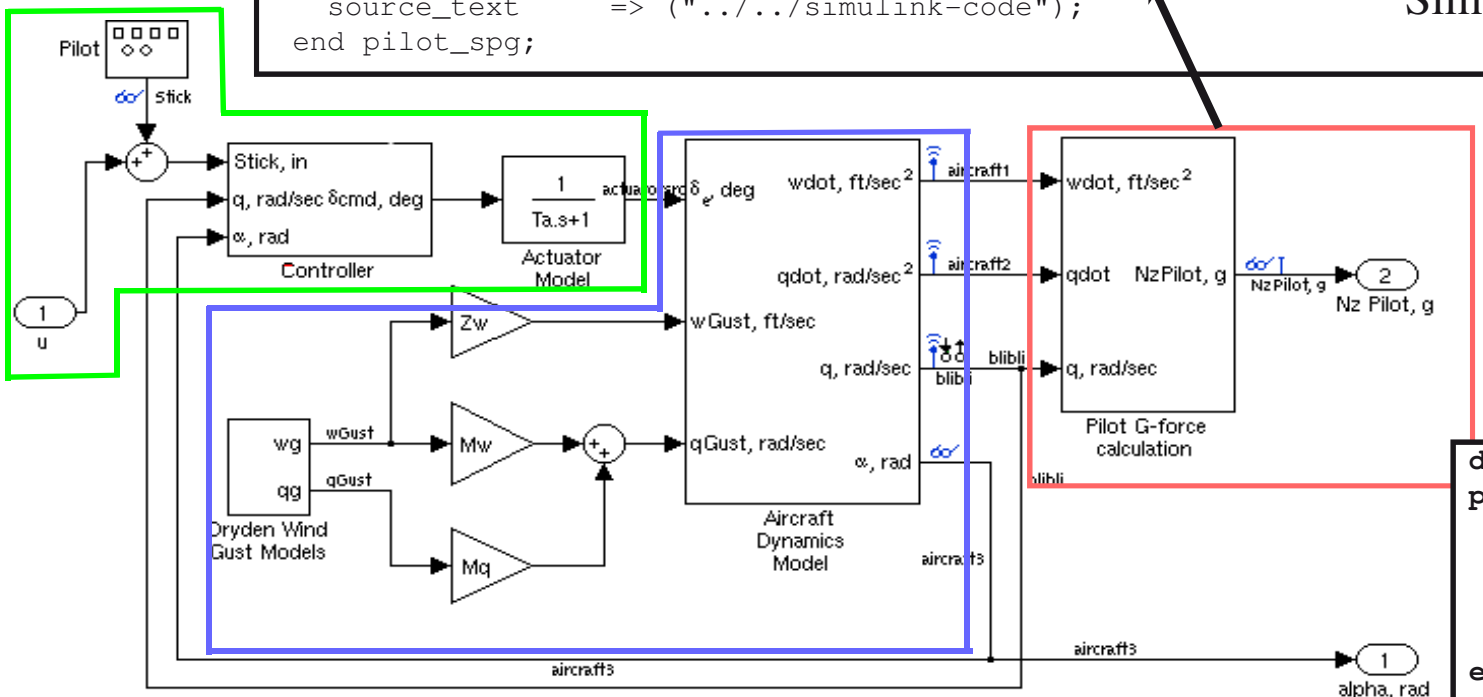
Use case

```
subprogram pilot_spg
features
   aircraft1 : in parameter simulink_realt
      {Simulink::Signal => "sldemo_f14/Aircraft Dynamics Model/Vertical Channel/Sum";};
   aircraft2 : in parameter simulink_realt
      {Simulink::Signal => "sldemo_f14/Aircraft Dynamics Model/Pitch Channel/Sum";};
   blibli    : in parameter simulink_realt
      {Simulink::Signal => "sldemo_f14/Aircraft Dynamics Model/Pitch Channel/Integrate qdot";};
properties
  source_language => Simulink;
  source_name     => "sldemo_f14";
  source_text     => ("../../simulink-code");
end pilot_spg;
```

Simulink block mapping




```
data simulink_realt
properties
   Type_Source_Name => "real_T";
    Source_Name => "sldemo_f14";
   Source_Data_Size => 8 Bytes;
   source_language => Simulink;
end simulink_realt;
```

Types mapping

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Implementation status

- **Implementation in our AADL-toolsuite: Ocarina**
  - Use case with a significant AADL and Simulink models
- **Integration of Simulink generated code**
  - Currently use real-time workshop (RTW)

Mapping rules, pros/cons

- **Simple approach, works fine**
  - Use case with significant models
  - Only one thread can execute Simulink code
- **Need to check mapping consistency**
  - Mapping can contain semantic errors
  - E.g. no respect of scheduling properties
- **Need to integrate other Simulink code generators**
  - Simulink embedded coder
  - From a tooling perspective: address variations in code generated when new releases of Simulnk come out

Conclusion

- **Introduce the 0 line of code programming**
  - Full MBE approach
  - Integrate and deploy Simulink models in a distributed systems
- **Some work remains for a full integration**
- **Extend this approach to other modeling approaches**
  - Integration of SCADE/Lustre/Esterel generated code