

Generation of Functional Mock-up Units from Causal Block Diagrams

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Overview

- ⊗ Functional Mockup Interface
- ⊗ Starting point
- ⊗ Flattening
- ⊗ Optimization
- ⊗ Functional Mockup Unit
- ⊗ Experiment

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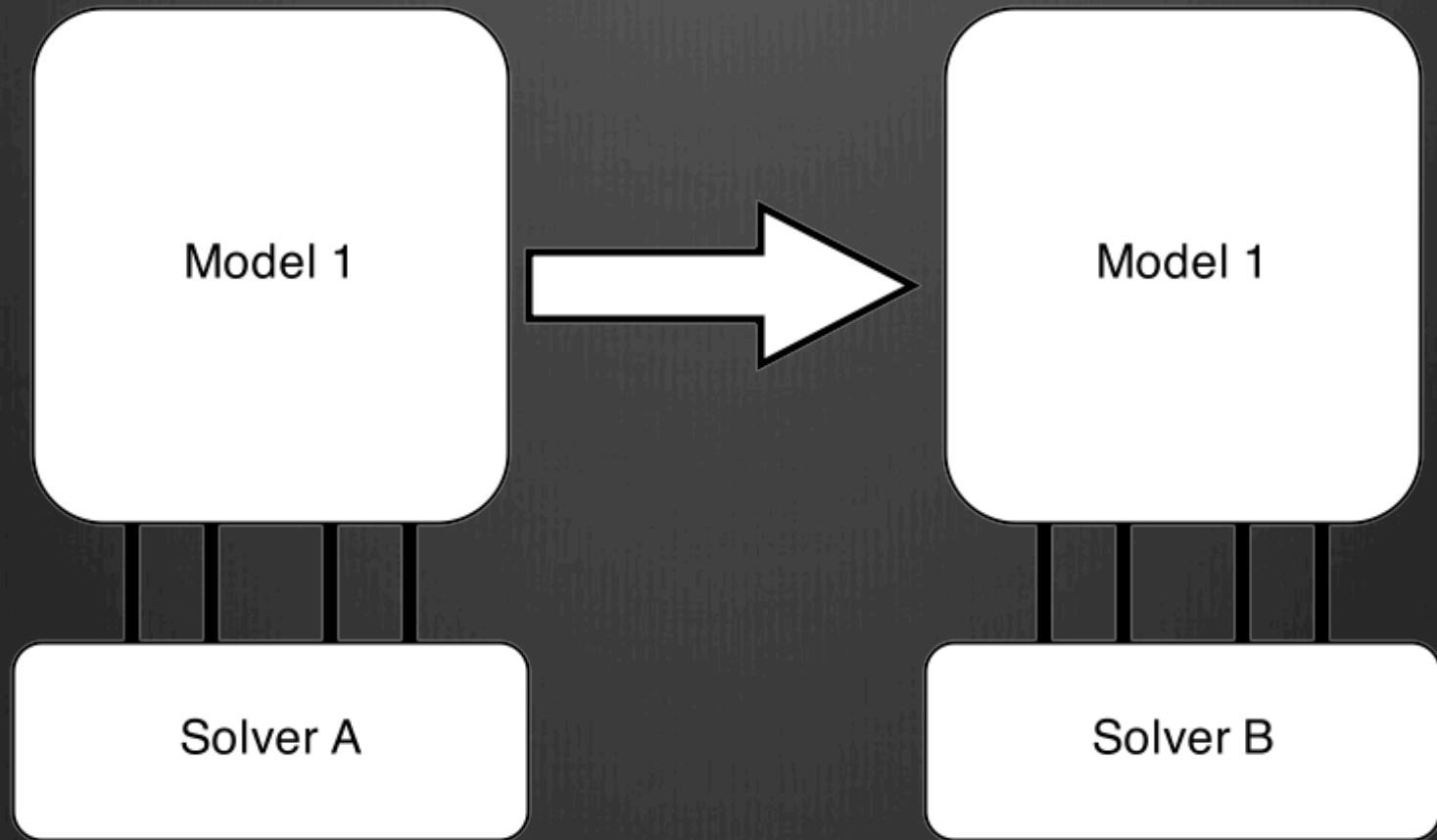
FMI^[1]

Functional Mockup Interface:

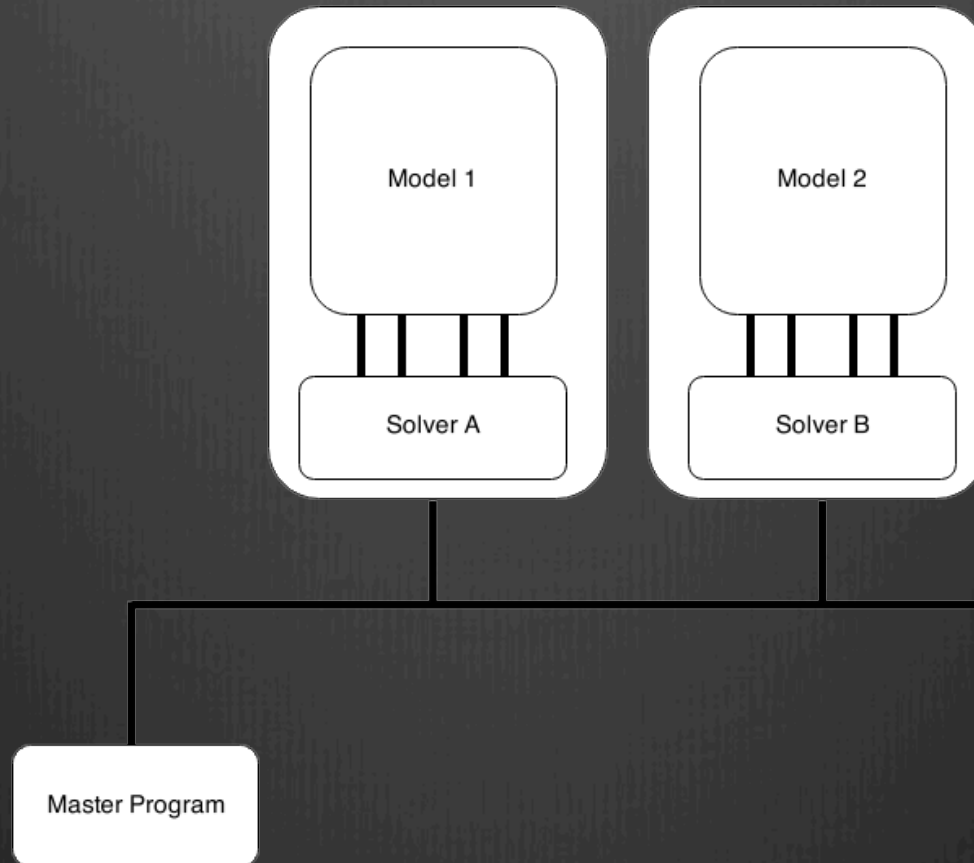
- *FMI for Model Exchange*
- *FMI for Co-Simulation*

[1] T. Blochwitz, M. Otter, M. Arnold, C. Bausch, C. Clauss, H. Elmqvist, et al., The functional mockup interface for tool independent exchange of simulation models, in: Modelica'2011 Conference, March, 2011, pp. 20–22.

Model Exchange



Co-Simulation



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Causal Block Diagram

Framework in Python

- Base Block
- CBD block
- Linear Blocks
- Delay Blocks

- In and output blocks

Causal Block Diagram

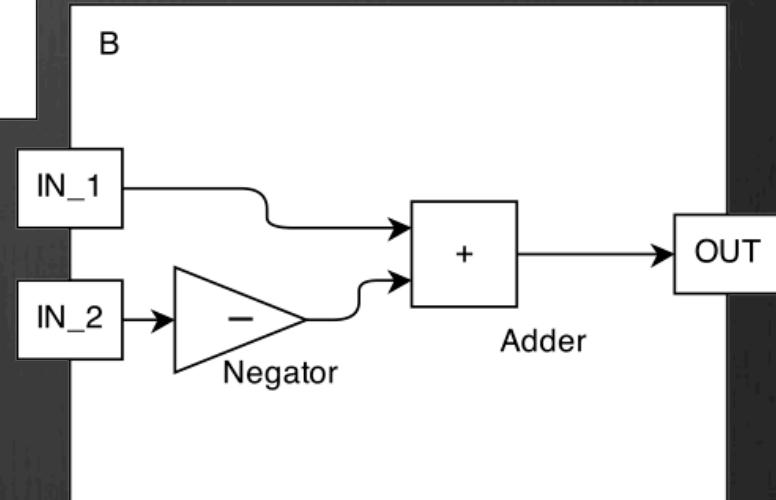
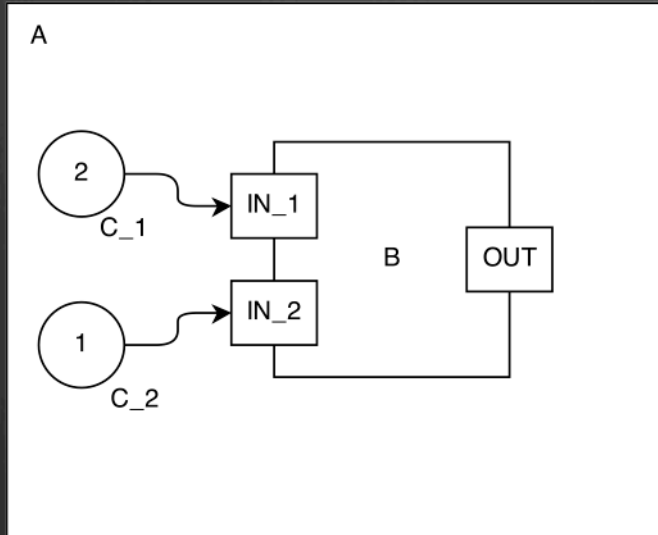
Simulator

- Dependency graph
- Sorted list of components
- Strong components

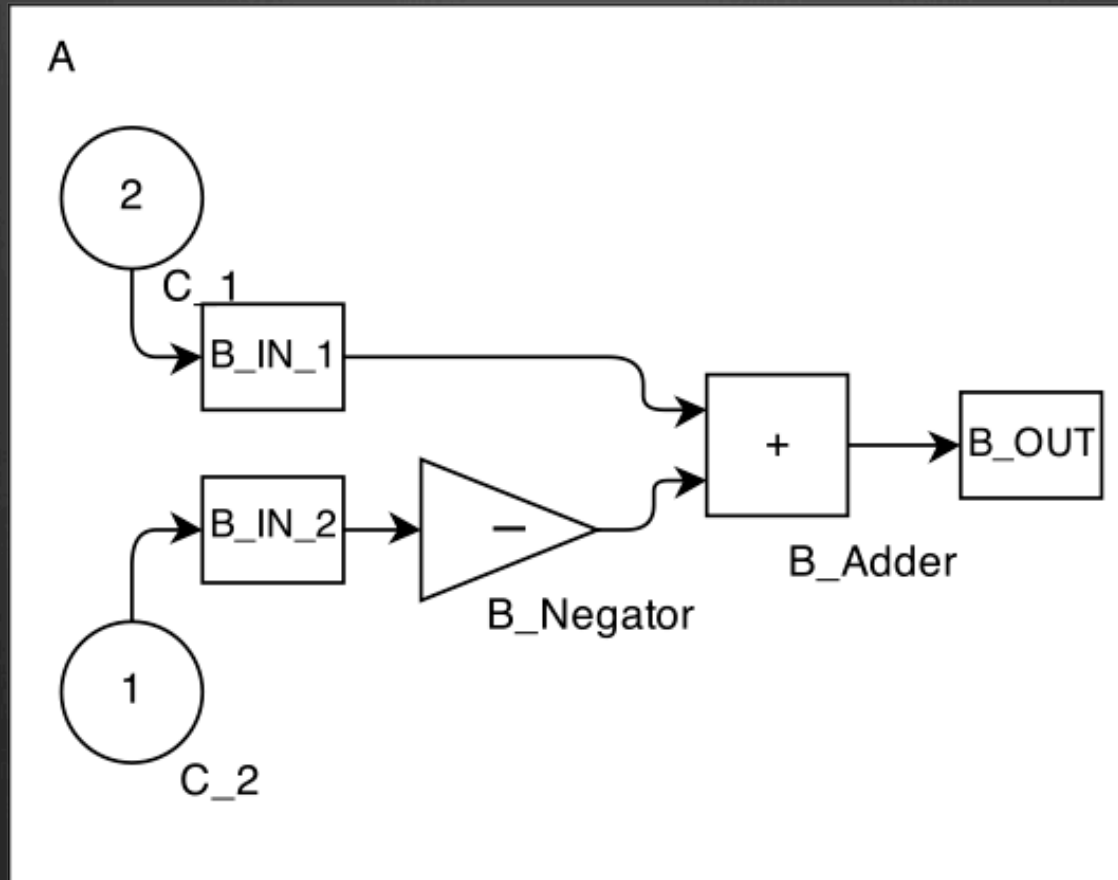
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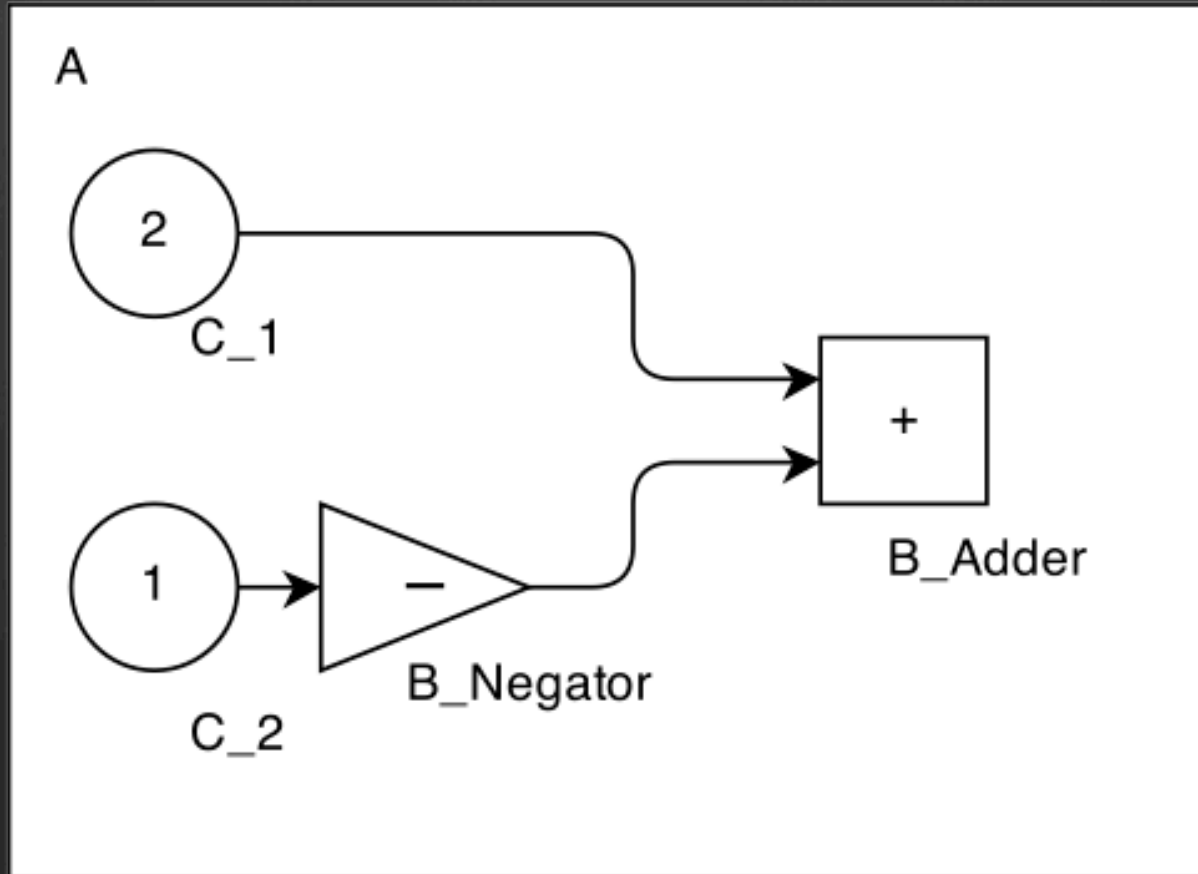
Flattening



Flattening



Flattening

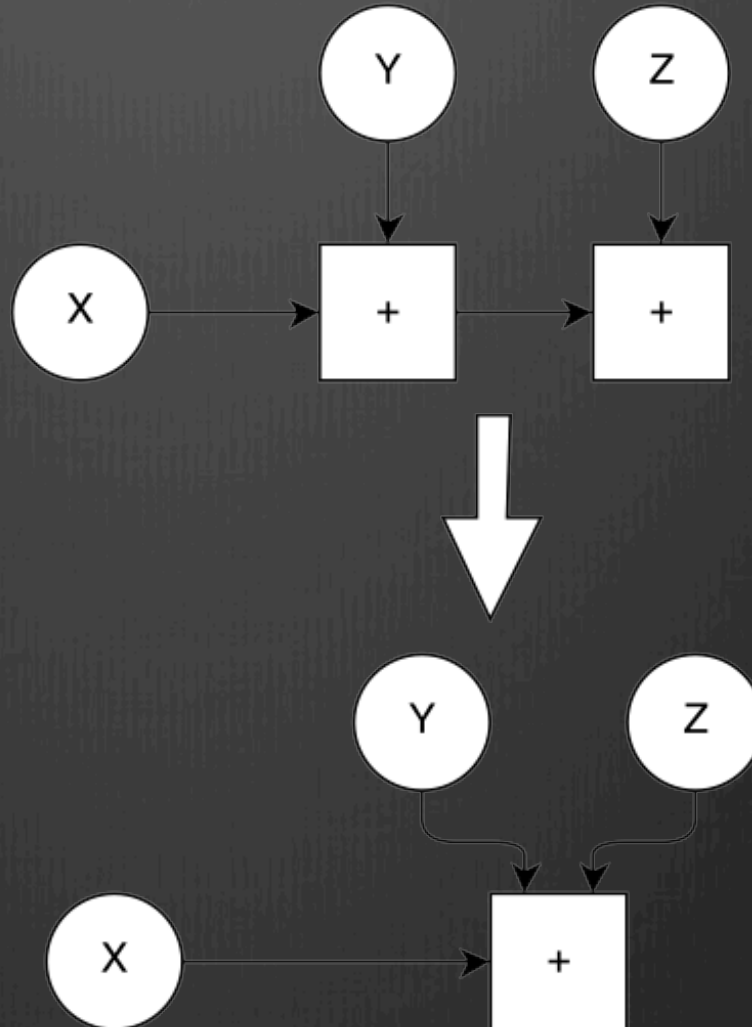


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Optimization

Collapse Blocks



Optimization

Constant folding

Special Cases

- 0 as input for adder
- 0 as input for product
- 1 as input for product

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- ⊗ **Functional Mockup Unit**
- ⊗ Experiment

Generate the Functional Mockup Unit

Functional mockup Unit:

- XML-file
- C-code

Functional Mockup Unit

XML File

- Model description
- Model variables
- (Solver details)

Functional Mockup Unit

C-code

- Based on SDK^[2]
- Subset of functions

[2] <https://www.qtronic.de/en/fmusdk.html>

Functional Mockup Unit

C-code

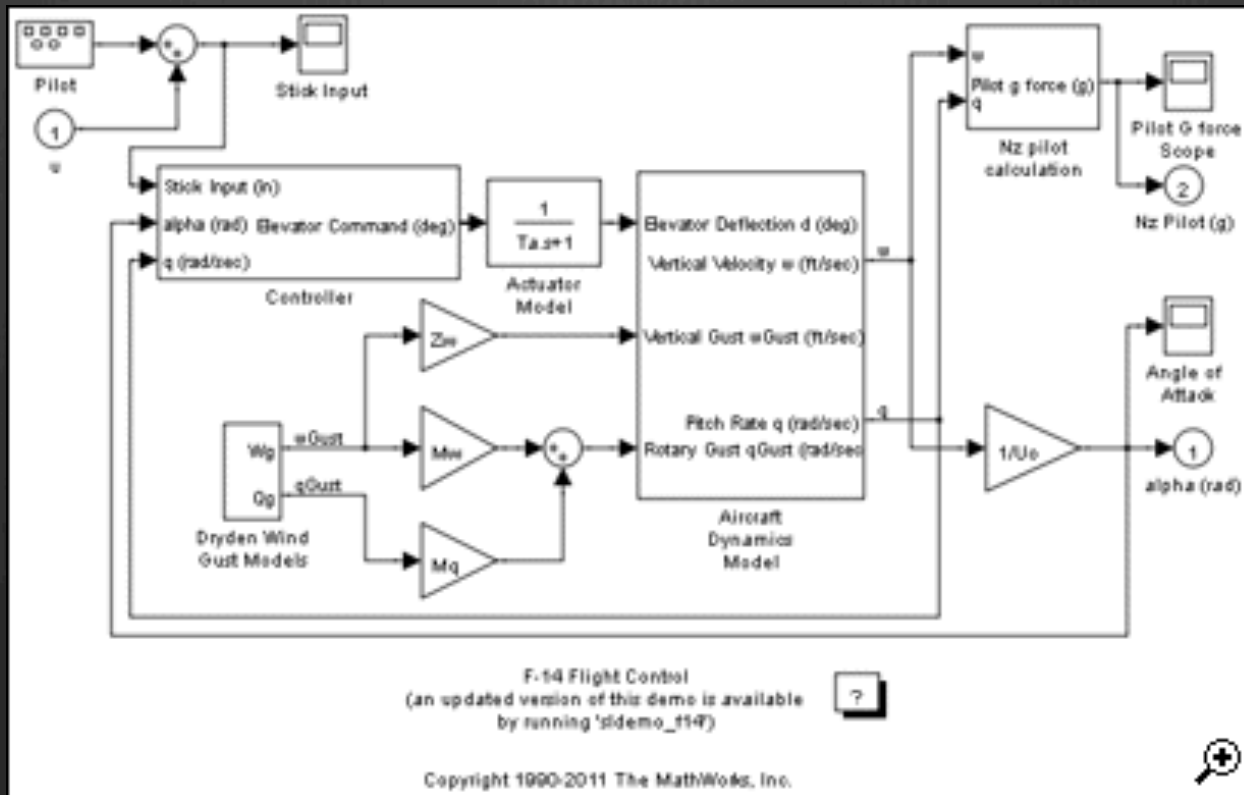
- variables array
- setStartValues()
- getReal()
- ComputeVariables()

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Experiment

F14



Experiment

Model of F14		Mean computation Time (s)	Number of Blocks
Python	Not optimized	9.96355	140
	Optimized	8.570786	116
FMU	Not optimized	0.012619	140
	Optimized	0.009318	116

Questions?

Conclusion