

Introducing Behavior in Function Blocks Xavier Rebeuf

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Introducing Behavior in Function Blocks

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Introduction

Distributed industrialprocess control



Compose hardware and software components

PB: Interoperability between components



Introduction

Distributed industrialprocess control



Compose hardware and software components

PB: Interoperability between components

- Abstraction of elementary component = Function block
- Composition of function blocks = Functional Requirement Diagram





Introduction

Distributed industrialprocess control



Compose hardware and software components

PB: Interoperability between components

- Abstraction of elementary component = Function block
- Composition of function blocks = Functional Requirement Diagram
 - Structural architecture



Validation of static interoperability



Not enough to validate temporal interoperability



Behavior modeling



Application simulation



Plan

- Description of the standard
- Adaptation taking into account the behavior
- Simulation of the application
- Example
- Conclusion



Plan

Description of the standard

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Goal: Have a common standard by which the users can be assured of compatible, interworkable, interconnectable, interoperable and interchangeable of the device they choose



« function block is an encapsulation of data and algorithms to provide a specific function, which can be self understanding »











Function Blocks – How to use







Function Blocks – How to use



Functional Requirement Diagrams



Objectives of FRDs is to describe:

- Control functions
- Performance
- Constraints

Problem:

- FRDs consider only static aspects
- How to describe temporal characteristics

Considered Architecture model





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Architecture model





Architecture model

➢ For each level : introduction of a unit to manage the behavior;





Architecture model

- ➢ For each level : introduction of a unit to manage the behavior;
- Introduction of a global timer to modelize real timer and synchronization management.





Execution model

> We only consider events (necessary for the execution scheduling)

- > Synchronous/asynchronous
- Cyclic/acyclic



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Application behavior

Algorithm description

- Algo#ID: algorithm identifier
- [MinTime,MaxTime]: bounds of execution time
- Probability density function: distribution

Execution rules

« ON event IF condition DO action »

- Action to perform when an event occurs
- Condition: predicate on local variables
- Action: operations on local variables / event sending
- « ON FB_invocation(num_port) DO Send (Algo_invocation(algoID), channelID) »
 - Extensions

« AT *time* IF *condition* DO *action* » « EACH *time* IF *condition* DO *action* »





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Simulation

Goals

- Validating system temporal properties
- System dimensioning regard to execution support architecture
- Distribution over resources



OPNET tool

- performance evaluation
 - Communication networks
 - distributed systems





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Example



- Network: CAN protocol
- Device: composed by three resources
- Transmitters: random messages





- Delay between transmitter and actuator
- Average values





Conclusion

Behavior model for Function blocks

- Rely on the structural architecture
- Dynamic behavior of an application = execution rules
- Execution rules used by state machines

Simulation

- Validating system temporal properties
- System dimensioning
- Distribution over resources

Future works

- Simulate complex applications
- Extend to other system features
- Detail the description of the behavior (operational modes)
- •Time constraints in the execution rules (timed automata)