# Design Decisions

## Basics

* Each Actor can only process on message at a time.
* Because computation delay is negligible compare to network delay, statements in a message server is executed atomically until an explicit delay statement is reached.
* At most one Continuous behavior can be active on each continuous variable. This restriction is due to tooling (SpaceEx) and compositional semantic.

## Separation of Cyber actors from physical actors

Physical actors are the actors that process physical behaviors. They contain a set of continuous variables and a set of modes. The modes define the continuous behavior on the variables. A physical actor can only have one current mode. Physical actors can send messages to cyber actors on the mode expiration. Physical actors can read-share their variables. These actors can have delayed statements.

Cyber actors are the actors that process cyber behaviors. They contain a set of discrete variables and a set of methods (message servers). Cyber actors can communicate which other by sending (asynchronous) messages. Cyber actors can change the physical actors mode (synchronous).

# Features of HPalang (Hybrid Rebeca) are

* Formal semantics based on Hybrid Automata
* Asynchronous message passing between actors
* Computation time modeling
* Physical/Continuous behavior modeling
* Discrete behavior modeling

# Semantics

Runtime State =

DVar : set of all discrete variables names.

CVar : set of all continuous variables names.

Mtd : set of all method declarations.

Each method is defined as the tuple .

# Statements



Statement for defining a continuous behavior. and are invariant of behavior, flow of continuous variable and the guard of transition (expiration of the behavior) and are a sequence of statements which will be executed when transition is taken.



# Auxiliary functions

in which D(x) returns the delay variable for actor ID.

in which bod returns the body of method in actor .

# Operational Semantics

The global state is a function and DS is the discrete state and is defined as where and CS is the continuous states and is defined as .

# Transitions

***Message Take***

***Continuous Behavior Expiration***

***Continuous Variable Assignment***

***Discrete Variable Assignment***

***Conditional True***

***Conditional False***

***Resume Statement***

***Continuous Behavior Statement***

***Delay Statement***

***Message Send***

**If message will be invalidated exactly on deadline**

**Hybrid Translation**

Preprocess on LTS

1. Prioritizing transition: if a state has at least one transition all its guarded transitions are removed
2. Merging transition: Merging transition so only guarded transition are left

From ) and CVar To

**Simplifications and assumptions**

No Parameter for methods.

Only one guard and invariant in continuous behavior.