Behavioural Hybrid Process Calculus

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Hybrid Systems

- **Continuous dynamics**
  - mechanical movement
  - chemical reactions
  - electrical circuits
- **Discrete dynamics**
  - collisions
  - valves, pumps, switches
  - digital control

Examples of Hybrid Systems

- **Embedded**
  - Phone
  - TV
  - Vehicle
- **Traffic Control Systems**
  - Highway Supervision
  - Air Traffic Management
  - Sea Traffic Management
- **Production Processes Control and Robotics**
  - Chemical industry
  - Energy (power generation)
  - Food industry

Language

$$P : \quad a.P \mid [\ ].P \mid_{i\ I} P_i \mid P \parallel_A^H P \mid P[\ ] \mid B$$

$$\frac{\{B\ v \qquad B\ v \mid v\ I\},\ \{B\ w \quad \searrow \quad ,w\ J\},I \neq \varnothing}{B\ v \qquad\qquad B\ v}$$

$v\ I\ J \qquad\qquad v\ I$

Process Calculus Ingredients

Trajectories & their continuations

Synchronization only on specified actions & signals

Behavioural approach

- Trajectory-prefix
- Superposition
- Parallel Composition
- Separation of Concerns
- Continuous Behaviour

Choice is made when it is really time to do it

Discrete and continuous behaviours can be separated syntactically

Hybrid Transition System

HTS $\langle S, A, \ , W, \ , \ _c \rangle$

S is a state space,

A is a set of discrete action names,

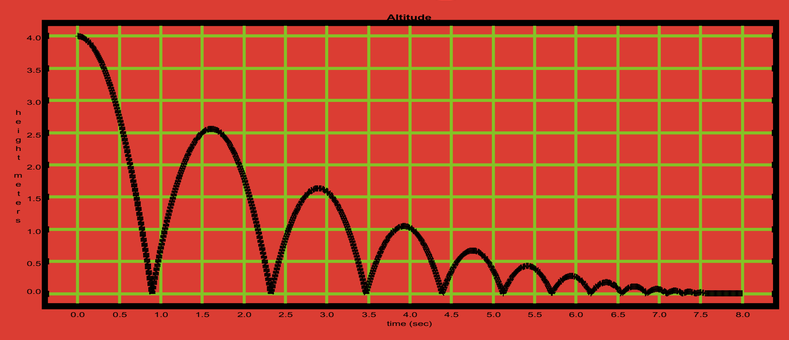
S E S is a discrete transition relation ($s \xrightarrow{a} s$),

W is a signal space,

is a set of (initial) trajectories $: (0,t] \to W$ for $t \in R$

$_c$ S S is a continuous transition relation ($s \xrightarrow{}_c s$)

Bouncing ball



$$BB\ h_0, v_0 \quad \stackrel{df}{=} \quad h, v : \quad h_0, v_0 \mid h \quad 0 \ .\ BB\ 0, \ cv$$

$$h_0, v_0 \quad \stackrel{df}{=} \quad h, v : h(0) \quad h_0, v(0) \quad v_0 \quad \dot{h} \quad v, \dot{v} \quad g$$

Plans

Development of analytical techniques for hybrid systems in the BHPC framework

Simulation of BHPC

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