Detail in Section 1

In this section the author introduces the modeling of timed automata.

First, the fundamental concepts are defined. The author utilizes state-transition graphs for the modeling with labeled transition for event symbols. The definitions of transition system and reachable state are given. The author shows that a complex system is a product of simple ones interactive. This character is valuable for synchronization.

Sometimes timing constrains need to be taken into account. The finite graphs, augmented with finite clocks, are introduced for the representation. Its vertices are called locations and edges switches. We implement a clock constraint called invariant at each location. Unless it becomes false time can only elapse in one location. Simple examples are introduced for instruction, and the advantage of the independent setting of different clocks, is clarified.

The formal definition of timed automata is give based on the discussion of clock constraints and interpretations. It is a group of elements containing the sets of locations, of initial location, of labels, of labels, mapping relationship between location and clock constrains, and a set of switches. The semantics of a timed automaton is defined by the association with a transition system.

Two kinds of transitions in the state are introduced: State change due to elapse of time and State change due to a location-switch, their mathematical definition given. Also the concept of Nonzenoness is discussed. Automata is defined as nonzeno with the property of 1) Ability to enable some outgoing edge with violation of an invariant; 2) Admittance of possibility of time diversion at each reachable state.

Product construction is introduced for the decomposition of complex system as product of component systems. The automaton of product, its mapping and switch definition with disjoint clock sets given are introduced: its location is pair of component ones, invariant is the conjunction, and switches come from synchronization.

An example for an automatic controller of control of railroad crossing gate is given with a detailed description and analysis about its working process. Finally, the author discusses the compositionality for intersystem component communication and modeling of real-time system. In these cases, control range of system and environment must be distinctive for the decomposition of complexity.