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TIMED AUTOMATA WITH PERIODIC CLOCK CONSTRAINTS [1]

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ABSTRACT

The traditional constraints on the clocks of a timed automaton are based on real intervals, e. g., the value of a clock belongs to the interval $(0, 1)$. Here, we introduce a new set of constraints, which we call "periodic", and which are based on regularly repeated real intervals, e. g., the value modulo 2 of a clock belongs to the interval $(0, 1)$ which means that it belongs to $(0, 1)$ or $(2, 3)$ or $(4, 5)$ ...

Automata with these new constraints have greater expressive power than the automata with traditional sets while satisfiability remains decidable. We address questions concerning ϵ-moves and determinism: simulation of automata with periodic constraints by automata with traditional constraints, properties of deterministic automata with periodic constraints (like closure under Boolean operations and decidability of the inclusion problem) and removal of ϵ-moves under certain conditions. Then, we enrich our model by introducing "count-down" clocks and show that the expressive power is not increased. Finally, we study three special cases: 1) all transitions reset clocks, 2) no transition reset clocks, and 3) the time domain is discrete and prove the decidability of the inclusion problem under each of these hypotheses.

Keywords: model checking, analysis of real-time systems, timed automata, ω-automata.

1. Introduction

Emphasis on concrete time, i. e., on *when* events occur and not only in *which order* they occur, is a vivid concern of the ongoing research on how real-time systems should be modelled or verified. Among the most popular models to be found in the literature are different kinds of real-time temporal logics that are extensions of the

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