Average-Time Games on Timed Automata

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Abstract. A timed automata is a finite automata accompanied by a finite set of real-valued variables called *clocks*. Clock variables may appear in guards of transitions of a timed automaton, where they can be compared against integers. The syntax of timed automata also allows clock values to be reset to zero after executing a transition. An average time game is played on the infinite graph of configurations of a timed automaton. The two players, Min and Max, construct an infinite run of the automaton by taking turns to perform a timed transition. Player Min wants to minimize the average time per transition and player Max wants to maximize it.

We introduce an abstraction of timed automata, which we call *boundary region graph*. We show that an average-time game on timed automata can be solved by solving an average-time game on boundary region graph, which gives an EXPTIME algorithm to solve these games. We also show that average-time games are EXPTIME-COMPLETE as the countdown games can be reduced to average-time games on timed automata with at least two clocks.

A direct consequence is an elementary proof of determinacy for average-time games. This work complements our previous results on reachability-time games and it partially solves a problem posed by Bouyer et al., to design an algorithm for solving average payoff games on priced timed automata.