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.