Real-time Model Checking

— Open problems —

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Algorithms and datastructures

- **Fully symbolic exploration** of timed automata:
  - BDD-like representation of transitions;
  - Clock Difference Diagrams, but no canonical form...
- **Zone-based implementations** for the verification of priced-timed automata:
  - optimal infinite runs;
  - multi-priced timed automata;
  - energy timed automata and games...
- **Algorithms and implementations** for model-checking linear-time properties.
- **Partial-order reductions** for timed automata.
- **Bounded model-checking** for timed automata using SAT solvers.

Timed games

- **Non-zero-sum games**:
  - multi-player timed games;
  - instead of computing winning strategies, we look for equilibria.
- **Partial observability**:
  - minimal set of observations needed to ensure controllability
  - CEGAR approach to incomplete information.
- **Probabilistic timed games**:

Weighted timed automata and games

- **Priced timed games with two clocks**
- **Optimal infinite runs with safety**
- **Timed automata with exponential observers** and even richer dynamics
- **Energy timed games** with several clocks.

Implementability issues

- **Timed automata are not implementable!**
  - computers are digital;
  - communications are not instantaneous;
  - different clocks have (slightly) different rates.
- **Modified semantics**
  - tube semantics
  - probabilistic semantics
  - guard enlargement (robustness)
- **Zone-based algorithms** for robustness checking
- **Robust model-checking** of weighted timed automata.
- **Robust control**:
  - synthesis of implementable controllers.