Abstract. UPPAAL is a tool suite for automatic verification of safety and bounded liveness properties of real-time systems modeled as networks of timed automata. It includes: a graphical interface that supports graphical and textual representations of networks of timed automata, and automatic transformation from graphical representations to textual format, a compiler that transforms a certain class of linear hybrid systems to networks of timed automata, and a model-checker which is implemented based on constraint-solving techniques. UPPAAL also supports diagnostic model-checking providing diagnostic information in case verification of a particular real-time systems fails.

The current version of UPPAAL is available on the World Wide Web via the UPPAAL home page http://www.docs.uu.se/docs/rtmv/uppaal.

1 Introduction

UPPAAL is a new tool suite for automatic verification of safety and bounded liveness properties of networks of timed automata [13, 8, 6]. The tool was developed during the spring of 1995 as the result of intense research collaboration between BRICS at Aalborg University and Department of Computing Systems at Uppsala University. The two main design criteria for UPPAAL has been efficiency and ease of usage.

The current version of UPPAAL, as well as its future extensions, is implemented in C++. Model-checking is often hampered by various state-explosion problems. In UPPAAL these problems are dealt with by a combination of on-the-fly verification together with a new and coarser symbolic technique reducing the verification problem to that of solving simple linear constraint systems. The features and tools of UPPAAL includes:

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*** Basic Research in Computer Science, Centre of the Danish National Research Foundation.
- A graphical interface based on Autograph.
- An automatic compilation of the graphical definition into a textual format.
- Analysis of certain types of hybrid automata by compilation into ordinary timed automata. In particular, UPPAAL allows automata with varying and drifting time-speed of clocks.
- A number of simple, but in practice extremely useful syntactical checks are made before verification can commence.
- Generation of diagnostic traces in case verification of a particular real-time system fails.

In this paper we present the various features of UPPAAL, review and provide pointers to the theoretical foundation as well as applications to various case-studies.

2 An Overview of UPPAAL

UPPAAL consists of a suite of tools for verifying safety properties of real-time system. An overview of the system is shown in Figure 1. In this section we briefly describe the main features of UPPAAL.

2.1 Graphical Description of Networks of Timed Automata

It is possible to draw networks of timed automata using Autograph, given that certain syntactical rules are followed, e.g. the different automata in the network must be enclosed in boxes with the name of the process in the structural label, there must be a textual box describing the system configuration, i.e. declaration of clocks, channels and auxiliary integer variables. To be able