Hierarchy is Good For Discrete Time:
a Compositional Approach to Discrete Time Verification

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1 Introduction

Model checking is now widely used as an automatic and exhaustive way to verify complex systems. However, this approach suffers from an intrinsic combinatorial explosion, due to both a high number of synchronized components and a high level of expressivity in these components.

With respect to the expressivity issue, we consider the particular problem of introducing explicit time constraints in the components of a system. In this modeling step, the choice of a time domain is important, impacting on the size of the resulting model, the class of properties which can be verified and the performances of the verification.

In this presentation, we show that hierarchical encoding of elementary components encapsulating labeled transition systems (LTS), synchronized by means of public transitions, is an efficient way to encode discrete time.

2 Instantiable Transition Systems

Instantiable Transition Systems (ITS) are a framework designed to exploit the hierarchical characteristics of SDD [2]. This structure is used to encode the state space, for the description of component based systems. ITS were introduced in [4]. Here are the main principles ITS rely on:

- ITS types (elementary) represent a LTS and export some public transitions that can be synchronized with other ITS types,
- composite ITS gather several ITS (composite or elementary) and propose a new interface that can be connected to some of the synchronized public actions of enclosed ITS,
- instanciation allows to create a number of entities having the same behavior. This emphasizes the description of regularities in distributed systems.

3 Encoding discrete time with ITS

The basic idea of using ITS to model discrete time is to propose an extra interface dedicated to time elapse [3]. This interface interacts with local clocks. When time elapse the same way all over the system, the elapse interfaces must be synchronized together. It is also possible to have local synchronization of clocks to model several timelines.

This presentation shows the main principles of this mechanism and illustrates it on a simple example from the literature. Then, we emphasize its interest in a small medical case study: the Body Area Network. Here, ITS are generated from a high-level language dedicated to the description of Wireless Sensor Networks: Verisensor [1].

References

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