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## Verification of real time properties in fiacre language

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Université  
de Toulouse

# THÈSE

## En vue de l'obtention du DOCTORAT DE L'UNIVERSITÉ DE TOULOUSE

**Délivré par :**

Institut National des Sciences Appliquées de Toulouse (INSA Toulouse)

**Discipline ou spécialité :**

Sûreté logicielle et Calcul de haute performance

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**Présentée et soutenue par :**

Nouha ABID

**le :** mardi 11 décembre 2012

**Titre :**

Verification of Real Time Properties in Fiacre Language

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# Verification of Real Time Properties in Fiacre Language

Nouha ABID



◇□ **Her story all over** ◇□

There will be time, there will be time,  
to prepare a face to meet the faces that you meet,  
there will be time to murder and create  
and time for all the works and days of hands,  
that lift and drop a question on your plate,  
time for you and time for me  
and time yet for a hundred indecisions  
and for a hundred visions and revisions,  
before the taking of a toast and tea.

– **T.S. Eliot**–

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## Abstract

The formal verification of critical, reactive systems is a very complicated task, especially for non experts. In this work, we more particularly address the problem of *real time systems*, that is in the situation where the correctness of the system depends upon timing constraints, such as the “timeliness” of some interactions. Many solutions have been proposed to ease the specification and the verification of such systems. An interesting approach—that we follow in this thesis—is based on the definition of *specification patterns*, that is sets of general, reusable templates for commonly occurring classes of properties. However, patterns are rarely implemented, in the sense that the designers of specification languages rarely provide an effective verification method for checking a pattern on a system. The most common technique is to rely on a timed extension of a temporal logic to define the semantics of patterns and then to use a model-checker for this logic. However, this approach may be inadequate, in particular if patterns require the use of a logic associated to an undecidable model-checking problem or to an algorithm with a very high practical complexity.

We make several contributions. We propose a complete theoretical framework to specify and check real time properties on the formal model of a system. First, our framework provides a set of real time specification patterns (that may be viewed as a timed extension of Dwyer’s patterns). We provide a verification technique based on the use of observers that has been implemented in a tool for the Fiacre modelling language. Finally, we provide two methods to check the correctness of our verification approach; a “semantics”—theoretical— method as well as a “graphical”—practical— method.

**[Keywords:]** Verification; Requirement; Specification Patterns; Model Checking; Observers; Real Time Systems