

# Some Issues About Verifying Interactive Narrative Structures

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## ABSTRACT

We sketch out in this paper some issues about applying model checking techniques to verification of interactive narrative structures.

## Keywords

Interactive Narrative, Hypertext, Model Checking.

## 1. INTRODUCTION

Numerous new technologies applications have appeared in the past ten years which require interactive narrative structures. These applications have emerged from domains ranging from electronic arts to video games, from electronic literature to music and cinema.

In these contexts, the user (she can be called reader, player, interactor, depending on the application domain and the research community) wanders among scenes (text fragments in hypertext literature, or dramatic actions in interactive drama), and chooses to realize actions that influence what can occur next. The content of what is presented to the user, the way it is presented, as well as the set of actions the user can realize next are dynamically computed with respect to the actions the user performs.

As the complexity of the application gets bigger (number of scenes, variety and range of actions the user can choose to perform, influence of the actions of the user), it becomes difficult to keep control over the huge number of sequences of scenes that can occur.

Let us consider for instance interactive storytelling. Insuring the consistency of every single story that can occur depending on the actions of the user is a very challenging issue. There is a paradox in trying to provide the user with a large amount of non deterministic choices on the one hand, and on the other hand to try to satisfy consistency properties whatever be the actions chosen by the user. The trade-off is to give the user the freedom to perform a large variety of actions together with keeping the user's activity under strong enough control so that some narrative

consistency properties can be satisfied.

Our aim is to investigate the application of programming languages verification frameworks to interactive narrative structures and to discuss the kinds of properties that can be automatically tested this way.

## 2. STRUCTURE VERIFICATION FRAMEWORKS

Several frameworks were proposed in order to provide the designer of an interactive narrative structure with tools for automatic testing properties of the structure. These frameworks are based on the transformation of the structure into a formal model (for instance: finite automata, Petri nets or first order logic) and the application of model checking techniques issued from research in programming languages.

In the domain of video games, Natkin and Vega [1] studied the transformation of a video game interaction structure into a Petri net. In the domain of hypertexts, Réty [2] proposed the transformation of an adaptive hypertext structure into first order logic.

A logical query language was defined by Stotts, Furuta and Cabarrus [3] that allows for expressing structural properties of an hypertext structure. These authors also defined a subset of this query language, called Hypertext Temporal Logic (HTL), that can be efficiently automatically tested by model checking. We think the expressive power of this sub-language to be strong enough for expressing and testing a large range of properties of interest to interactive narrative structure designers.

However, the transformation of an interactive narrative application into a formal model is not always possible without losing information. For instance, in the case of video games, the transformation of Vega and Natkin into Petri nets do not take into account the knowledge of the user: there may exist a way of going through a mirror and reaching some next level, and the user may not know how to perform this action (she even may not be aware such action exists). In this case, the verification tool will answer that the user can access the next level, while she actually cannot.

## 3. DIFFERENT KINDS OF PROPERTIES THAT CAN BE CHECKED

The designer of an interactive narrative structure may be interested into different kinds and different levels of properties of the structure.

### 3.1 Properties of the Structure

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Examples of such properties are:

- Does scene A always eventually occur (whatever be the actions the user performs)?
- Does scene A always occur before scene B?
- How long is the shortest path from scene A to scene B?

These are the properties that can be directly expressed into Hypertext Temporal Logic.

### 3.2 Structural Properties of the Story

- Does the user always eventually learn who is the murderer ?
- Does the gangster always read the secret message before he gets blind?

Such properties can be checked by testing equivalent properties of the structure. For instance, the first example can be checked by testing whether the scene in which the name of the murderer is given eventually occurs.

### 3.3 Structural Properties of the Narration

- Is there always a suspense effect: does the user always gets into the scene where character A is killed before she learns who is the murderer.
- Is there always enough suspense: how long is the shortest path from the scene where character A is killed to the scene where the user learns who is the murderer?

As above, such properties can be checked by testing equivalent properties of the structure.

### 3.4 Non-Structural Properties

Some properties the designer of an interactive narrative structure is interested in do not only depend on the structure. In the case of interactive drama, an example of such a properties could be:

- Does the narration always contain enough conflicting situations so that the user always experience expected narrative effects?

The evaluation of non-structural properties remains to be investigated. We think that, at least in some cases, non-structural properties can get an answer or a partial answer by checking some structural properties.

## 4. CONCLUSION

Verification frameworks can be very useful to interactive narrative structure design but the successful application of model checking methods to interactive narration needs more research in this direction. Two major issues that need to be investigated are:

- What are the consequences of the loss of information that can occur in the transformation of an interactive narrative into a formal model. What properties that can be checked on the formal structure are still valid for the interactive narrative.
- How non structural properties can be checked by testing structural properties? What structural properties can be tested this way?

## 5. REFERENCES

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