

# AUTHORING MULTIMEDIA DOCUMENTS THROUGH GRAMMATICAL SPECIFICATIONS

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## ABSTRACT

The diversity of multimedia devices is an important feature on the Internet, which demands an executable mechanism to intelligently adjust the appearance of a document according to different viewing contexts. In order to satisfy this requirement, a graph-grammar-based approach for multimedia authoring is presented by extending a context-sensitive graph grammar formalism, *Reserved Graph Grammar (RGG)*, with the capability of spatial specifications. Based on a parser for the RGG, a graph grammar functions as a mapping from the structure of a document to a desirable layout, and graph transformations are automatically performed when contexts are changed.

## 1. INTRODUCTION

Multimedia authoring is a challenging issue when considering the diversity and various capabilities of media devices. An authoring tool should provide an easy approach to not only specifying the structural relations with spatial and temporal relations among medial objects, but also meeting the dynamic requirements, i.e. the authoring tool should provide a mechanism to support the intelligent adaptation of appearances according to different contexts. Fortunately, the graph grammar is a possible solution.

Motivated by the theoretical support for pattern recognition, compiler construction, and data type description, graph grammars originated in the late 60 have provided a theoretically sound and well-established foundation [Roz97]. Graph grammars are powerful in defining logic relations among constructs and providing a natural approach to specifying the hyper-graph structure of a multimedia document. Especially, the *Reserved Graph Grammar (RGG)* is a context-sensitive graph grammar formalism with a parsing complexity of polynomial time under a non-ambiguous condition [Zha01]. The applications of the RGG [Zha01a] [Kon03] demonstrate its powerful expressiveness.

However, we cannot apply the RGG directly to multimedia authoring, since it is unable to specify how

constructs look like, one of the important aspects in multimedia authoring. This paper presents a spatial extension to the RGG and illustrates its application in multimedia authoring.

The rest of the paper is organized as the following. Section 2 illustrates how to extend the RGG with spatial specifications. Section 3 presents our approach to multimedia authoring and goes through an example. Section 4 lists related works, followed by the conclusion in Section 5.

## 2. EXTENDING RESERVED GRAPH GRAMMAR

### 2.1. Graph grammar notations

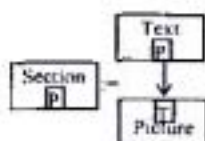


Figure 1. A production in RGG

The RGG is a context-sensitive graph grammar formalism with a parsing complexity of polynomial time under a non-ambiguous condition. In the RGG, nodes are organized into a two-level hierarchy as illustrated in Figure 1. A large rectangle is

the first level called a *super vertex* with embedded small rectangles as the second level called *vertices*. Each vertex is labeled by a unique character. A grammar rule (Figure 1) is called a *production* consisting of two sub-graphs, called *left graph* and *right graph*. A sub-graph in the host graph matching the left or right graph is called a *redex*. The RGG employs a marking technique to solve the embedding problem and avoid ambiguity. If a super vertex or a vertex is marked, it will reserve its outgoing edges connected to vertices outside the replaced sub-graph in the application of a production. A marked vertex is represented with a gray background (to save space, we use a circle with a unique integer to represent a marked vertex in the later example). The RGG is equipped with a deterministic parsing algorithm, called *selection-free parsing algorithm (SFPA)* trying only one parsing path. Zhang *et al.* proved that the time complexity of SFPA is polynomial under a non-ambiguous condition [Zha01].

The RGG provides a powerful mechanism to represent structures graphically and perform automatic syntax validation through an automatically generated