

Human-Computer Collaboration in Level Design for Computer Games

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Introduction

Creating a good level for a game is a time-consuming and highly iterative process: the level may start as a simple sketch of the space, which is then filled in with specific geometry. Designers will typically play the level themselves many times before showing it to anyone else, checking that it is playable, engaging, and meets their expectations [1]. Making a change to small section of a level, such as moving a single critical piece of geometry, can have a significant impact on the design and require much of the rest of the level to be modified as well. The growth of the games industry [2] and the increasing complexity of virtual worlds points to a need for better design tools that can ease this authoring burden.

This poster presents *Tanagra*, an intelligent level design tool that incorporates procedural content generation. The tool operates within the domain of 2D platformers, such as *Super Mario World* (Nintendo, 1990). *Tanagra* takes a mixed-initiative approach to design, in which content is created through iterative cycles between the human designer and procedural support in a collaborative way. This approach capitalizes on the strengths of both the human and computer designers: the computer is capable of producing many different variations on a level more rapidly than human designers, whose strengths lie in creativity and judging the quality of content.

Related Work

Current work in author-guided procedural level generation tends to place all authorial control over the generator at the beginning of the process [3-5], occasionally allowing editing after the level is complete. For example, the world builder for *Civilization IV* (Firaxis Games, 2007) allows the designer to set certain terrain parameters ahead of time, such as the size of the land masses, distribution of water and land, and climate. After the generator creates the initial world, the designer can modify the terrain according to her own desires. However, there is no way to request another map that respects the changes that the designer has made, or that only a part of the level be regenerated. The mixed-initiative nature of *Tanagra* means that the designer and computer can collaborate throughout the design process.

One important exception is the *SketchaWorld* project [6], which provides a mixed-initiative authoring environment for virtual worlds, including terrain editing and city building. This project faces many of the same design concerns as *Tanagra* in determining how best to have designers interact with a PCG system. *SketchaWorld* focuses on building large-scale virtual worlds made up of largely non-interactive structures, whereas *Tanagra* focuses on building levels that dictate the core gameplay.

Description

Tanagra's design is guided by principles for intelligent creativity and design support tools [7-10]. It works *within* the iterative design process by supporting new decisions from the designer at any time during creation, and rapidly re-generating sections of a level as needed. Decisions that are made by the human designer are protected such that they cannot be overruled by the system. Levels made using Tanagra are always playable; i.e. every platform and object in the level is reachable, and it is possible to proceed from the left to right side of the level. Tanagra also explores novel editing operations: the designer can directly manipulate the pacing of the level by editing the underlying beat structure.

Tanagra uses a combination of reactive planning (using ABL [11]) and numerical constraint programming (using Choco [12]) to respond to designer changes in realtime. Reactive planning allows for the expression of generator behaviors, such as placing patterns of geometry or altering the pacing of the level, which can be interleaved with a human designer's actions. These behaviors monitor multiple aspects of the generator in parallel, and their hierarchical nature allows for complex geometry patterns to be built up from simpler components. The geometric relationship between level components is expressed as a set of numerical constraints that must be satisfied, thus ensuring that the design tool will never allow for the creation of an unplayable level. This architecture sits atop a rhythm-based representation [13] for levels that controls the pacing of the level, where each beat in the rhythm corresponds to a single action taken by the player.

Further information about the Tanagra system and its motivations can be found in our recent publications [14-15], and a video of Tanagra in action is available online¹.

Future Work

Tanagra is a complete system that is now ready for user studies, which will examine how people interact with the system and what editing interfaces and operations are most appropriate. I also intend to explore how the approach used in Tanagra, and lessons learned from its design, can apply to both quests and levels in role-playing games.

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