Assisting End-Users in Understanding and Programming Simulations

Christoph Neumann
Oregon State University
neumann@eecs.oregonstate.edu

1. Introduction

We live in a media-rich environment. Today’s technology user is accustomed to visual, interactive content but faced with challenges for authoring such content. The divide between the user and the creator grows with the greater complexity of the media. We seek to enable end-users to develop their own virtual environments through end-user programming. In particular, we are interested in helping American football coaches create digital playbooks with animated content. Such an environment requires the presentation of a large amount of information. This information can be associated with virtual agents, spatial locations, particular play formations, etc. We are currently focusing on assistive visualization techniques for both the programming and presentation of the strategy information.

2. Domain, Method and Goals

Through user-centered design, we are developing a tool to allow American football coaches to create a simulation-driven virtual playbook. Coaches program virtual players through a constraint-based, visual programming language and then execute the simulation to animate the virtual players. Our language is modeled after the notation coaches already use in their playbooks and classroom demonstrations. The virtual playbook consists of “scenarios” which involve “offensive” and “defensive” players. The coach associates rules with players to create an executable scenario. These scenarios can be used in the classroom or on an individual player’s notebook computer as a dynamic visualization to complement or possibly replace a static printed playbook. See figure 1 for a screenshot of our prototype.

We are extending this work to allow coaches to develop a body of rules that span scenarios thus creating a knowledge base of intended behavior. These rules will then be drawn upon to rapidly create new scenarios. Additionally, the knowledge base will be used to allow for human players to interactively control a virtual player within a scenario while the other virtual players react via the rules programmed in by the coaches. Our ultimate goal is to create a tool that coaches use to quickly generate content to train their human players rather than a “smart” football system which is able to infer behaviors in new scenarios.

Commercial offerings, such as Coach’s Office [1], provide automation tools for many administrative tasks, but do not allow coaches to create simulations of scenarios.

Our system is closely related to Pickering’s COACH system [2], but we are focusing on assisting a coach in developing simulations and using the simulations for training real players.

3. Opportunities and Challenges

We are exploring opportunities to assist the coaches in creating, using, modifying and understanding scenarios. Such research topics include using coordinated and filtered views, rule representation and programming, immersive 3D rendering, using physical data to improve the realism of the animation, and introducing finer levels of control.

3.1. Spectrum of Information

While authoring and using the content, coaches need to convey information at multiple levels:

- **Play level**: The general objectives and purpose of a particular formation.
Position level: What particular kinds of players (eg. wide receivers) should be doing as part of the scenario.

Player level: What a particular player should be doing within a particular scenario or play—including behavior based on other players in the same scenario.

Some of the information coaches need is semantically useful to the simulation (the rules), but some of the information may only be useful to the human players (due to its vagueness, complexity, intractability, etc.) It is useful to capture this additional information into some form of a continuous spectrum of information where coaches and players can move from higher level concepts to lower-level details. The challenge is finding a user-centric model of moving through the information and associating rules with the explanatory content.

3.2. Visualization

Coaches have a variety of needs for the content: to develop a canon of plays, work through the implications of particular scenarios, and demonstrate proper and incorrect behavior to human players. Currently the coaches rely on printed playbooks with descriptions and annotations, white board drawings, overhead projections, and video footage to understand and communicate different scenarios. Coaches are interested in explaining and demonstrating the “right” behavior to players while clarifying by demonstrating the “wrong” behavior. Often coaches use several different video clips to illustrate the behavior the coach intends. A 2D view is appropriate for an overview, but a 3D view is more appropriate for demonstrating specifics of a scenario to the players. This 3D view could serve to augment the video footage or replace it in some instances. Developing the right visualization to support these different activities is one of the research challenges we are undertaking.

3.3. Understanding and Debugging

We are investigating visualization techniques to assist the coach in developing and understanding the rules for a given scenario. Having many rules can cause unforeseen interactions making it difficult for the coaches to understand what is going on in a particular scenario. We want the coaches to focus on authoring content, not debugging constraints. We can avoid this problem, to some extent, through the design of our rules, but we can also mitigate this problem through our authoring tool.

Understanding player behavior is critical for authoring. It should be clear what causes a player’s behavior so the coach can tailor the behavior to his/her liking. Coaches need visual, intuitive, dynamic methods to assist them in understanding and defining behavior.

A causality visualization would allow the coaches to understand the chain of rules affecting a player. This helps the coach understand what happened. Rapid feedback shows the coach the implications of his/her changes to the scenario. This helps the coach understand what the player will do. Filtering allows the coach to limit the displayed information to that which is relevant to what the coach is examining. This allows the coach to remove the visual noise and focus on specific interactions. We seek to incorporate these visualizations in such a way as to keep the mental burden low on the coaches so they are free to focus on authoring instead of wading through semantics.

3.4. Generating the Rules

As previously mentioned, the coaches use lots of information at many different levels. Not all of this information is semantically useful for the simulation. We have determined a fundamental set of rules and information to create primitive simulations, but we seek to expand this set. The challenge is increasing the rules set in a sound way while maintaining the intuitive nature of the rules for coaches.

A key factor in preserving the intuitive nature of the rules is grounding the rules in the visual vocabulary the coaches already use. With both explicit and implicit notation, the coaches pack quite a bit of information into a single play diagram. Explicit rules have been the easiest to define (such as “run here”), but implicit information (such as “gap” coverage) is more difficult.

We are continuing to research how we can incorporate the coaches’ notation while extending it when prior notation does not exist. In particular, we are interested in mechanisms to allow the coach to express the implicit information while maintaining a familiar look to the scenario diagrams.

4. Conclusion

We seek to enable media-rich content users to become content authors. Through our visual, constraint programming language and assistive use of interactive visualizations, we hope to enable American football coaches to create and use simulations effectively.

References