In-Game Cameras

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ABSTRACT
In this paper, the In-Game Cameras project will be presented from theory to execution. The project aims at tackling the effect of cameras in video games on the players.

General Terms
Design, Experimentation, Theory

Keywords
Video Games, Camera Control, Football

1. INTRODUCTION
The project aims to research and ultimately improve the expressive range of the camerawork in commercial video games. It will do so by exploring customized camera behavior.

The question that will hopefully be answered through this research is whether or not a "good" camera can be deduced from scientific data.

2. BACKGROUND
Steven Drucker analyzes the complexities of camera control in his paper entitled *Intelligent Camera Control for Graphical Environments*. He sees the problem that people are too focused on the "question of *how* to move a camera rather than *why* to move it." He looks for a more "intelligent method for controlling virtual cameras in computer graphics."

Building on this assumption, the In-Game Cameras project focuses on just that. How can a camera move in relation to the best performance of the user? Cameras should be tailored to the user instead of tailored to the easiest implementation.

3. GAME PROTOTYPE
The theory must be tested within a game environment. The research forced us in choosing a game situation with enough control points on the camera position. A restricted environment was chosen using a quarterback football drill. This quarterback drill allows a user to move a quarterback around a small area and throw a football at an open wide receiver. The quarterback must dodge flying projectiles so he is not sacked during the play. This situation has a clear success meter with completed passes and a clear failure meter with sacked quarterbacks.

The game itself is constructed using Virtools. The control scheme interfaces with an Xbox 360 controller so the user feels closer to a console gaming experience. Electronic Art's Tiburon Studios sent the team athlete models and animations for use in the drill. The assets proved invaluable for get the feel of the avatars. A stadium was modeled with a football field to give the user a strong sports tie-in. There are three ball-launchers models that shoot a volley of white balls at the quarterback.

Allowing the user to feel comfortable playing the game was a major priority to ensure accurate testing, which is why so much effort went into the prototype.

Figure 1. Image rendered from QB drill virtual environment inside Virtools project.

4. USER TESTING
The user testing was performed on ten different students. Each user produced data.

4.1 DATA
The raw data collected from the prototype is the camera position, pass completions, and quarterback sacks. This information is continuously outputted into a text file while a user is playing the

game. Player performance overtime can be calculated as (pass completions)/(quarterback sacks). The higher the percentage, the better the player did. Instantaneous success and failure is more the focus; therefore, completed passes and sacks represent in themselves most of the information that is needed.

The camera position is captured as Y and Z coordinates relative to the quarterback. The camera will always point towards the quarterback, which relieves the need to capture more information about camera orientation. The time of each sack and completion is also captured into storage.

4.2 IMPLEMENTATION

The implementation of the calibration system is based on a three stage process. This three stage process was designed to ensure accurate and worthwhile results.

4.3 Stage One

Stage One is important because it shows a basis for later comparison. The stage consists of the user finding what he/she thinks is the best camera position. The user uses the two analog sticks on the Xbox 360 controller to move the camera up/down and in/out. By giving the user control over where he/she wants the camera during the first stage, the test does not let the user have any skewed perception on where the test itself thinks it should be.

Once the user has found the suitable position, he presses the button "A" on the controller to begin playing the quarterback drill aspect of the test.

4.4 Stage Two

The second stage of the system begins right after the button is pressed. Once the stage is triggered, the balls start to launch out of the ball-machines and the receiver begins to run around. The camera stays fixed at the position the user defined in Stage One.

This period of play lasts for two minutes. The time designated for this stage is used to allow the user to get accustomed to the gameplay. It also gives a good control group for the last stage. The camera is fixed, and it is in a position the user-defined.

4.5 Stage Three

The final stage in the calibration system is dedicated to finding the performance ideal. We already have the user-defined ideal from the user's own chosen camera position from Stage One.

This performance ideal is the sweet spot for the player and is where the player showed the most success. The technique for finding this ideal is to move the camera around a wide variety of positions to see where the player performed the best.

After the two minutes are up on Stage Two, Stage Three begins. The camera begins to follow a predefined curve that is designed to cover extreme angles, as well as commonly predicted ideal camera positions.

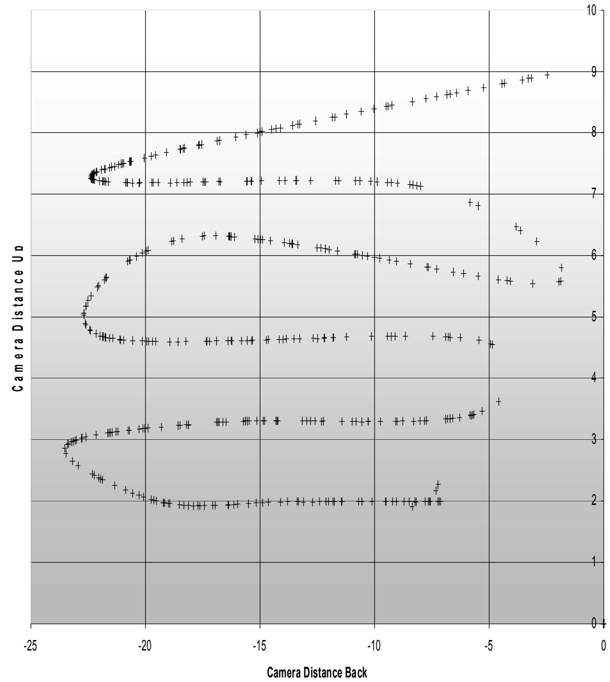

Figure 2. This scatter graph shows all the completions performed throughout all the playtests.

5. UNDERSTANDING THE DATA

Interpreting the data into meaningful information is the next step in the process.

5.1 User Preference Ideal

The preference ideal can be calculated by taking the mean of the chosen camera starting positions of all the users. This should show the position where the players generally want to have the camera based on preference.

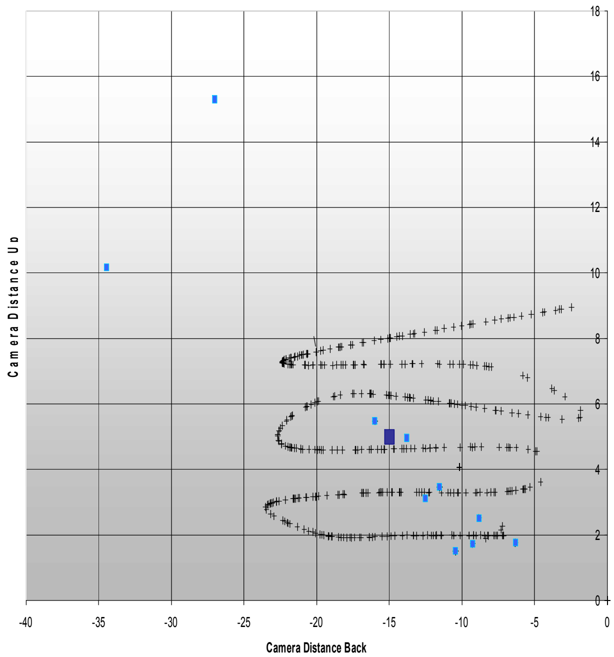

Figure 3. The light blue squares represent the user specified camera positions, while the dark blue square represents the mean of the light blue positions. The dark blue is called the user preference ideal.

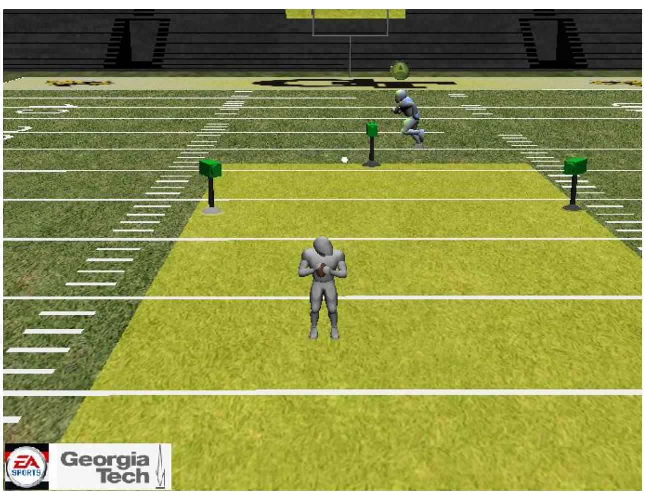

Figure 4. This is the camera position for the user preference ideal.

5.2 Performance Ideal

The performance ideal is calculated by taking the mean of all the positions where the player made a completion. This should show the position where the most success can be had while playing the game.

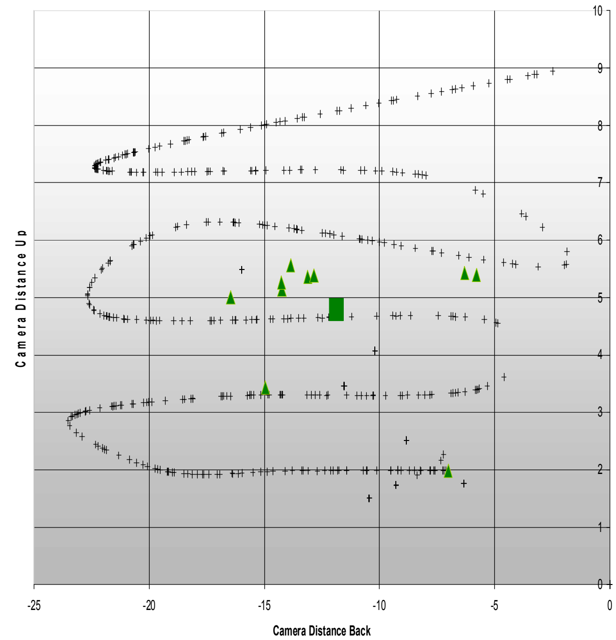

Figure 5. The light green triangles represent the calculated performance camera positions, while the dark green square represents the mean of the light green positions. The dark green is called the performance ideal.

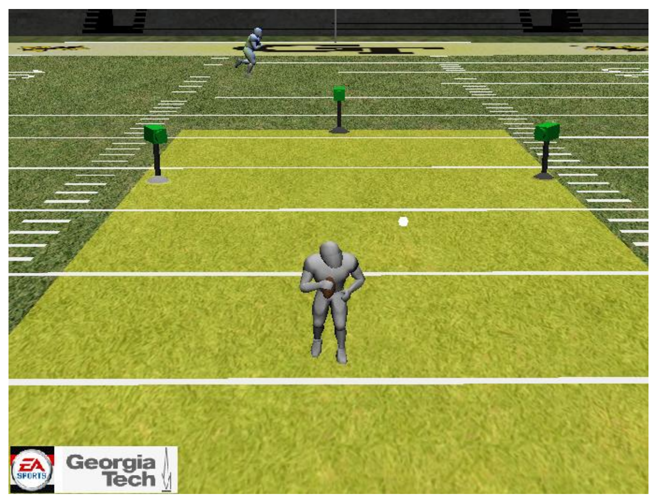

Figure 6. This is the camera position for the performance ideal.

5.3 Comparing Ideals

Why would someone want to compare the performance and preference ideals? The differences are interesting to dissect. For example, the preference ideal may be different because the player takes into account a visually pleasant viewing angle. The player may subconsciously want to see extraneous information that is not required to play the game well.

Generally, people play games for entertainment, but there is a subset of people that play games only for competition. These competitive players want all the advantages they can get. They want to have a camera system that is designed to find the camera positions that provide them the most success. Many of them would be excited to have a camera system tailored to their own play style.

Another benefit to having a more efficient camera system is that users play the game better. People like to play games that they think they are good at, and if a better camera system makes them more successful, then the game will become more successful in the public.

In this testing situation the two ideals are very close. The user chosen ideal is 4.999m up and 15.017m back. The calculated performance ideal is 4.793m up and 11.883m back.

6. PURPOSE

In commercial games a version of this system can be used during production to pinpoint camera positions. By playtesting the game with this system, the information obtained can better help the producers decided on which camera angles to use.

An extension of this system can be used in a much more meaningful manner. Players can have a personalized camera scheme utilizing this system. Xbox Live Gamertags could have the scheme attached to it to create a player profile that is carried from game to game.

7. ACKNOWLEDGMENTS

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REFERENCES

[1] Drucker, Mark. 1994. Intelligent Camera Control for Graphical Environments [Ph. D. thesis]: Massachusetts Institute of Technology.