Demonstration of Network Latency and the Peeker's Advantage in First-person Shooter Games

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1 INTRODUCTION

First-person shooter (FPS) games are among the most popular genres of computer games. Peeking around a corner and moving to attack a stationary defender is part of the core FPS gameplay. A *peeker's advantage* arises in part due to the FPS network architecture wherein when a player's client must relay their actions via a server to the other client(s) before the other player(s) see them. Consider the example in Figure 1 showing an event timeline for a network game with two clients and a server, with time progressing top to bottom. Player 1's action to move their avatar on client 1 is sent to the server and then, after processing, to client 2 where the new world is rendered for player 2. The latencies between clients and server limit how soon player 2 sees actions taken by player 1, thus providing an advantage for the peeker (player 1) moving to take a corner from a stationary defender.

Independently of latency, the amount of advantage a peeker may have depends upon the relative distance of the peeker and the defender to the corner. The peeker loses some advantage when the defender's avatar is further from the corner than the peeker's, as the geometry causes more of the peeker's avatar to protrude and become visible to the defender. Consequently, the peeker can see less of the defender's avatar and, in fact, the defender can see and potentially shoot the peeker before even being seen. The opposite is true when the peeker is further away from the corner than the defender, where the peeker has both an earlier and larger target than the defender.

Despite the prevalence of peeker-defender encounters in FPS games and general awareness of the peeker's advantage by competitive FPS players (e.g., [1]), there are few studies measuring its effects. Doing so can not only confirm general understanding of player performance during a common tactical operation, but may yield insights into how experts (e.g., competitive FPS gamers) use

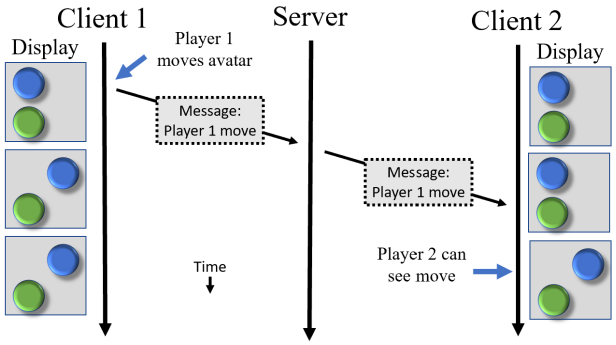

Figure 1: Latency's effects on action display times.

computer interfaces. This demonstration accompanies our recently accepted paper on this topic [2].

Our demonstration lets participant experience the peeker's advantage. A custom FPS game isolates the roles of a peeker and defender while controlling peeker distance and network latencies. Users are randomly assigned a role (peeker or defender), one-way latency to the server, and peeker distance from the corner, and then compete for a short game round, repeating to get experiences in both roles and for different latencies.

2 DEMONSTRATION DESCRIPTION

A video of the gameplay for a peeker and defender captured via two Twitch feeds live streaming is at: https://youtu.be/BZqlOlc1nHc.

We extended an open-source FPS game – FirstPersonScience (FPSci)[1] [3] – to support multi-player networking with an authoritative server and self-prediction [4] on the clients, as in Figure 1. We designed a custom map that supports two players in a typical peeker-defender interaction: the defending player is stationary and faces the corner which the peeking player approaches and rounds for a firefight. The avatar view on both the Peeker's screen and the Defender's screen is shown in Figure 2.

The overview in Figure 3 presents a top-down perspective of the map, indicating the possible starting locations of the peeker and the location of the defender. The defender is always 25 meters from the corner with the respawn position slightly randomized so as to not be predictable each encounter. The defender's positional movement is disabled, but they can look around (aim) freely. The peeker has a movement bound from the corner that is restricted to a fixed distance so as to be able to get into position to see and shoot the defender but not approach closer. The peeker's movement speed

[1]https://github.com/NVlabs/FPSci

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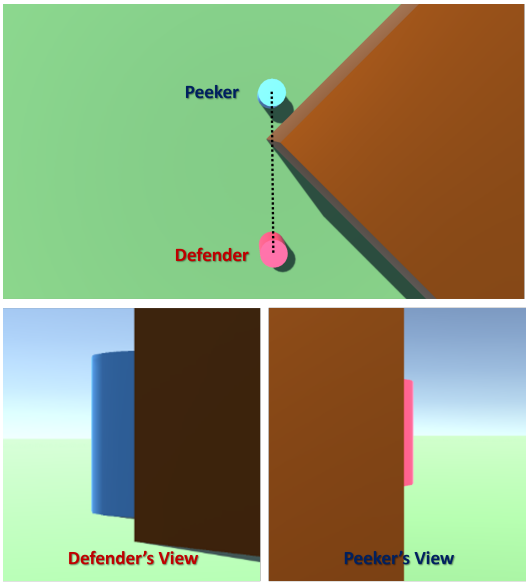

Figure 2: Avatars from Peeker and Defender points of view.

is fixed at a rate similar to that of avatars in typical commercial FPS games and jumping is disabled. The peeker can counter-strafe – a technique competitive players use when peeking to make their avatars harder to hit. The weapon used by both peeker and defender one-shot-kill with unlimited ammo and a fire rate of 2 shots per second.

Once either avatar is shot, both respawn to their starting locations. The gameplay consists of 15 second rounds where players try to shoot each other as many times as possible. The player that scores more hits in each 15 second-round wins that round. At the end of the session, the player that wins more rounds, wins the match.

Network latency is added to the system by delaying outgoing packets in the game client by a fixed amount before sending.

A test harness controls all the independent variables for each round: role (peeker vs. defender), latency for each client-server connection, and peeker distance from the corner.

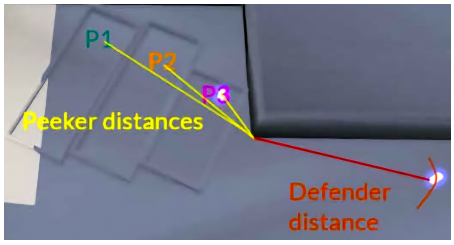

Figure 3: Top-Down view of the map and player positions.

3 EXAMPLE RESULTS

Twenty-four (24) experienced FPS gamers participated in a user study with our game system, providing performance data for peekers and defenders. Table 1 shows summary analysis – the delta

Table 1: Win percentage difference for peeker and defender. Values and shading indicates the strength of the peeker advantage.

	Defender		
	0 ms	30 ms	60 ms
Peeker	-5.4% ± 2.7%	3.4% ± 2.8%	30.8% ± 2.7%

(difference) in average encounter win percentage calculated as the peeker's win percentage minus the defender's win percentage. For example, a -5.4% means the peeker wins the encounter about 5% less often than the defender (i.e., 47.5% peeker win, 52.5% defender win). The ± after each is a 95% confidence interval bound. Green shading indicates the defender has an advantage and red shading indicates the peeker has an advantage. From the table, with no latency for either player (top left corner), the defender has a slight advantage. This advantage is likely due to aiming by the peeker that may take a bit longer since the defender's precise location is unknown and aiming while moving is harder than aiming while stationary. Higher defender latencies show the peeker advantage. For example, for defender latencies of 60 ms, the peeker advantage is pronounced, nearly 30% regardless of the peeker's latency.

4 SUMMARY

The growth and popularity of online games and esports in general, and FPS games specifically, provides an opportunity to demonstrate FPS player interactions with different system conditions. Our demonstration is designed to let participants experience the FPS *peeker's advantage* where the peeking player attacks the defending player around a corner – an encounter between two players fundamental to most FPS games. The advantage comes with differences in peeker and defender latencies and our demonstration lets the players experience this from both the peeker's and defender's perspectives. Doing so can provide an appreciation and understanding of latency and FPS gaming, as well as latency and games research.

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