BOOM! HEADSHOT!

or…Cheating and Subliminal Exploitation in Combat Simulations and Online Gaming

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Talk Overview

• Online Games and Combat Sims
• Why Security Matters in Gaming
• Tactics & Security Taxonomy
• Existing Knowledge Survey
  – Unintentional glitches
  – Glitches, exploits, cheats
• New Topic: Subliminal Exploits
• Studying Online Gaming
Games and Combat Sims

• Multi-player, online, team-based combat

• Counterstrike (Valve, Half-Life Mod)
• Battlefield 2 (EA Dice)
• Joint Operations (Novalogic)
• America’s Army (US DOD)
• Operation Flashpoint (BIS)
• Armed Assault (BIS)
Joint Operations
Joint Operations (2)
Armed Assault
Armed Assault (2)
Arcade versus Tactical

• Tactical Shooters
  – World simulation more accurate: players, scale, weather, tides
  – Not about who shoots first, but who sees who first.
  – No (accurate) firing on the move
  – Realistic damage (one shot can kill, immobilising/debilitating wounds)
  – Value of life greater (no respawn/revival)
  – Mobility and logistics as important as combat

• Overall goal: success in a tactical shooter relies on real world tactics, not game mechanics
Arcade versus Tactical (2)
Arcade versus Tactical (3)
First Person 3D Self Models
Entertainment Applications

- Single-player story driven
- Single-player arcade
- Multi-player arcade
  - humans are just used as better AI
- Multi-player team-based
  - players enjoy+benefit from grouping together
  - long term groupings form, leagues etc.
  - 8v8 up to 75v75
Military Applications

• Role-playing Scenarios and Tutoring
  – Remote internet sessions with in-the-field experts training recruits before first deployment
• Combat tactics training
• Logistics training
• Public Relations & Recruiting (America’s Army)
• General Mental Fitness
  – Decision Making, Reactions, Concentration
• Remote Drone Training
Why Cheating Matters to Gamers

• Online gaming is a **sport**  
  – Everyone deserves a fair chance, a level playing field  
  – cheating destroys this

• People don’t enjoy an unfair fight  
  – Mis-matched boxers = no fun

• The perception of unfairness/cheating also destroys enjoyment

• If gamers don’t enjoy it, they don’t stay playing  
  = no expansion pack sold  
  = no monthly subscription paid in (MMOGs)
Could Cheating Matter to the Military?

- Learning the Wrong Lessons
  - Diagnosed (OK… redesign the training to avoid those scenarios)
  - Undiagnosed (Untold, unmeasured damage!)

- Negative PR Image
  - America’s Army spreading “US military values” such as cheating / griefing / abuse
Tactics and Security Taxonomy

• We’ll look at
  – Unintentional Glitches & Anomalies
  – Deliberate Glitches & Exploits
  – Good Old Fashioned Cheats
  – Subliminal Exploits / Neo-Tactics
Unintentional Glitches and Anomalies

- spoil immersion/fairness
- inspire malicious glitches
Multi-Resolution Landscape
Multi-Resolution Landscape (2)
Invisibility Glitches
Stale Data
Deliberate Glitches and Exploits

- are considered cheating
- spoil the game for most players
Game Physics Exploits
“Lean Left Glitch” (2)
Team Exploits

• **Cross Capture Trick.** In Advance and Secure, two teams each try to capture each other’s base simultaneously.

3 men from red team and blue team each enter each other’s zones at precisely the same time.

Total reds: 6 men
Total blues: 6 men
Team Exploits (2)

- **Cross Capture Trick.** In Advance and Secure, two teams each try to capture each other’s base simultaneously.

  Rate of capture related to:
  - ratio of reds vs blues
  - proportion of team in zone

  Total reds: 6 men
  Total blues: 6 men
  Reds in zone: 50%
  Blues in zone: 50%
Team Exploits (3)

- **Cross Capture Trick.** In Advance and Secure, two teams each try to capture each other’s base simultaneously.

  Rate of capture proportional to:
  - ratio of reds vs blues
  - proportion of team in zone

Total reds: 6 men
Total blues: 4 men
Reds in zone: 50%
Blues in zone: 75%
Other Exploits

- **Glitching through Walls.** Drive a vehicle right up to a wall, hit the key to disemark. You appear the far side of wall.

- **“Dolphin Diving”**. Constantly change posture as you move. Bullet spread is calculated based on posture, but there is no spread at all during posture change.
Good Old-Fashioned Cheating

- uses special software
- can be fought with AV-style tools
“Wall Hacks”

PunkBuster Screenshot (_eof) JOTR TK-UKO-MiniKutu.npj 8915770 217.146.91.132:32768 !-WAR@-UKO-! *450fbd28a498f25e101fabb9101036d5* -RRTS- Fatal Attempted: w=640 X h=480 at (x=50%, y=50%) Resulting: w=320 X h=240 sample=2
Subliminal Exploits
aka. “Neo-Tactics”

-exploit emergent game properties
-are used unwittingly by players
-are mistaken for cheating
-are “mistaken” for genius
-matter just as much as cheating
Related Work on Network Factors versus Performance

First Shooter Advantage

1. Soldiers A & B face off, with a smoke screen between them.
2. When the smoke clears, each sees the other and opens fire.
3. Both players have equal reaction times, but different connection latencies.

Result: B wins (statistically)
First Shooter Debunked

• In tactical shooters, people rarely react to a central synchronised event. Instead, one player causes the event.

![Diagram showing the reaction times and latency between Soldier A, the server, and Soldier B, resulting in B winning statistically.](attachment:image.png)
First Mover Advantage

- A and B face off around a corner
- B stays still, A advances
- A gets “client prediction benefit” – he starts to move as soon as he pushes forward key
- A sees B first
- A has a worse ping than B
- A’s firing instructions take longer than B’s
- But A’s visual advantage outweigh this
- A wins (statistically)

A latency: 150ms
Server proc time: 25ms
B latency: 50ms
Client temporal buffering: 200ms

B sees A after 150+25+50+200=425ms
A sees B instantly, can shoot after 150ms
First Mover Advantage (2)

Soldier A

- A starts to move
- A sees B
- A fires on B

Server

- Frame rounding

Soldier B

- Temporal Buffering (200ms)
- A starts to move
- B sees A
- Human reaction time
- B fires on A

Result: A wins (statistically)

150ms latency
50ms latency
50ms latency
Auto-fire is a vector… spread 3 bullets along a path between A->B at 0.3 second intervals

Result: Packets take time to execute, cannot be compressed
Semi-Auto Advantage (2)

Semi-auto is a point... fire one bullet at point A, instantly

Result: Packets can be acted on instantly, so compress during modem buffering under laggy conditions (when buffer full)
Quantised Approach Advantage

1. Jet Approaches
2. Defender hears jet when it enters range
3. Defender aims and fires stinger

Moral: Attack from the points of the compass
Where did all the screen shots go?

• This stuff is usually too subtle to photograph
• If it was obvious, it would already be well understood
• Does industry know about it?
• Does it actually exist?
Covering Fire Advantage
Lightning Advantage
Lightning Advantage (2)
Lightning Advantage (3)
Studying Online Gaming

• Is hard
• It’s the real world out there
  – you can’t just hit pause
  – recruiting 64 players who will do what they’re told?
  – you need access to experienced players not novices
  – you need realistic network conditions (cable modems not academic network links)
• The community doesn’t welcome discussion of cheating methods (game dev driven taboo)
• Live experiments may fall foul of anti-cheating detection software (Punkbuster)
Getting the NetCode

- Game developers arelegendarily secretive. They work for 5 years in secret on some game.
- NetCode is a games dev’s crown jewels… it’s the core IP about how a company makes their game playable.
- There are one or two open source netcode stacks. But you need it for **Tactical Shooters**, not for arcade. They work totally differently (movement speed range is an order of magnitude larger).
- Novalogic never even debugged their own NetCode properly after introducing a patch with new vehicles (motorbikes/choppers).
- But no… I haven’t tried asking anyway. I probably should.
My Testing Configuration

- Bandwidth Limits
- Upstream Latency
- Downstream Latency
- Packet Loss

Experiment 1:
800ms upstream (client to server) delay exposes first Mover advantage to human eye
Better Configuration

- I/O, network and video recording
- Server + Client
- "Play and Serve"

- Traffic Shaper
  - Client A
  - Traffic Shaper
  - Client B
  - Traffic Shaper
  - The Internet
  - Other clients
Conclusions

• The online world is a very different place to reality, strange and sinister
  – Tries to deceive you that it is consistent
  – *Breaks the fundamental assumptions of science*
  – Not even causality is sacred
• If you open your mind to understand it, you can manipulate it to your advantage (like Neo)
• Traditional study of computer game security has focussed on eliminating cheating, but the *perception of cheating* is even more important.
• There may be consequences for military use
• Is a ripe research area (and you get to play games all day!)
More Information

• Boom, Headshot!


  – Includes literature survey
  – Includes more detailed explanation of game mechanics
  – More subliminal exploit examples

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