

# Melee AI in 'The Last of Us Part II'

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# Naughty Dog's Melee Team



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Melee Animation

# Overview

- Melee in TLOU & Uncharted 4 vs. TLOU2
- Melee Data
- Environmental & Animation Analysis Tools
- Building Blocks

# Melee in The Last of Us & Uncharted 4

# Melee in Previous ND Games

- Short enemy attack tells.
- No player dodge.
- Enemy starts swinging = certain hit.



# Melee in The Last of Us Part II

# Melee in The Last of Us Part II

- Longer enemy attack tells.
- More obvious enemy attack tells.
- Player can now dodge.
- More skill-based.



# Goals

- Equal weight & complexity to gun combat.
- Encourage melee encounter.
- Skilled players can survive unscathed.
- Polished feel.

# Melee Data

# Melee Attacks/Moves

```
(new melee-attack
  :anim 'swing-attack
  :start-func
    (and
      (characters-in-range? 3.0)
      (is-in-front?)
      (has-line-of-motion?)
    )
  :end-func
    (target-out-of-range? 5.0)
    (line-of-motion-blocked?)
  :events
    (make-event-list
      (npc-track-target)
      (avoid-overshoot-event)
    )
)
```

- Animations
- Starting/Ending conditions.
- Events
  - e.g.
    - Hit frames
    - Target tracking
    - Invincibility

# Melee Behaviors

```
(new melee-attack-behavior
  :name 'attack-basic-tell-close-combo
  :attack-list 'npc-basic-tell-close-attacks
  :test-hit-frame-overlap      #t
  :destination                 (melee-destination target)
  :range                       (range - -)
  :time-since-last-attack-ended (range 0.5 -)
  :range-hysteresis-upper      2.0
  :cooldown-npc                1.0
  :cooldown-global             0.0
  :num-ally-attackers-in-circle (range - 2)
  :start-func                  (... )
  :end-func                    (... )
  :update-func                 (... )
  :enter-func                  (... )
  :exit-func                   (... )
)
```

- Attack list
- Destination
- Motion type
- Enter/exit conditions

# Environmental & Animation Analysis Tools

Vision Raycasts: npc-maxd-1  
-> Player  
@ default -> head (fail) (+grass)



# Collision Casts

[npc-maxd-1]  
IdleSkill ()  
BehaviorNone

NotVisible

maxd-normal [DEV TASKED]  
v-1 t2final @Apr 22 2021 18:06:05 asset view: live,achou (NOTICE: YOU ARE USING 2 LOCAL ASSETS)

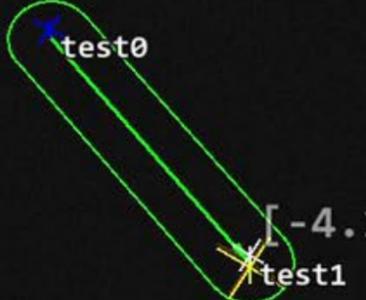


max navmeshes 3, polys 234, polycon 688, taps 40, polytaps 4



# Nav Probes

[npc-maxd-1]  
IdleSkill ()  
BehaviorNone



test2

0

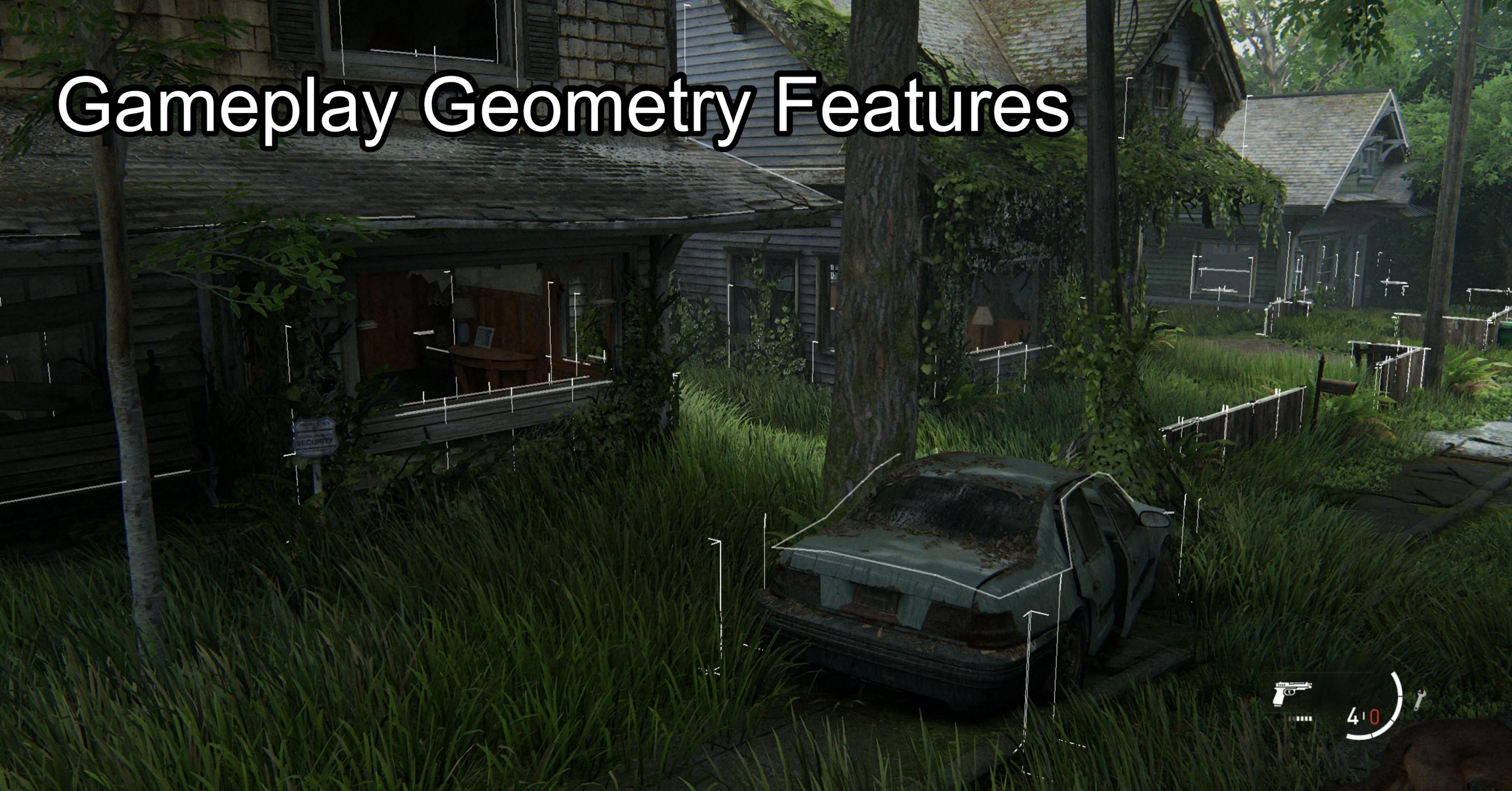
1

31

maxd-normal [DEV TASKED]  
v-1 t2final @Apr 22 2021 18:06:05 asset view: live,achou (NOTICE: YOU ARE USING 2 LOCAL ASSETS)



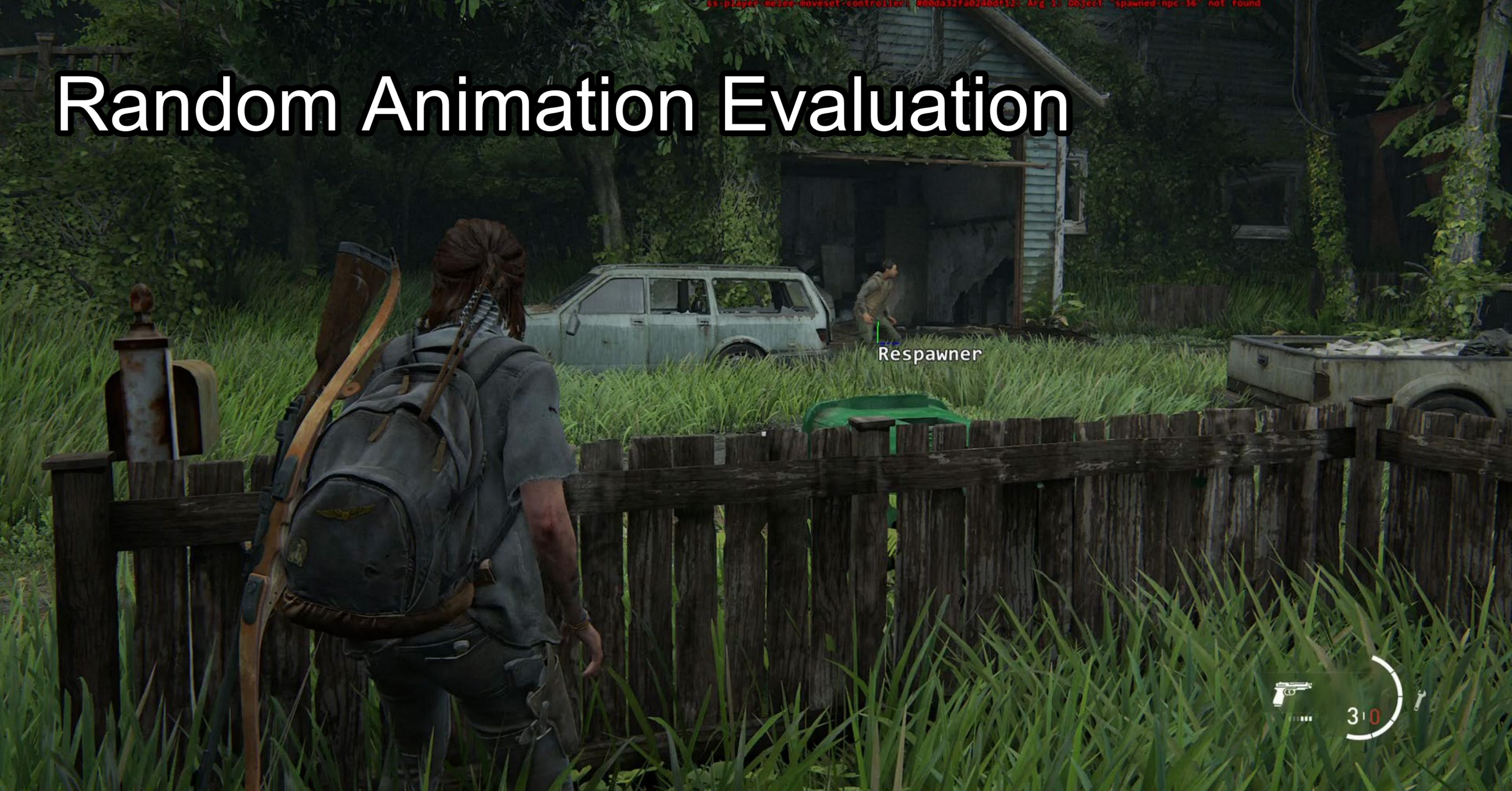
# Gameplay Geometry Features



# Random Animation Evaluation

“What is the transform (position/rotation/scale)  
of bone X at frame Y of animation Z?”

# Random Animation Evaluation



ss-player-melee-moveset-controller: #00da32fa0240df12: Arg 1: Object 'spawned-npc-36' not found

# Building Blocks

# Strafe Slots

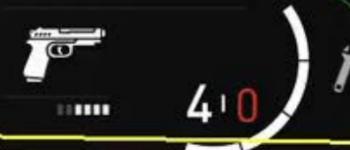


# Strafe Slots : Incoming Directions

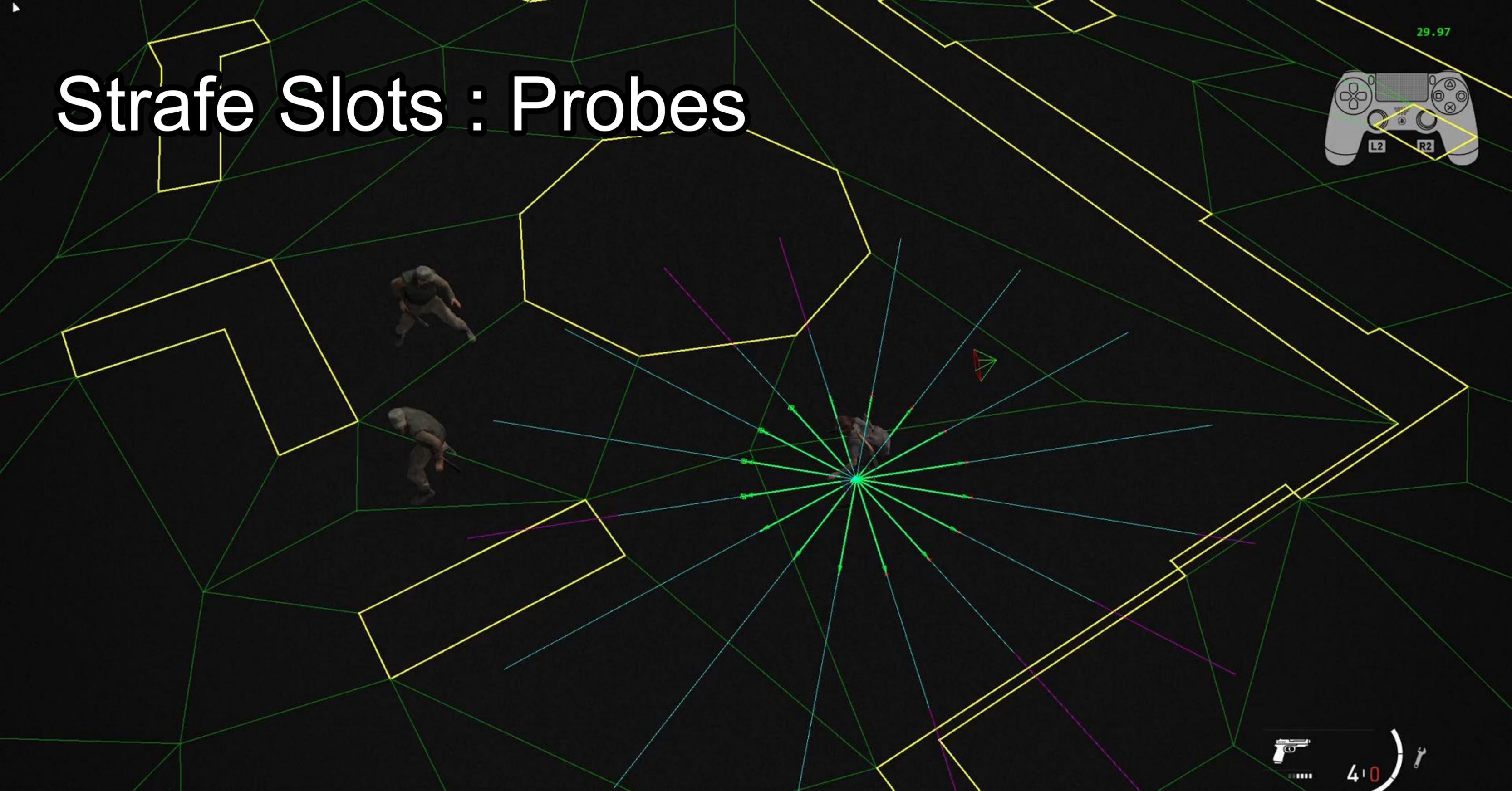
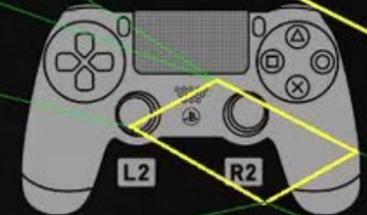
Path Length : 5.173  
Linear Dist : 5.242  
LoM Path Error: -0.069  
LoM Tolerance : 0.100  
Line of Motion: exact (respect characters)

Path Length : 7.602  
Linear Dist : 7.302  
LoM Path Error: 0.300  
LoM Tolerance : 0.100  
Line of Motion: no

-15.5  
-38.0

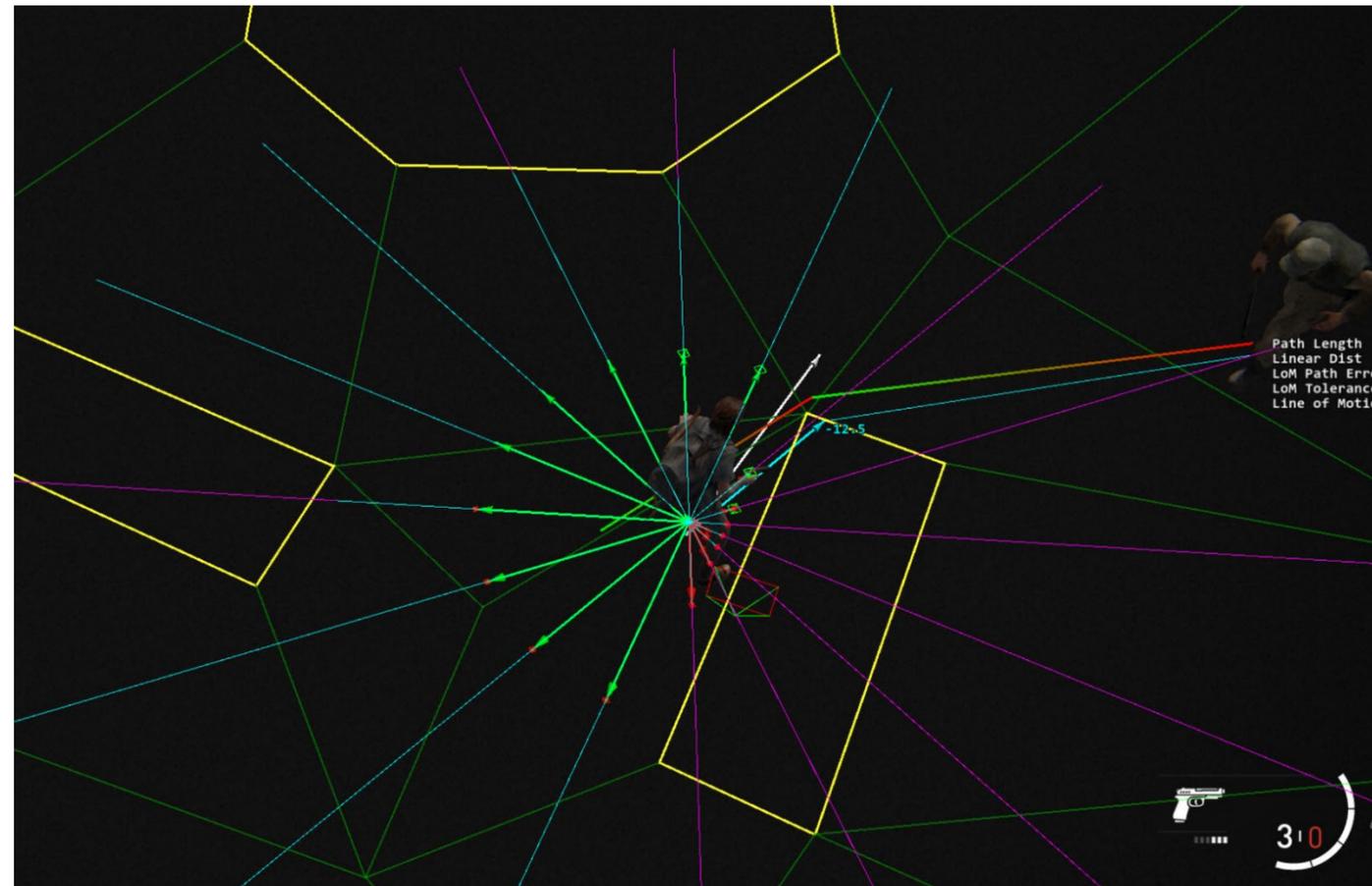


# Strafe Slots : Probes



# Strafe Slots : Final Picking

- Initial pick: incoming direction.
- Alternate sides and try the next further slot.



# Strafe Slots



# Line of Motion

set-character-force-contact-with-big-collision: Arg 1: Object '(INVALID\_STRING\_ID\_64)' not found  
npc-is-buddy?: Arg 1: NPC '(INVALID\_STRING\_ID\_64)' not found  
spawn-particles-at-joint: Arg 2: Object '(INVALID\_STRING\_ID\_64)' not found

29.97



[spawned-npc-7]  
MeleeSkill (Melee)

Forcing reached type stop





npc-1hblade-rt-foot-3m-upward-swing-a-idle-enter spawned\_npc-10 (ground-1k-azwesh) Player [unsynced]

# Target Tracking



npc-1hblade-1t-foot-3m-upward-swing-a-enter spawned\_npc-1 (ground-1k-uvuvvsh) Player [unsynced]

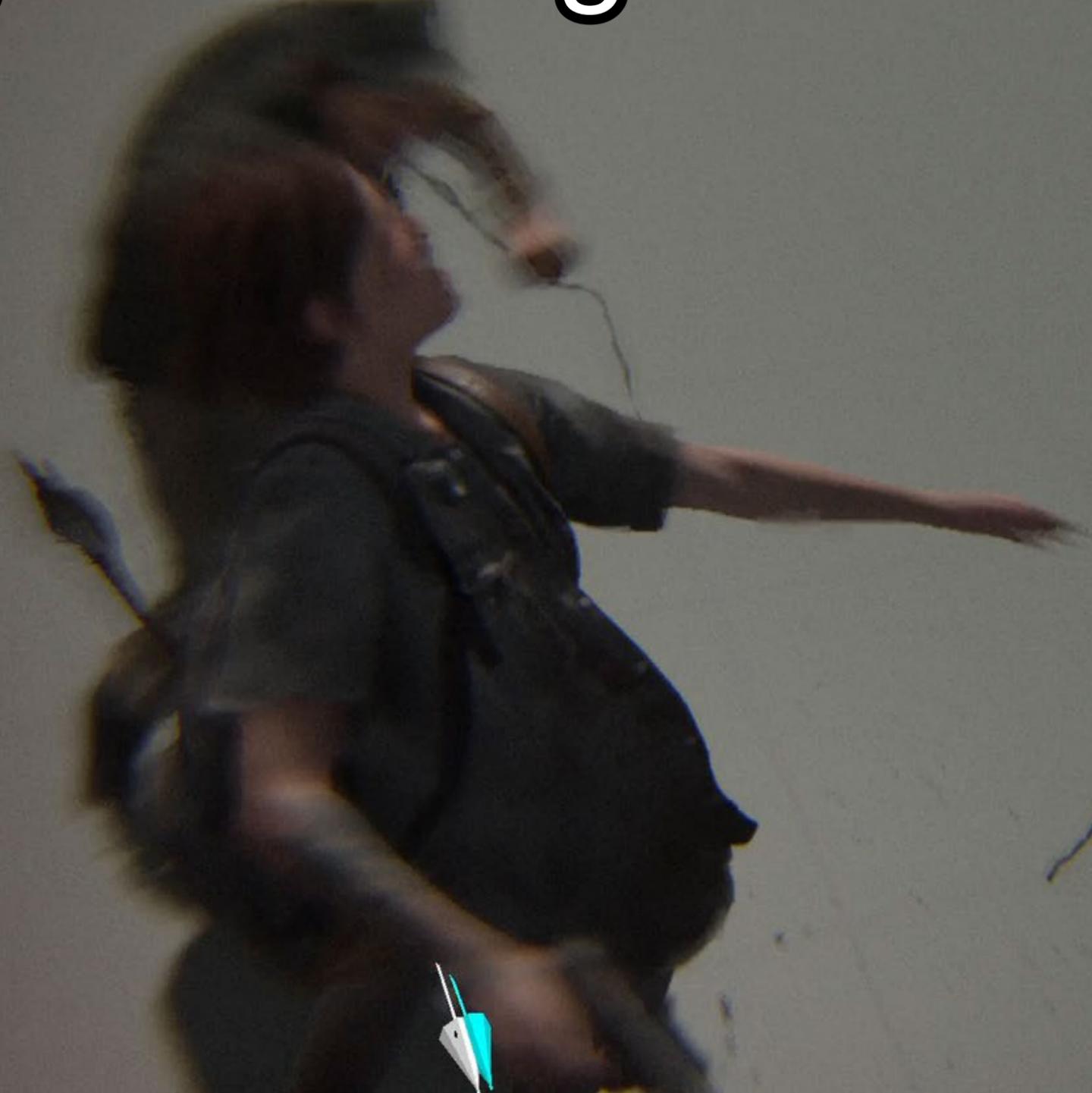
# Target Tracking

L Dodge



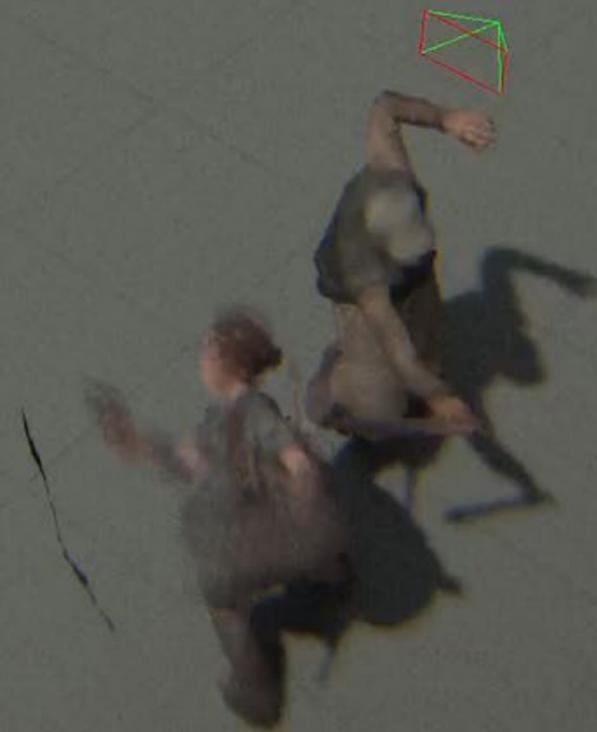
npc-1hblade-1t-foot-3m-downward-swing-a-hit spawned-npc-10 [unsynced] Player (ground-1k)  
npc-1hblade-rt-foot-horiz-combo-enter spawned-npc-10 (ground-1k-nvsmsh) Player [unsynced]

# Target Tracking

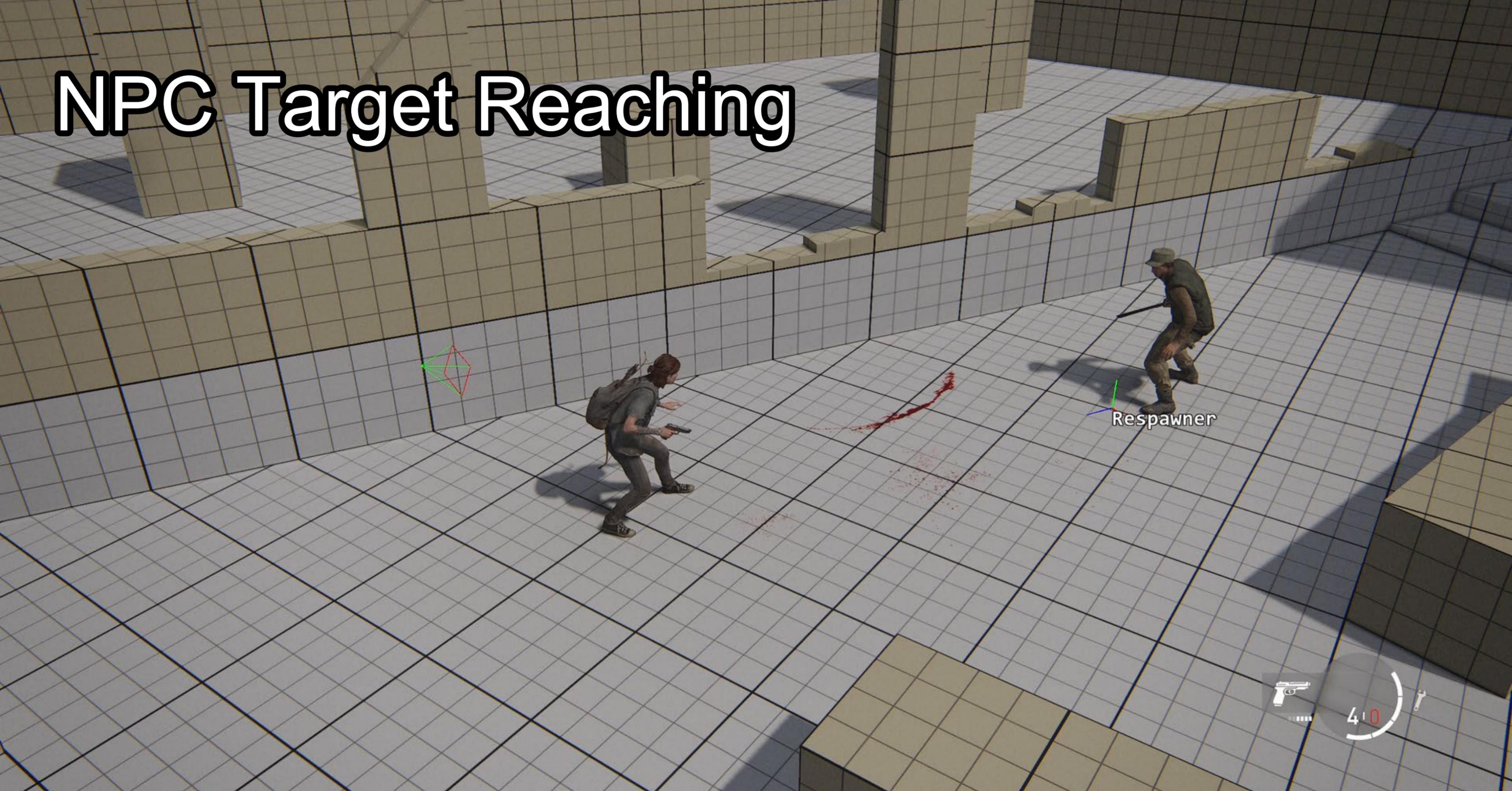


npc-1hblade-1t-foot-3m-horiz-sweep-a-hit spawned-npc-8 (ground-1k-sweep) Player [unsynced]  
ellie-1h-hr-hip-back-right-from-right-a spawned-npc-8 [unsynced] Player (custom-align)

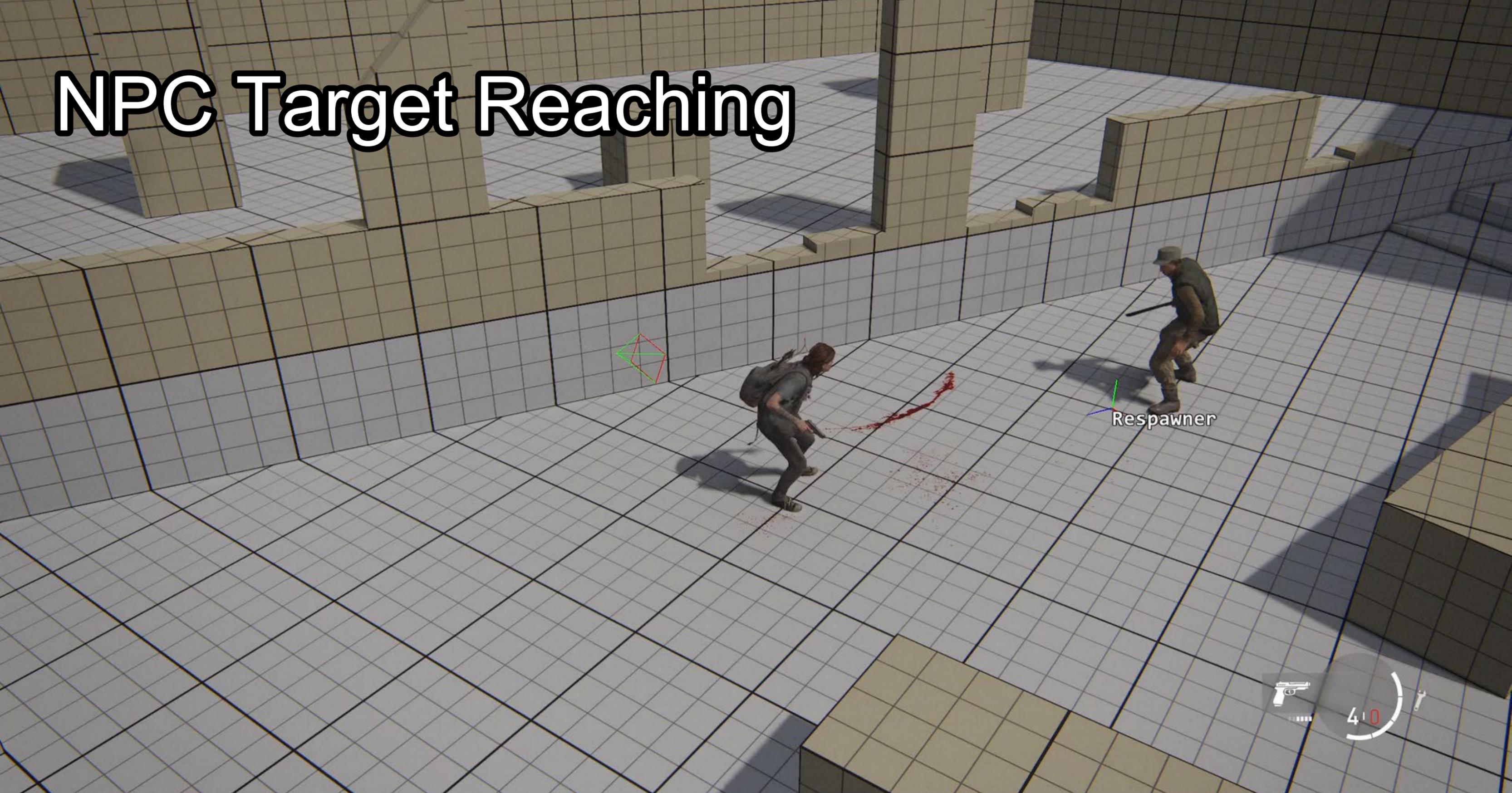
# Target Tracking



# NPC Target Reaching



# NPC Target Reaching

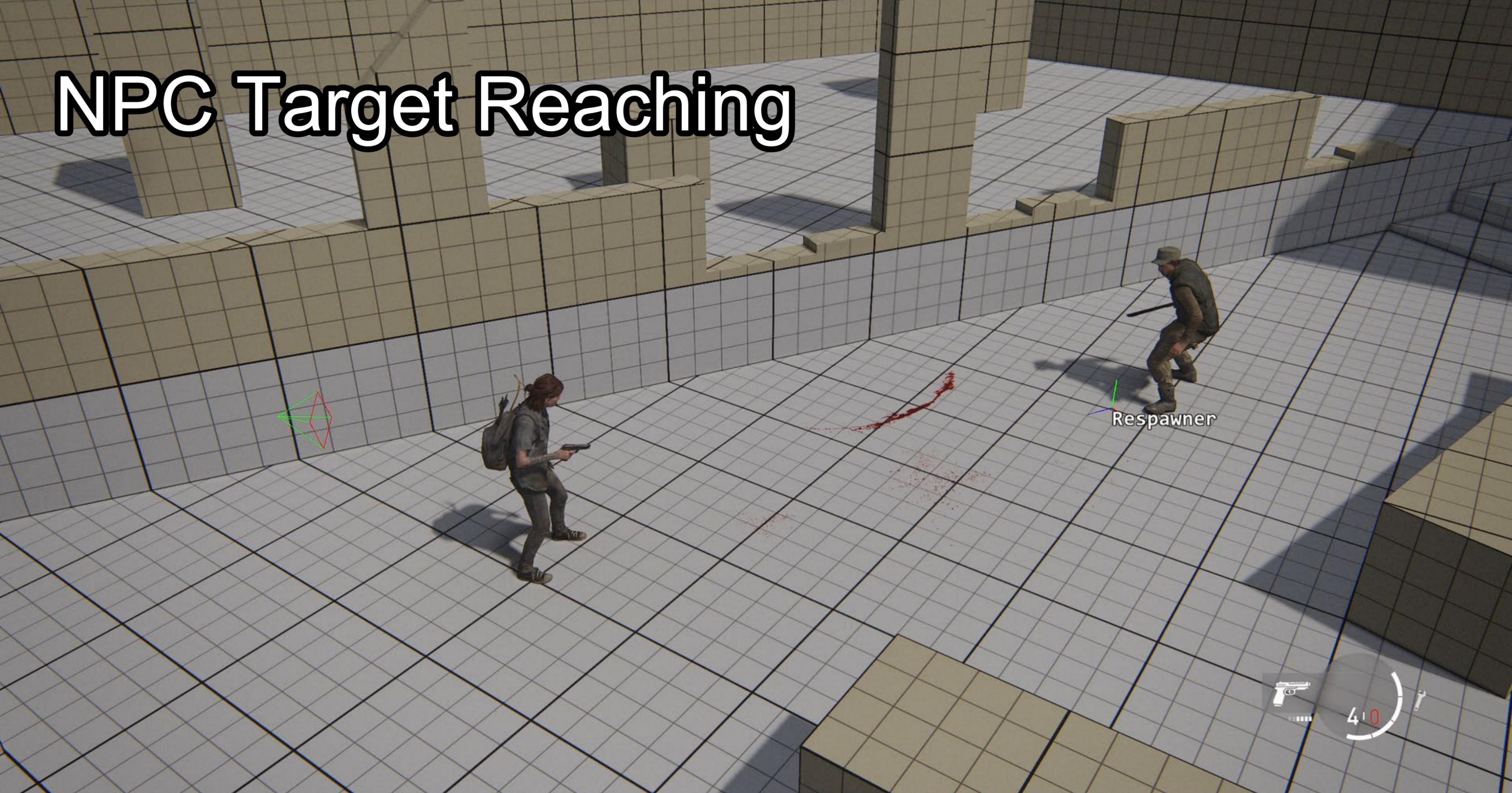


# NPC Target Reaching

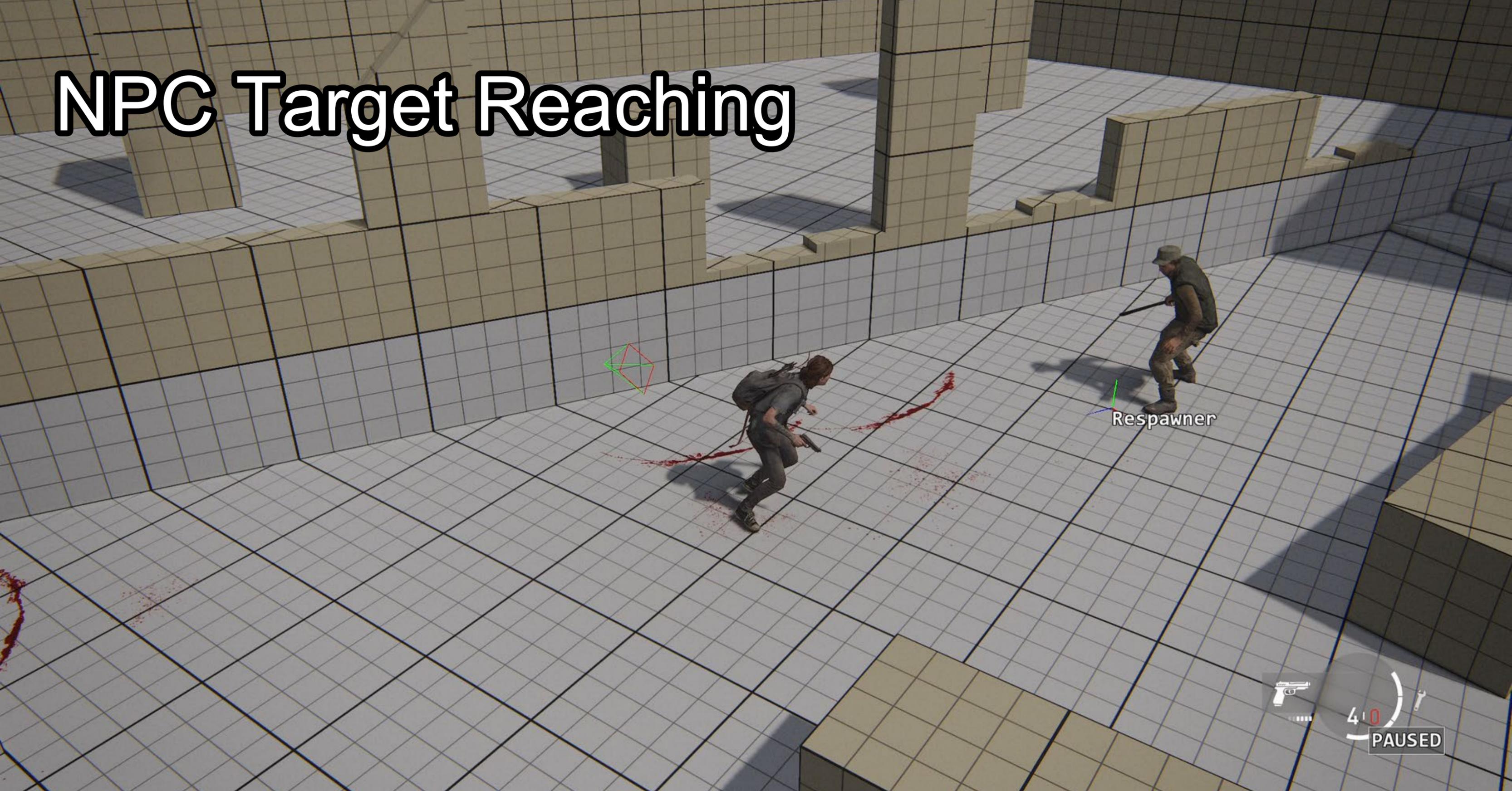
$$\text{(Ideal Movement Multiplier)} = \frac{\text{(Projected Distance to Cover)}}{\text{(Raw Remaining Distance)}}$$

$$\begin{aligned} \text{(Projected Distance to Cover)} = \\ \text{(Current Target Distance)} + \text{(Relative Speed)} \cdot \text{(Remaining Time)} \end{aligned}$$

# NPC Target Reaching



# NPC Target Reaching



4/0  
PAUSED

# Player Target Reaching



# Wall Moves



# Wall Moves : Wall Probes



# Wall Clearance & Features



Adjusted height: 0.99m

wall-height-adjusted  
Wall BF

kFrontRight-High



# Wall Animation Height Adjustment



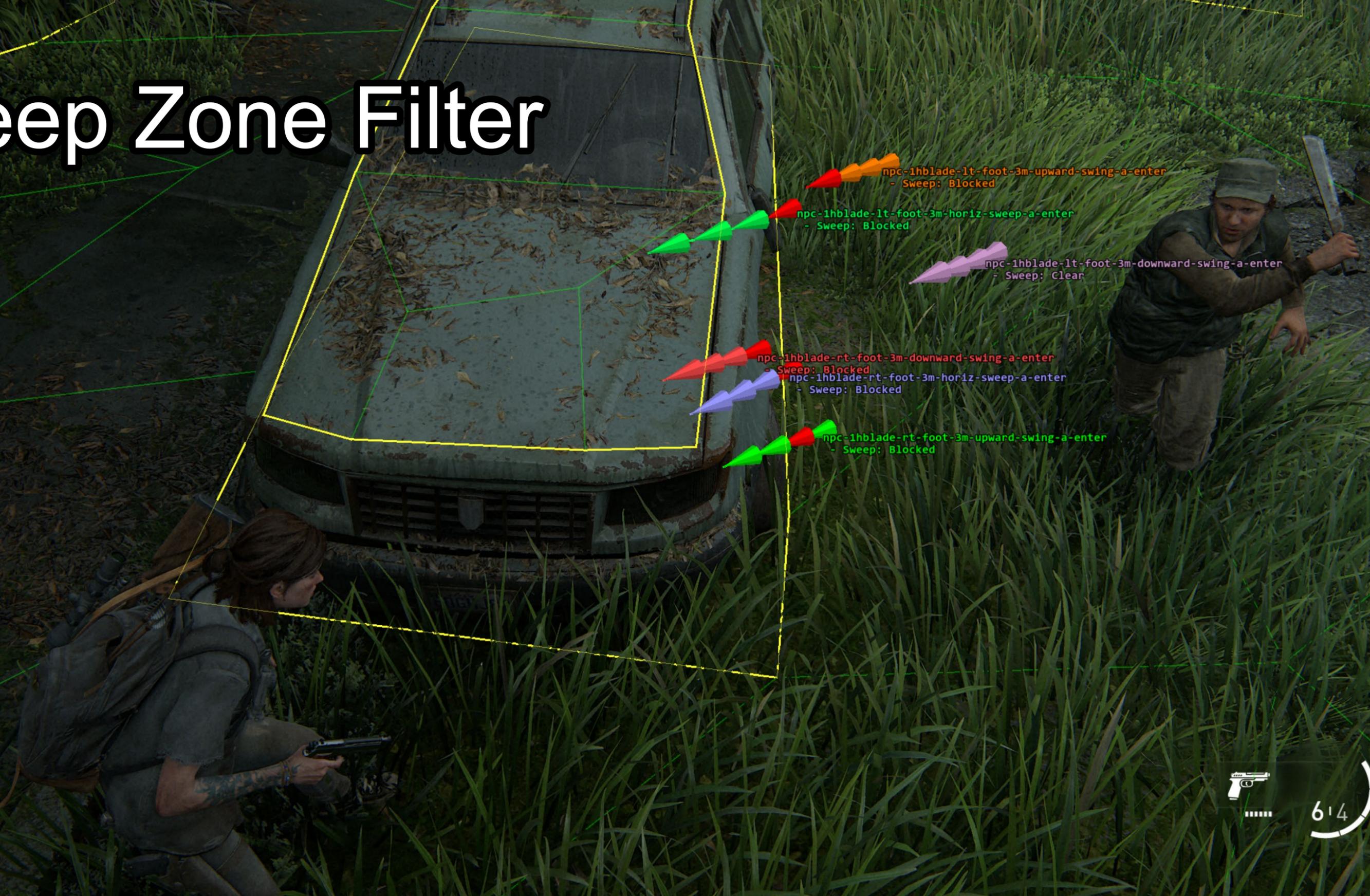
# Wall Animation Height Adjustment



# Wall Animation Height Adjustment



# Sweep Zone Filter



# Summary

- Run-Time Analysis Tools
  - Collision Casts
  - Nav Probes
  - Gameplay Geometric Features
  - Random Animation Evaluation
- Building Blocks
  - Strafe Slots
  - Line of Motion
  - Target Tracking
  - Target Reaching
  - Wall Probes
  - Wall Animation Height Adjustment
  - Sweep Zone Filter

GDC

The End

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