

UNDISPUTED²⁰⁰⁰

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The Next Generation of Fighting Games: Physics & Animation in UFC 2009 Undisputed

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Project Goals

Set the Standard for Fighting Games



Realistic Animation
Collision
Constant Control



Physics and Animation Techniques

- 1. Integrating Physics Simulation and Animation**
- 2. Character Navigation**
- 3. Full Body IK Targeting**



1. Integrating Physics with Animation



Integrating Physics with Animation

**Play animation
(prepare reference poses)**



Adjust Ragdoll speed

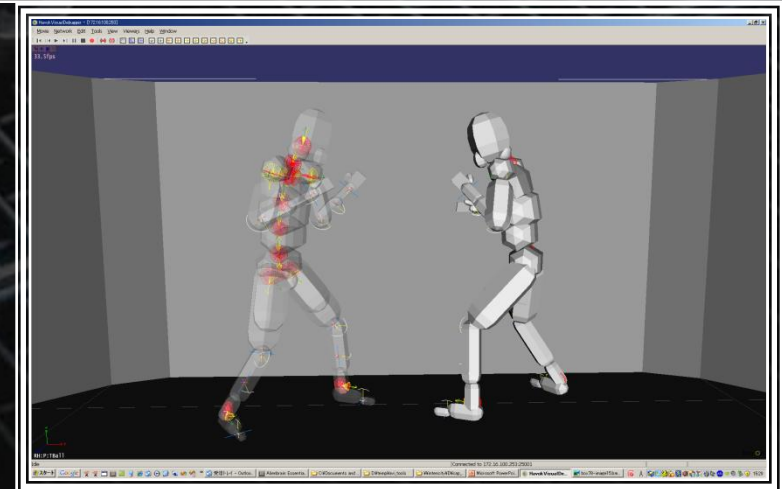
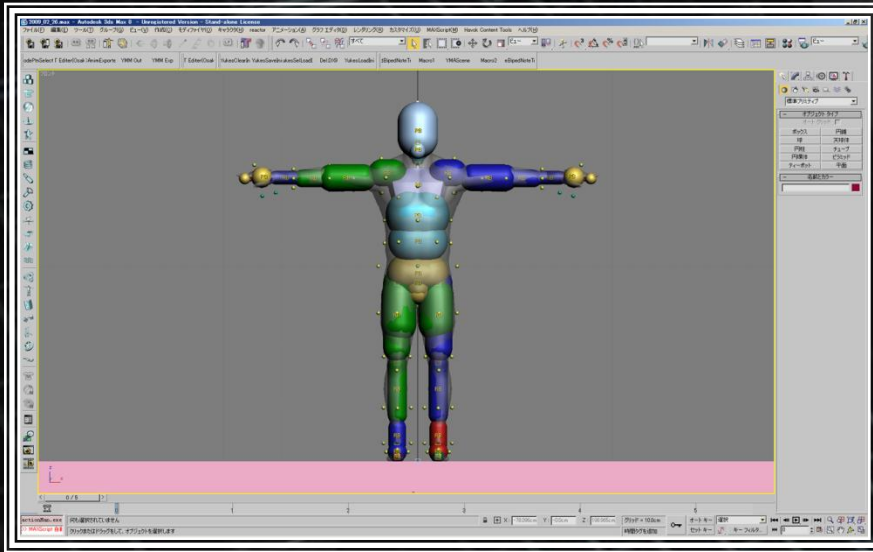


Simulate physics using Havok



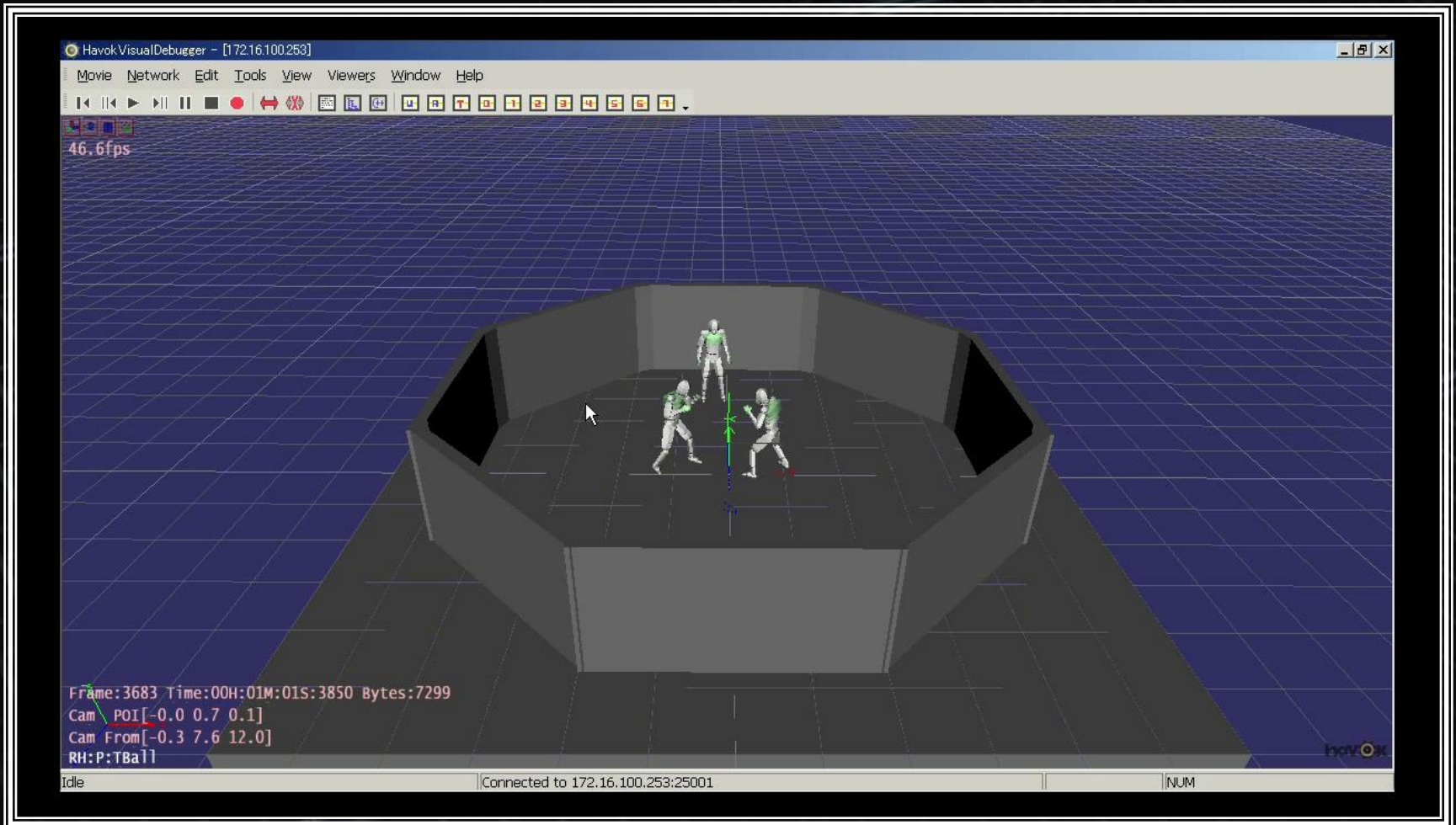
Implement poses into geometry

Physics Simulation Overview





Visual Debugger





Challenges We Faced

A. Animation playback not as expected

B. Unstable physics simulation

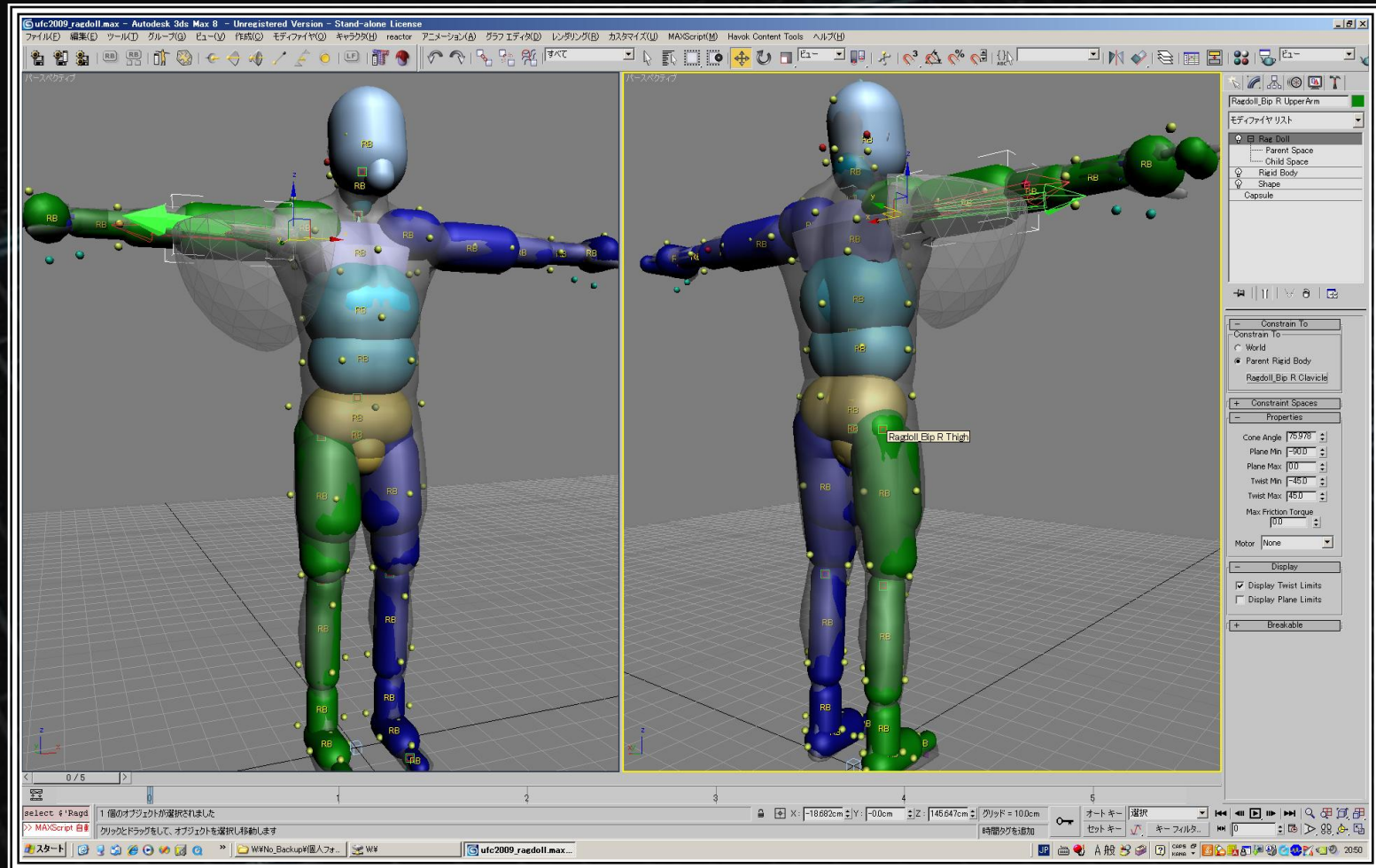
C. Fighters getting stuck to each other



A. Getting Animations To Play Properly

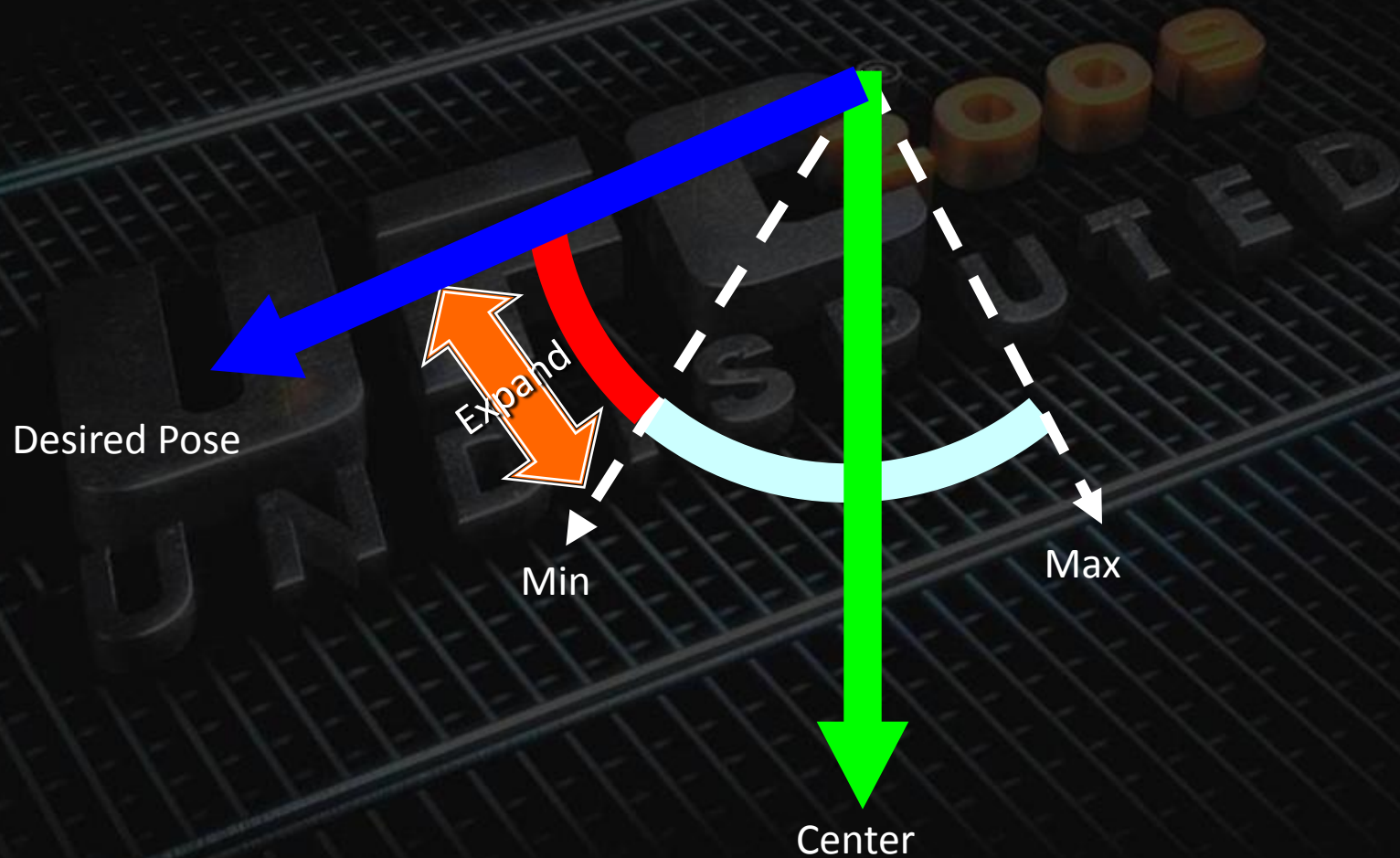
1. **Proper setup of Ragdolls**
2. **Adjust range of motion of constraints**
3. **Connect fighters using constraints**
4. **Find appropriate parameters using Ragdoll controller**
5. **Address self-collision problems**

A-1. Proper Setup of Ragdolls

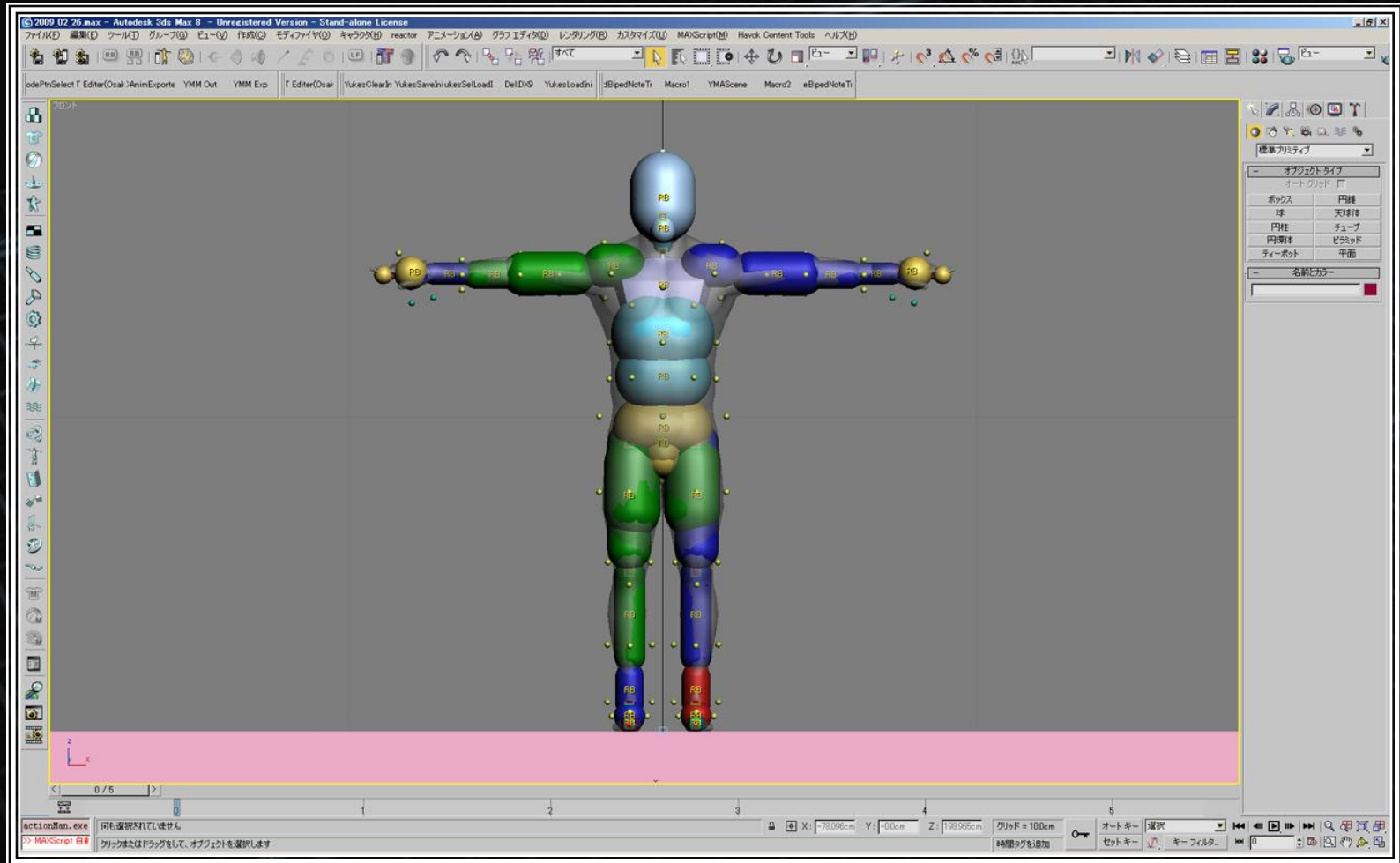




A-2. Adjust Motion Range of Constraints



A-3. Connect Fighters Using Constraints



A-4. Find Appropriate Parameters Using Ragdoll Controller

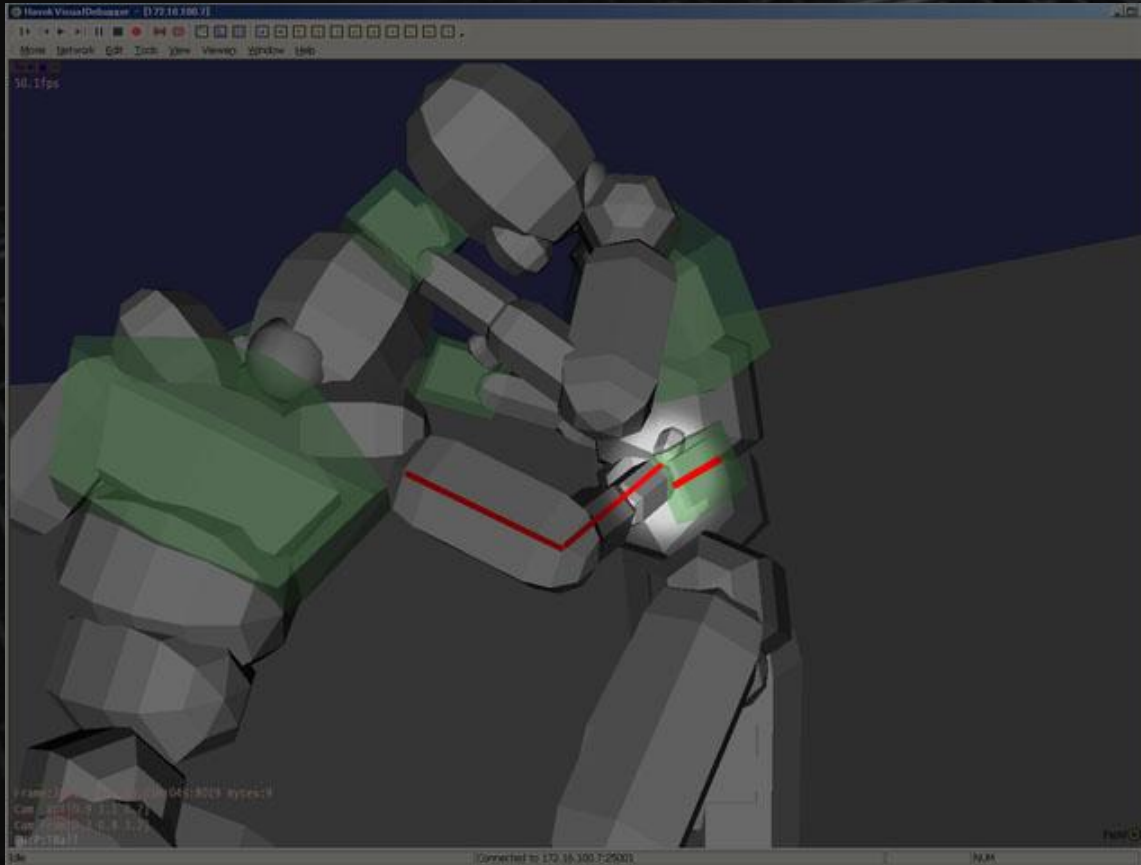




B. Stabilizing Physics Simulation

- Limit how close fighters can get to each other
- Prevent fighters from getting too close to fence
- Play animations for fighter's strike responses
- Adjust animations to prevent fighters from getting stuck
- Temporarily limit collision detection
- Make collisions have no effect in certain situations

B-1. Correcting Simulation Errors





B-2. Jittering - Causes

- **Self-collision**
- **Joint constraints too limiting**
- **Too many dynamic constraints**

C. Fixing Fighter Interactions

Before



After

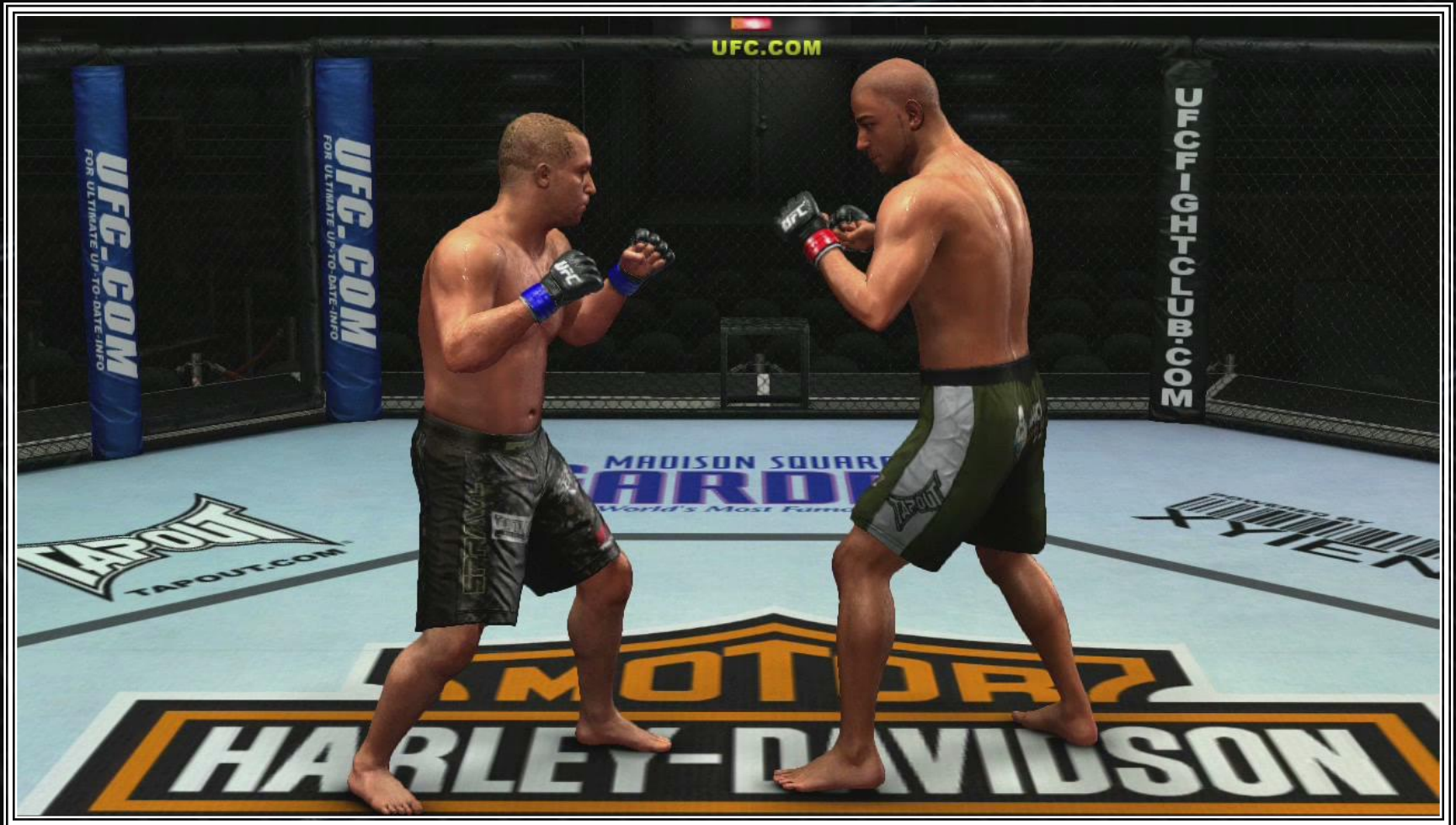


- Correct animation
- Fix animation poses using IK targeting
- Find pose errors
- Connect fighter to opponent with constraint(s)

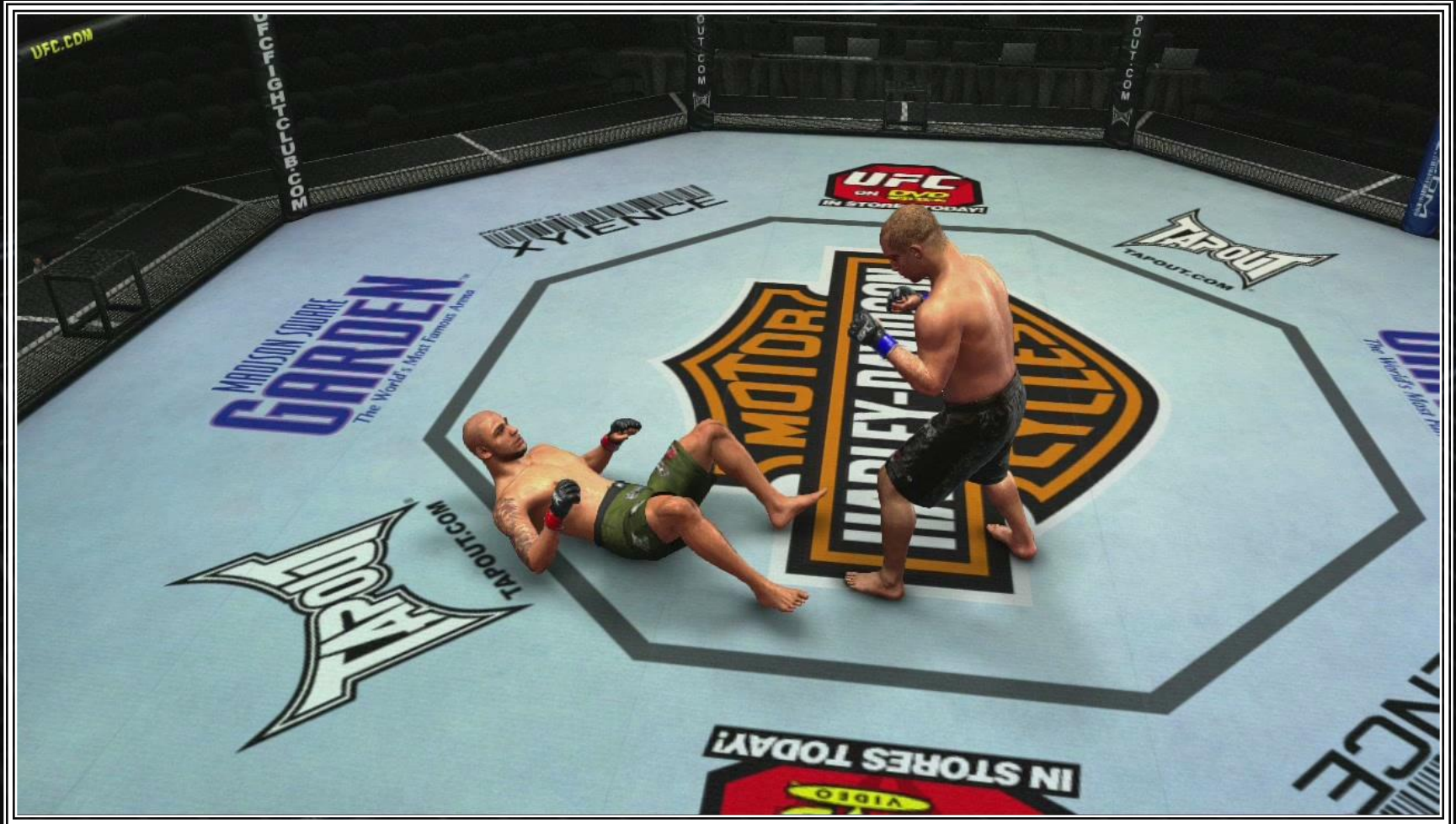
C-1. Example 1



C-2. Example 2



C-3. Example 3





2. Character Navigation



2-1. Navigation: Our Goals

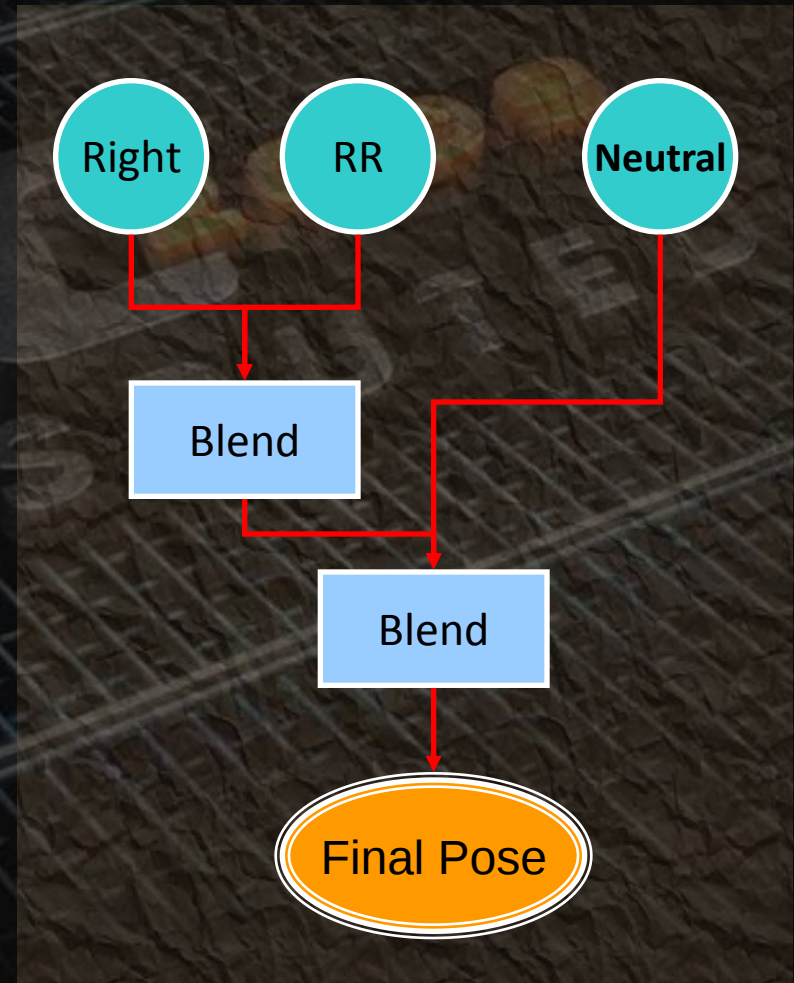
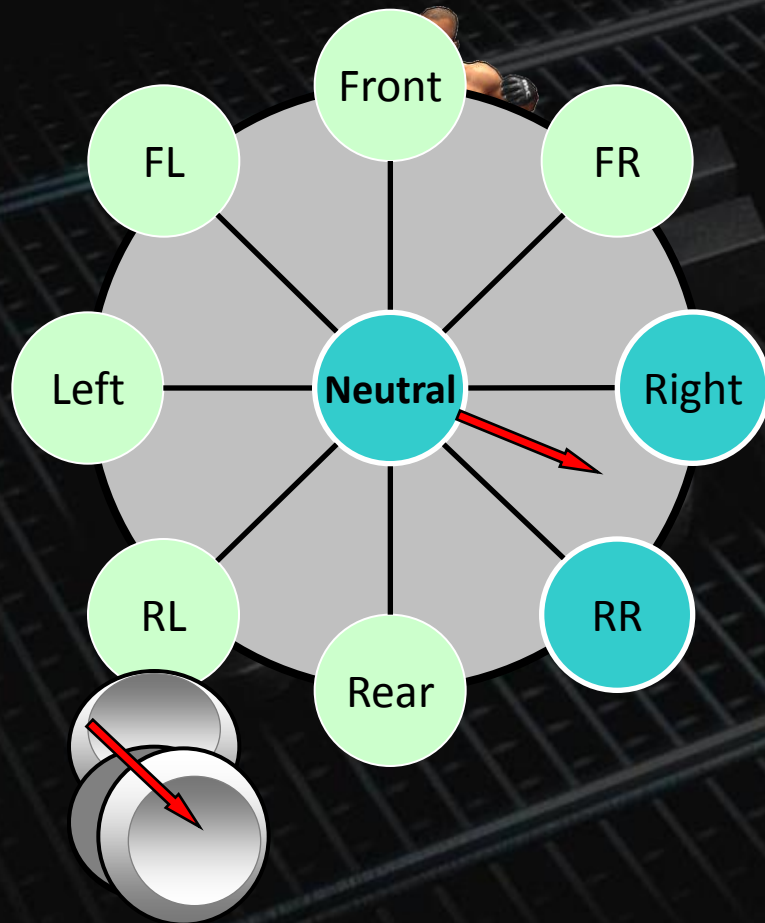
1. Realistic Animation

- Blending methods
- Blending prerequisites
- Preventing foot sliding

2. Constant Control

- Responsiveness

1-a. Blending Methods





1-b. Blending Prerequisites

- Animations of the same duration
- Standardized Foot Movements
- Minimize Leg Crossing



Animation Blending Example





1-c. Preventing Foot Sliding

- 2-Link IKs used to prevent foot sliding caused by blending and animation switching
- Animators use 3ds Max to set coordinates for foot/feet touching the ground



Footlock IK Example





2-a. Constant Control

- **Animation for resetting stance**
- **Changing Direction**
 - While walking
 - While inactive
 - During a strike



3. Full Body IK Targeting



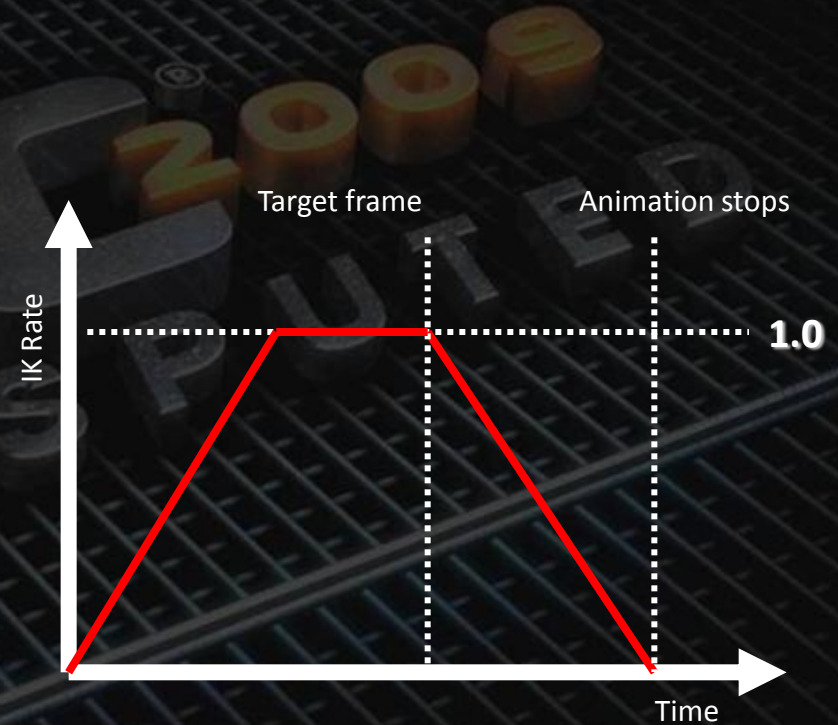
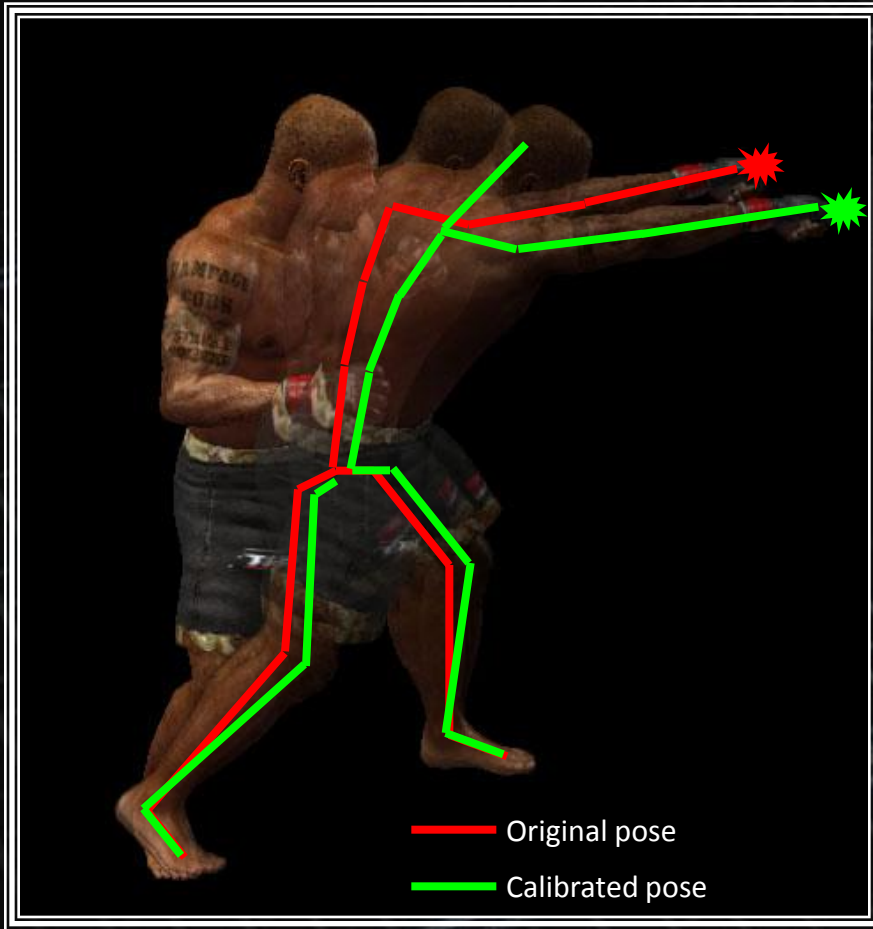
Targeting : Our Goals

Detect hits on opponents accurately

Use fewer animations more efficiently

Make character movement realistic

Process Overview





Flow

Initialize

Prepare target frame pose



Calibrate

Each frame

Fix target frame pose



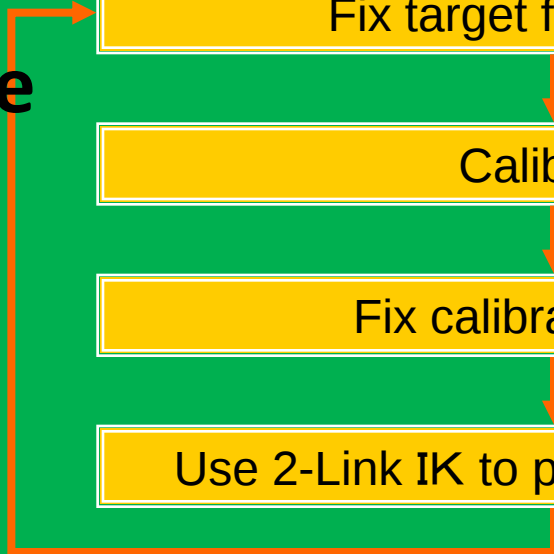
Calibrate



Fix calibrated pose

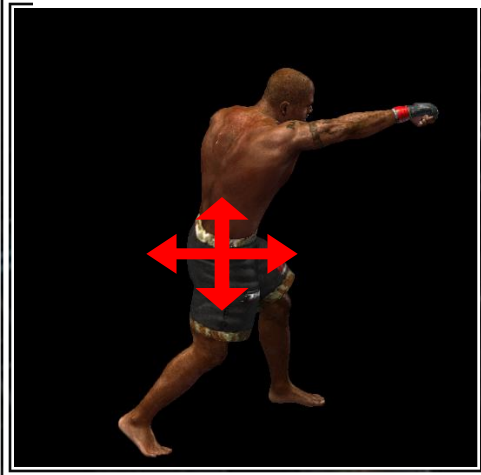


Use 2-Link IK to prevent foot sliding



Calibration

1. Movement



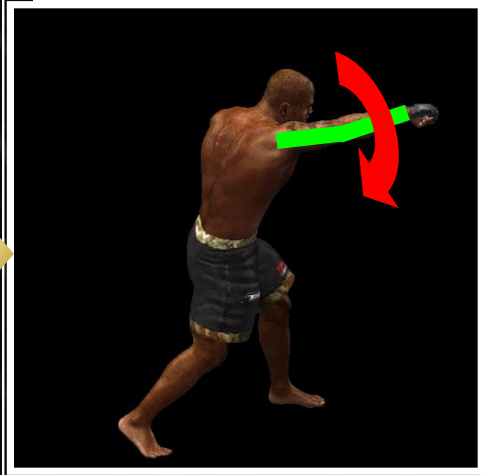
2. Twist



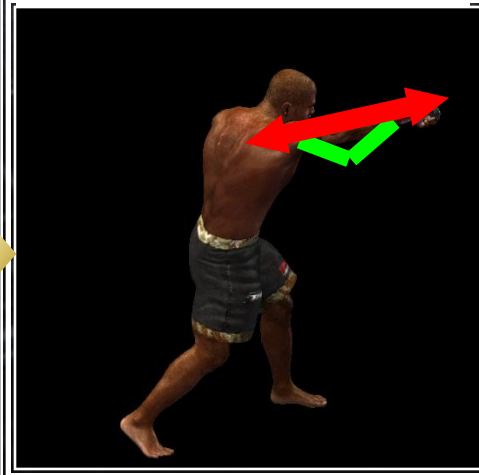
3. Lean



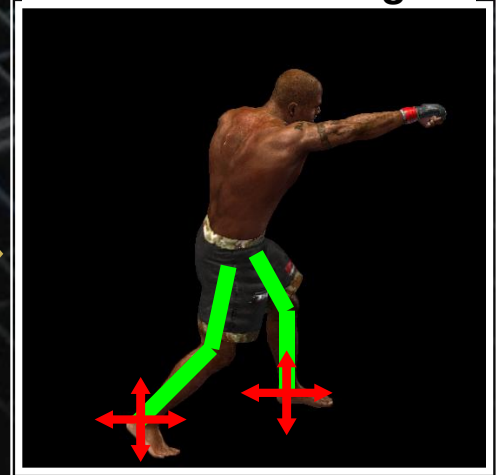
4. Punch Direction



5. Arm Extension



6. Foot Locking





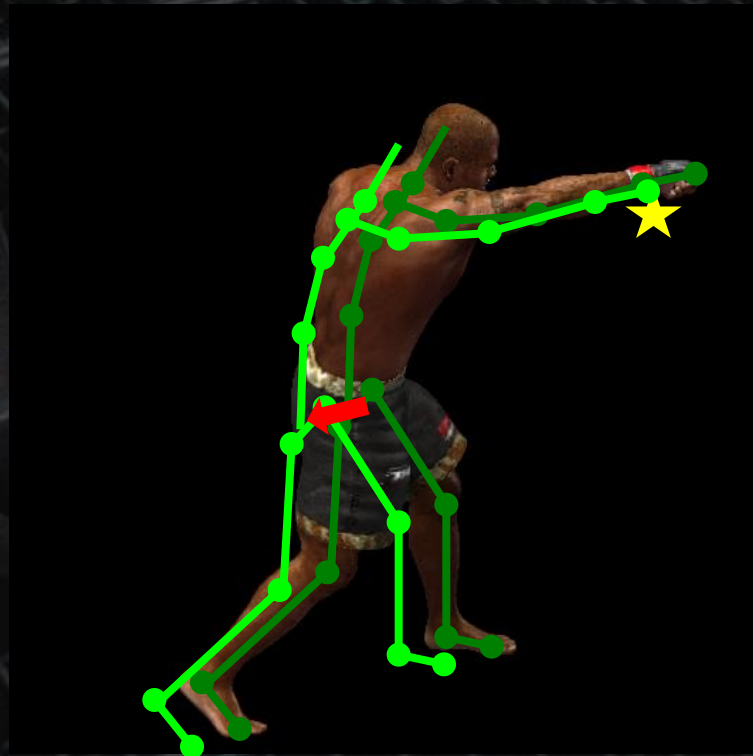
Difficulties We Faced

Predicting target frame poses proved harder than the calibration process.

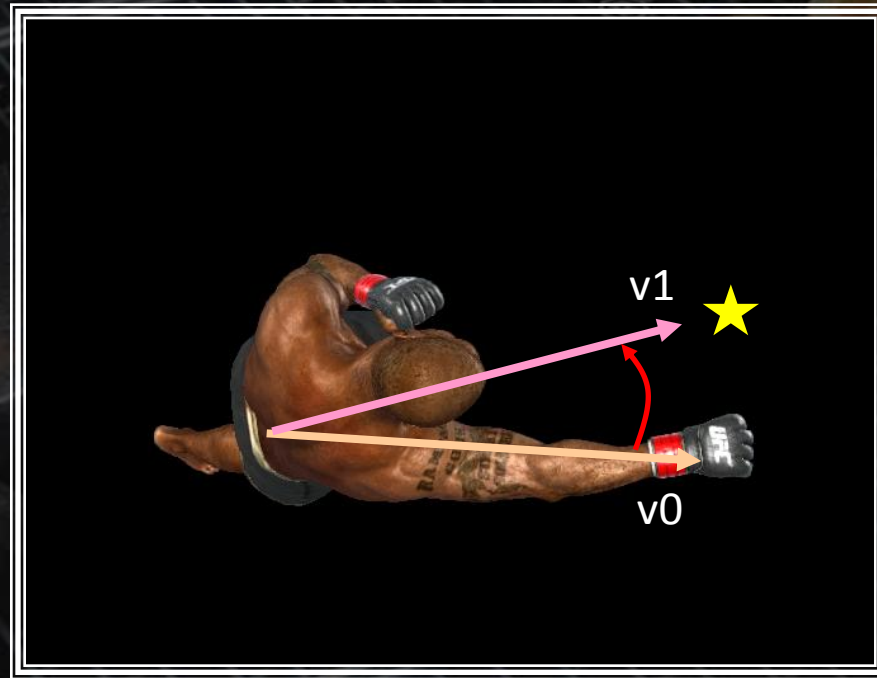
1: The poses we predicted and the actual poses frequently did not match.

2: Blending animations made it hard to create accurate poses in advance

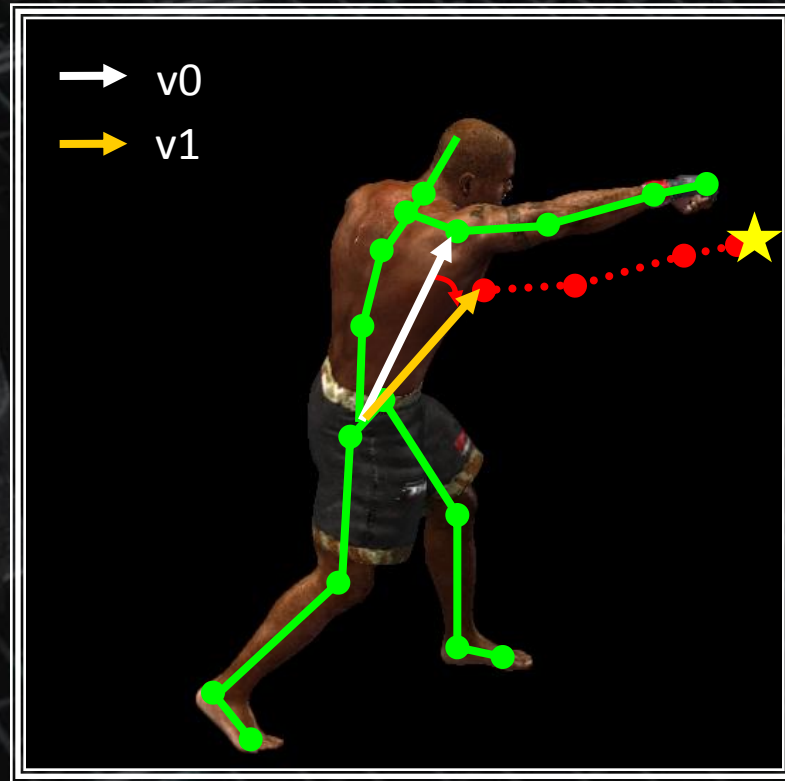
Step 1 : Movement



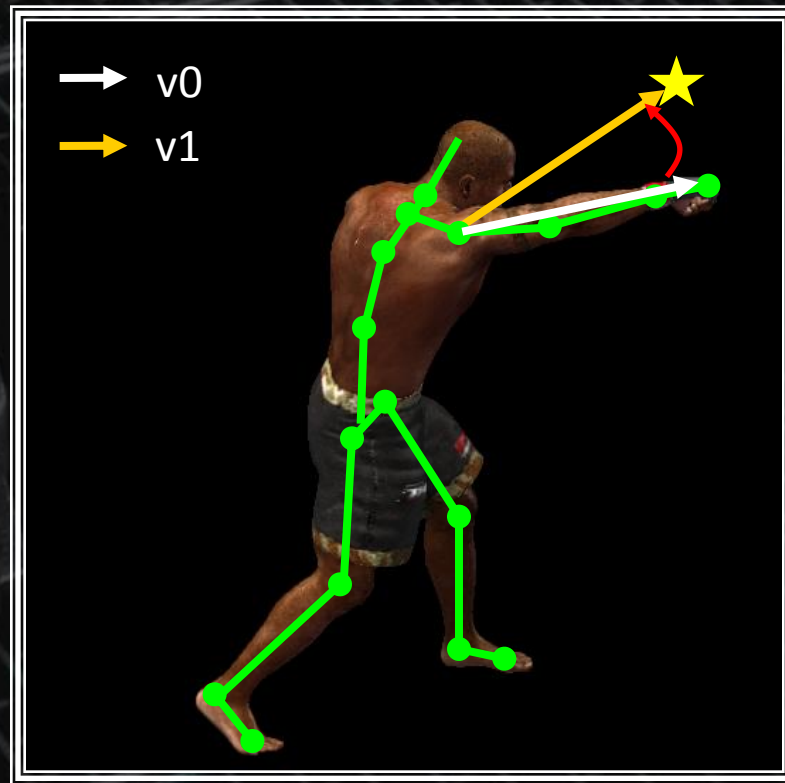
Step 2 : Twist



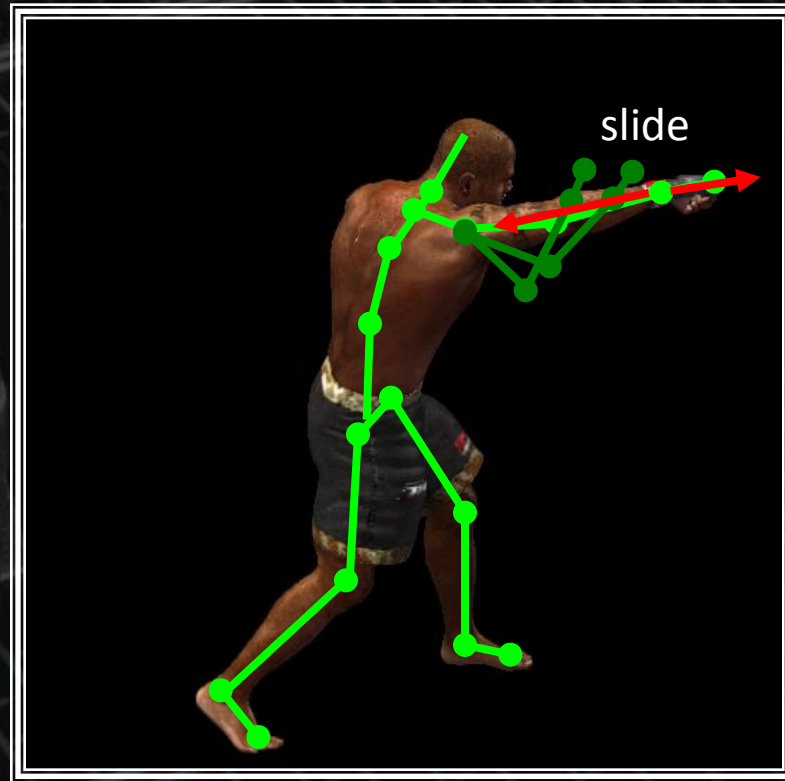
Step 3 : Lean



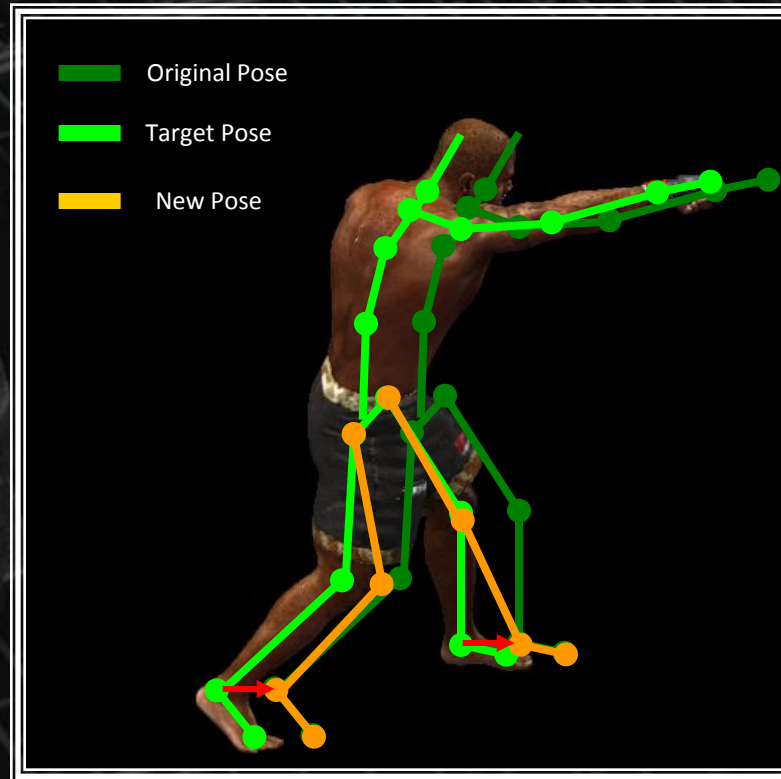
Step 4 : Punch Direction



Step 5 : Arm Extension



Step 6 : Foot Locking





Targeting Techniques

- YUKE'S Original “Full Body IK Targeting”
 - No iterative processing
 - Limited implementation
- Additional Benefit
 - Reduction of physics entanglement problems

Targeting





Conclusions

**Realistic Animation
Collision
Constant Control**



The Standard for Fighting Games

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Thank you.

Presented by Hiroki Ueno

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