“The Ultimate Fighting Championship”, “Ultimate Fighting”, “UFC”, “The Ultimate Fighter”, “Submission”, “As Real As It Gets”, and the eight-sided cage design are registered trademarks, trade dress or service marks owned exclusively by Zuffa, LLC in the United States and other jurisdictions. All other trademarks, trade dress, service marks or logos referenced herein may be the property of Zuffa, LLC or other respective owners. Any use of the preceding copyrighted program, trademarks, trade dress, or other intellectual property owned by Zuffa, LLC is strictly prohibited without the express written consent of Zuffa. All rights are hereby expressly reserved.

Game and Software © 2009 THQ Inc. © 2009 Zuffa, LLC. All Rights Reserved. Developed by YUKE’S Co., Ltd. YUKE’S Co., Ltd. and its logo are trademarks and/or registered trademarks of YUKE’S Co., Ltd.


THQ and the THQ logo are trademarks and/or registered trademarks of THQ Inc. All Rights Reserved. All other trademarks, trade dress, service marks, logos and copyrights are property of their respective owners.
The Next Generation of Fighting Games: Physics & Animation in UFC 2009 Undisputed

YUKE’S Co., Ltd.
Senior Technical Director
Hiroki Ueno
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

Desired Pose

Expand

Min

Max

Center
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

- 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-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

- Original pose
- Calibrated pose

IK Rate

Animation stops

Target frame

Time
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

\[ \vec{v}_0 \]

\[ \vec{v}_1 \]
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
Conclusions

Realistic Animation
Collision
Constant Control

The Standard for Fighting Games
Thank you.

Presented by Hiroki Ueno
YUKE’S Co., Ltd. / YUKE’S LA Inc.