

PUNCHING MAN

Kevin Doherty

BACKGROUND

- ▶ Karate
 - ▶ 13 years
 - ▶ 5 National Competitions
 - ▶ Member of United States Team
 - ▶ Volunteer Instructor



REVERSE PUNCH

- ▶ “*Gyaku Zuki*”
 - ▶ Opposite hand and foot
 - ▶ Basic
 - ▶ Common



PROCESS

▶ Ground Up

- ▶ Foot

- ▶ Leg

- ▶ Hips

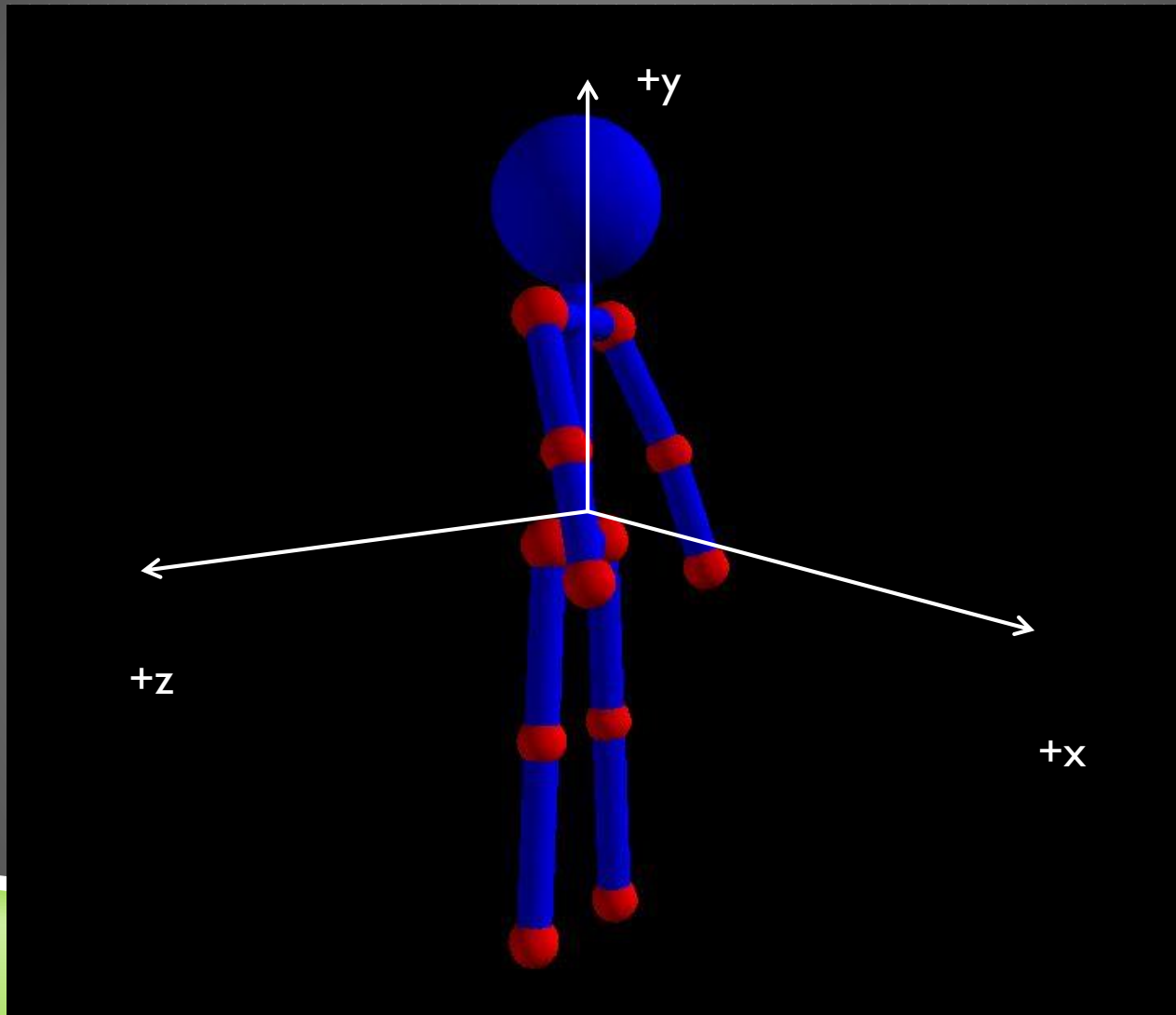
- ▶ Shoulders

- ▶ Arm

- ▶ Hand



ESTABLISHING DIRECTION



ESTABLISHING TIME

- ▶ Entire extension 500 units
- ▶ Entire retraction 500 units
- ▶ Let t represent time

HIPS

- ▶ Centered at origin
- ▶ Oriented in x-z plane
- ▶ Right hip starts at 45° “behind” (in $-x$ direction) the $+z$ -axis
- ▶ Rotates 45° counterclockwise about $-y$ -axis
- ▶ End parallel with z-axis
- ▶ Constant rotational speed from $t=0$ to $t=500$

SHOULDERS

- ▶ Start 1.5 units above hips
- ▶ Same orientation as hips
- ▶ Rotate “together”

UPPER RIGHT ARM

- ▶ 2 rotations
 - ▶ Horizontal
 - ▶ Starts parallel with hips
 - ▶ Rotates 45° clockwise about $+y$ -axis
 - ▶ Ends parallel to x -axis
 - ▶ Vertical
 - ▶ Starts pointing in $-y$ direction
 - ▶ Rotates 90° about $+z$ axis
 - ▶ Ends parallel with $+x$ direction
- ▶ Rotates at constant speed from $t=0$ to $t=500$

LOWER RIGHT ARM

- ▶ Rotates 90° clockwise about the +z-axis
- ▶ Constant rotational speed from $t=0$ to $t=500$

RIGHT HAND

- ▶ Rotates 90° Clockwise about $+x$ axis
- ▶ Rotation starts at $t=400$
 - ▶ Ends at $t=500$
 - ▶ Constant rotational speed
- ▶ Gradient



UPPER LEFT ARM

- ▶ Starting orientation
 - ▶ In x-z plane, 135° from shoulders
 - ▶ In x-y plane, 45° from chest
- ▶ Rotation
 - ▶ Clockwise about +y-axis
 - ▶ Constant rotational speed from $t=0$ to $t=500$

LOWER LEFT ARM AND HAND

- ▶ Starting Orientation
 - ▶ In x-y plane, 90° closer to +y-axis with respect to upper arm
- ▶ No motion with respect to upper left arm
- ▶ Hand does not rotate

RETRACTION

- ▶ Reverse all motions
- ▶ Same speed
- ▶ Same starting and ending location