- Support organic, complex environments
- Reactive solving is laggy
- Be less procedural-looking

Philosophy

- Predictive is better than Reactive
- Preserve the original motion
- Take inspiration from biomechanics

Predictive

- Prediction per foot
- Distance and time
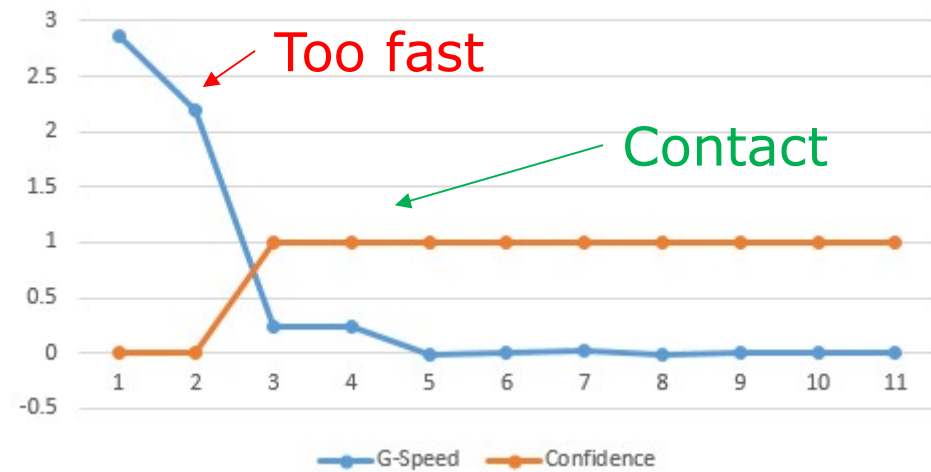- Tells us
  - Location
  - Blend time / ratio

Prediction Data Setup

- Absolutely must be automated
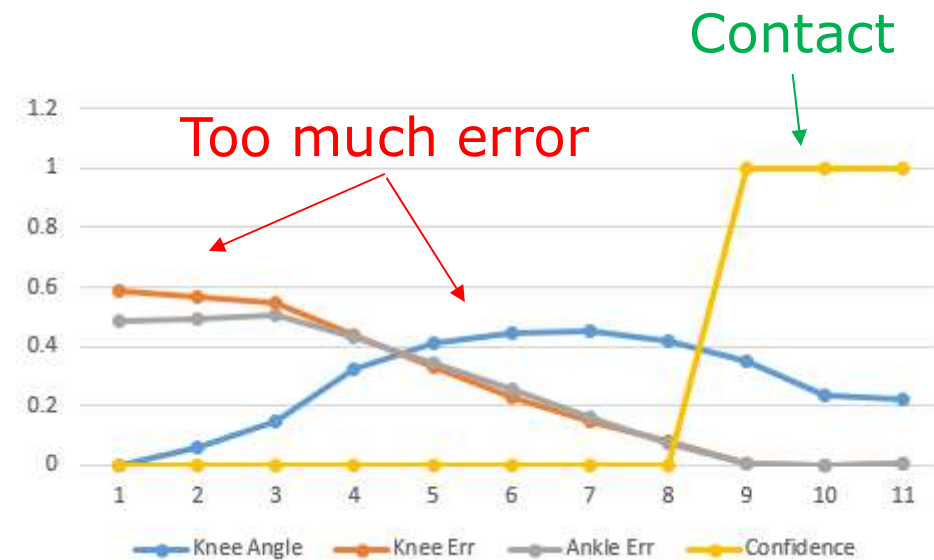- Need delay and distance for each step
- Debug data!!!
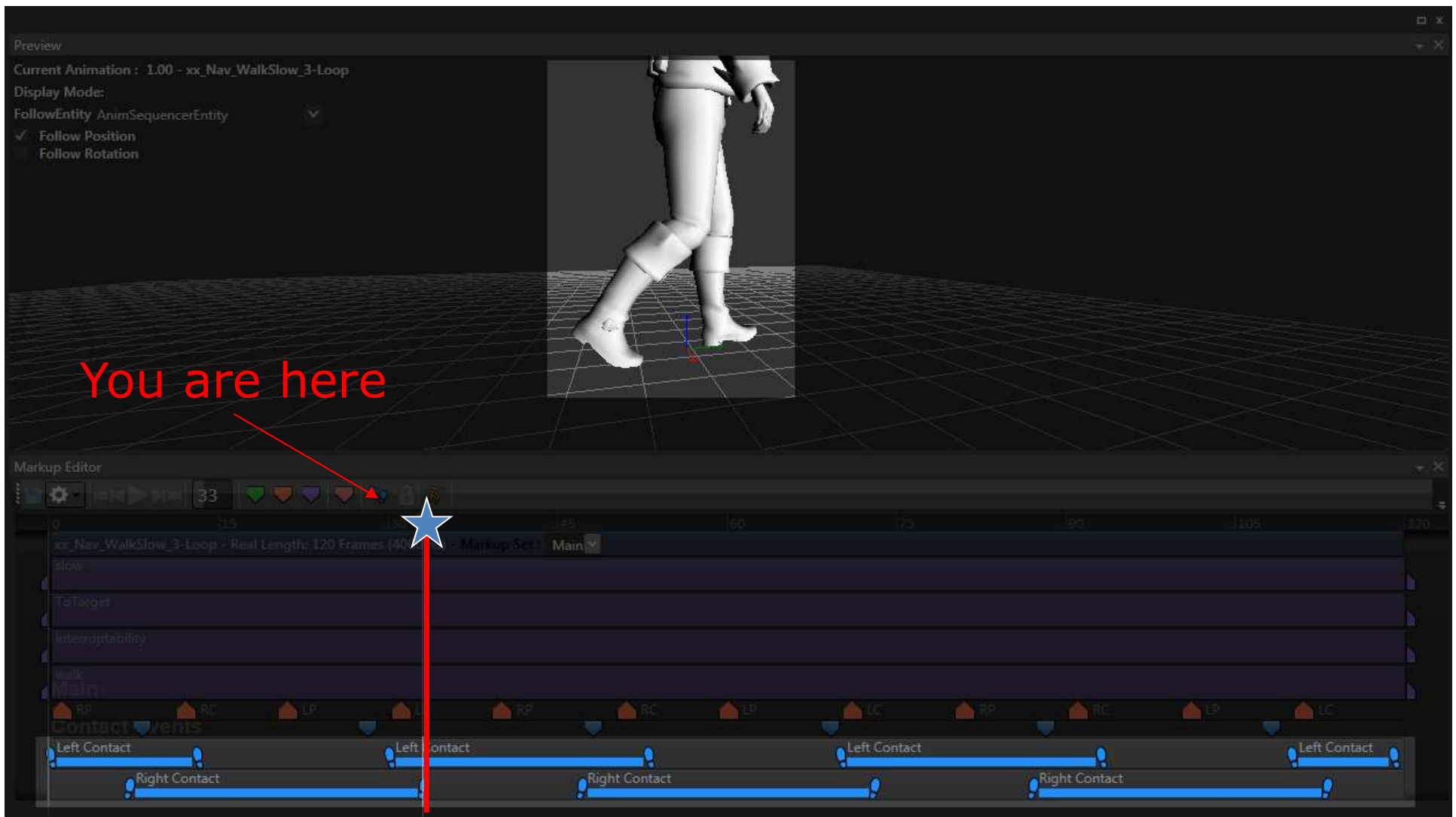
Toe Pos / Vel Filter

- Toe speed
- Toe height

IK Pose Filter

- Assume ground
- Solve foot
- Check pos error
- Check rot error

Predictive Character Motion

- Happens largely through the hips
- Use slope from last to predicted position
- Hip height follows the slope
- Use the forward speed from the anim

Real Displacement

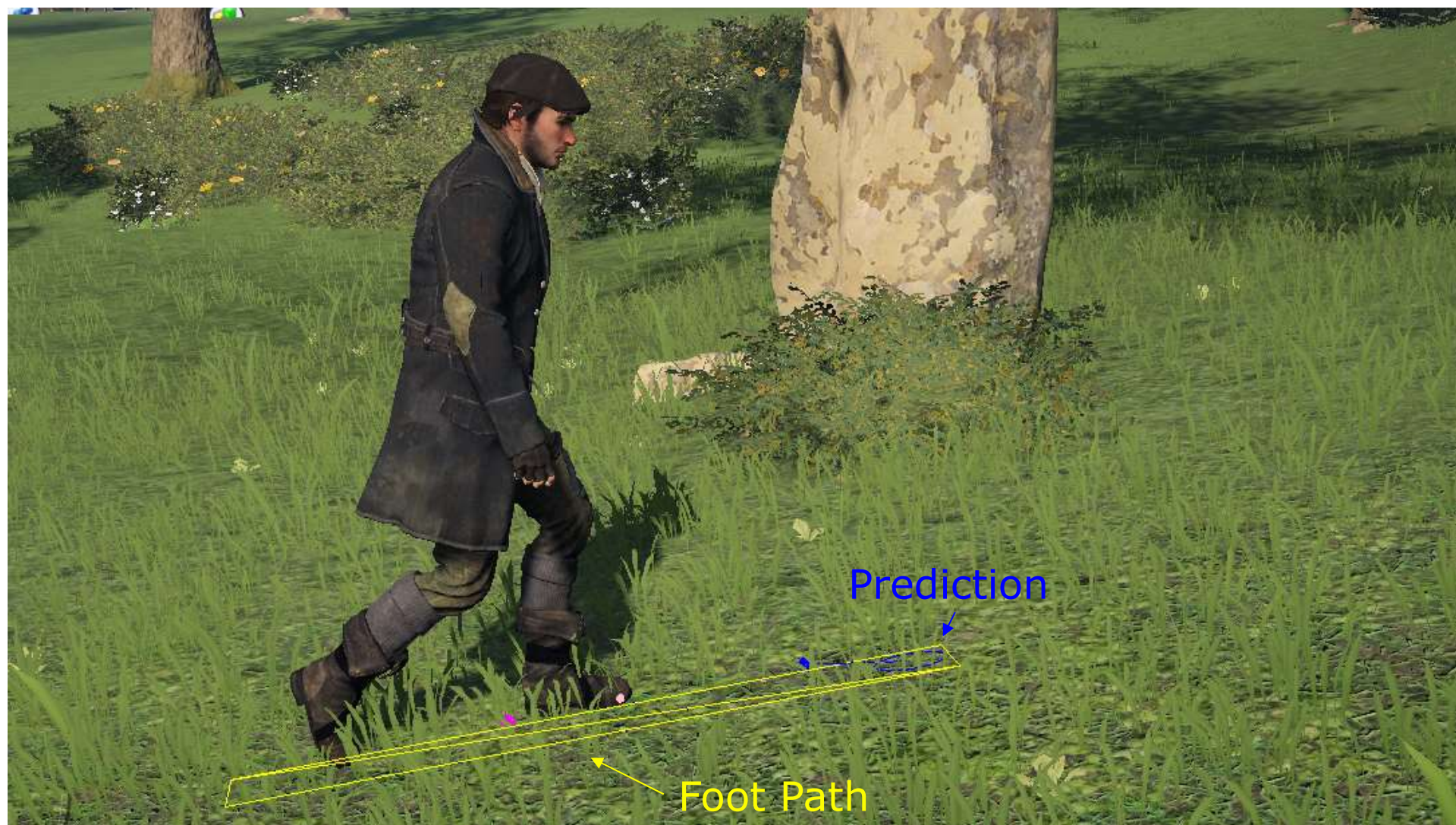Anim Displacement

Avg Predicted Ground
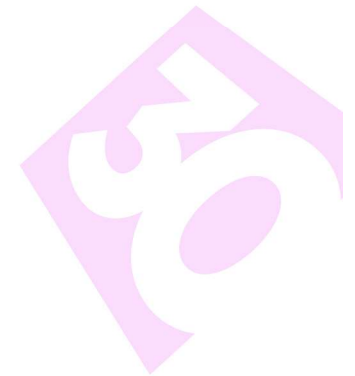
Predictive Foot Motion

- Each foot is fully independant
  - Foot forward comes from animations
  - Height in anim is height above foot path
  - Never let the foot go below foot path

Prediction

Foot Path

Foot Locking

- Locking is fully defined in the data
- Don't fully lock the foot!
    - Multiple constraint scenarios

Foot Locked

- Foot on ground
- Position locked
- Free to rotate
- Most used scenario

Foot Sliding

- Foot kept on ground
- Free to slide (a bit)
- Free to rotate
- Match anim silhouette
- Small difference in anim pos

Lifted

Foot Unlocked

- Fully break the lock
- Prefer smooth motion
- Large difference in anim pos

Stabilizing the Hips

- Hips will bounce on slopes
- Define a support leg, use for hip height
  - Differs when ascending/descending
- Critical springs on hip to remove bounce
  - Directly use displacement
  - Use spring to add the pull

Unstable

Stable

Foot Orientation

- Adjust pitch based on heading
  - Foot horizontal when going up
  - Foot parallel when going down
- Limit pitch and roll, will pull on hips
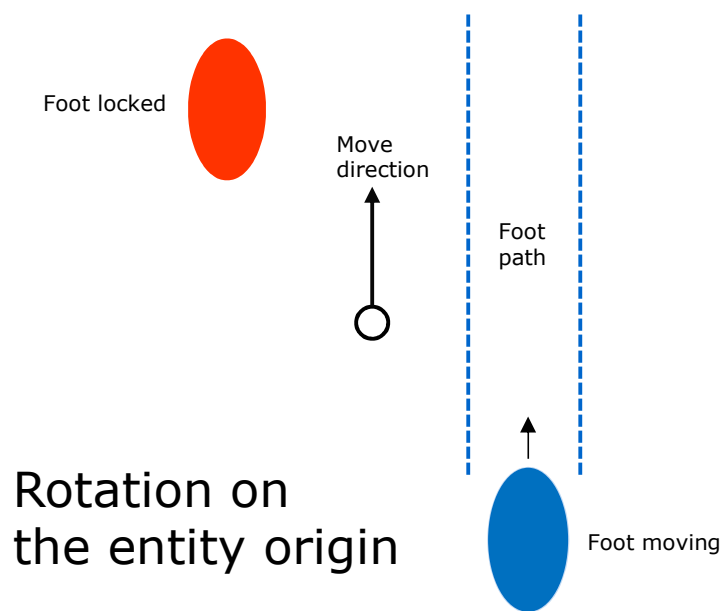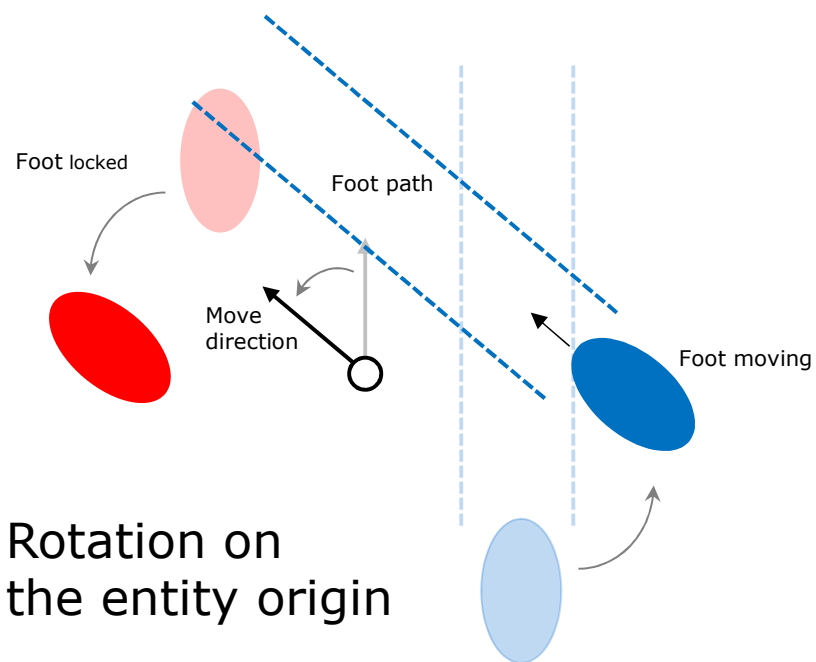- Don't use it at all when running
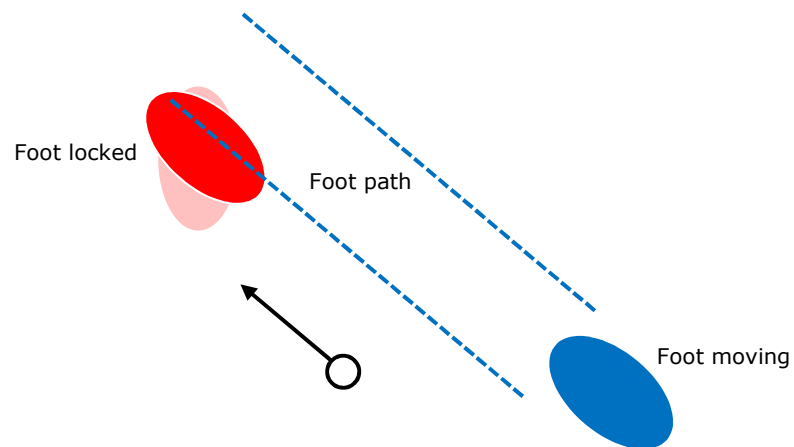
Orientation Off

Orientation On

Flat

Rolled

Moving forward

Foot locked

Move
direction

Foot
path

Rotation on
the entity origin

Foot moving

Rotation translates the feet when unlocked

Foot locked

Foot path

Move direction

Foot moving

Rotation on the entity origin

Rotation rotates the feet when locked

Foot locked

Foot path

Foot moving

Rotation on
the entity origin

Body unbalanced
Foot penetration

Rotation on
the entity origin

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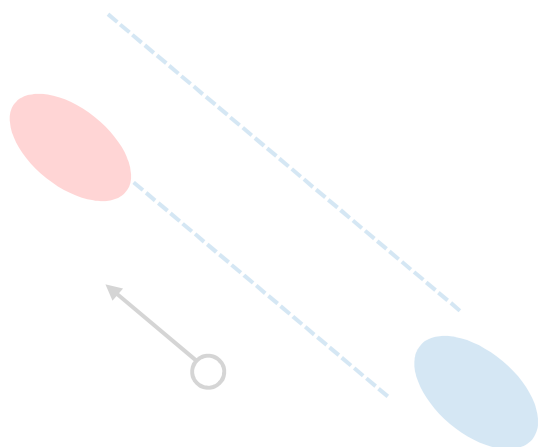
Leg twisted
Body unbalanced
Legs penetration

Use a rotation center nearer
the contact foot

Foot locked

Move
direction

Pivot
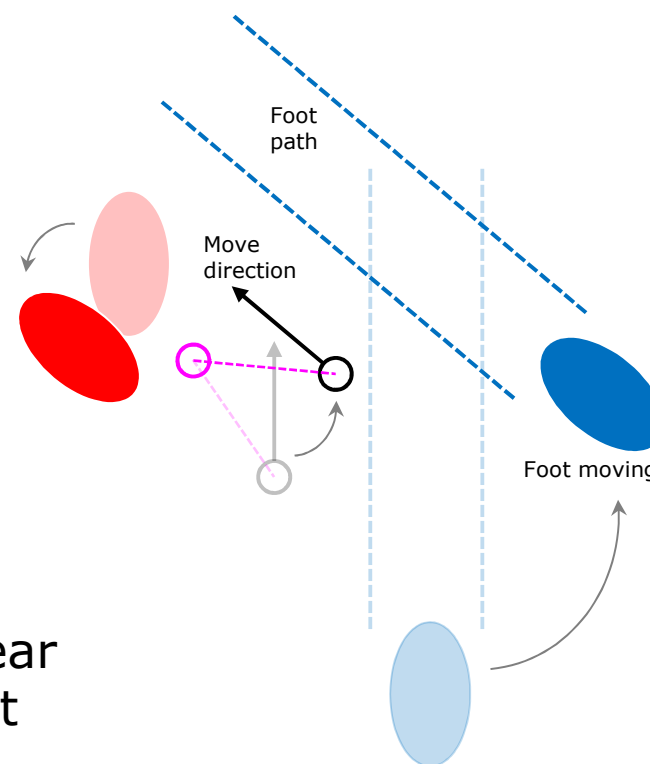
Foot
path

Rotation on
the center of mass

Rotation near
contact foot

Foot moving
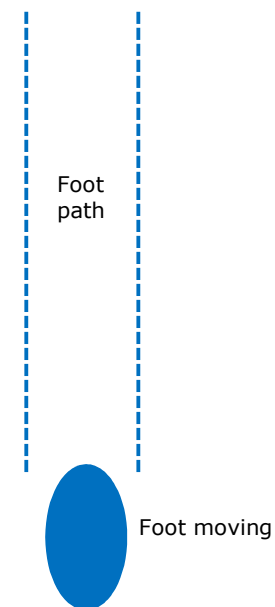
Leg twisted
Body unbalanced
Legs penetration

Rotation on
the center of mass
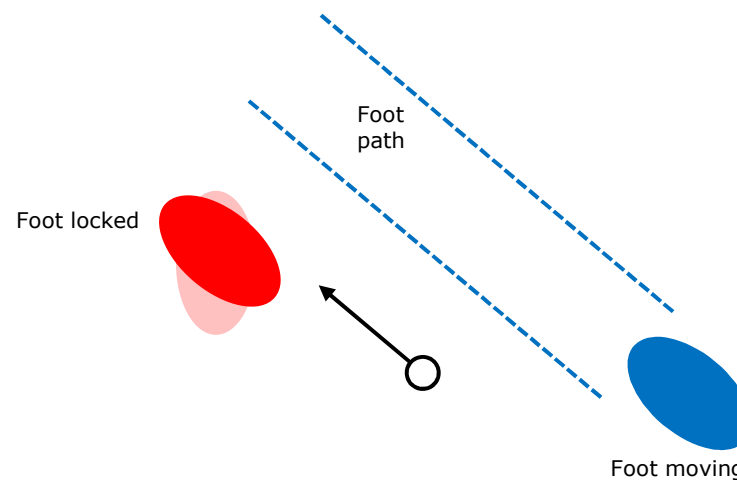
Rotation generates a smaller
displacement on the contact

Foot
path

Move
direction

Foot moving
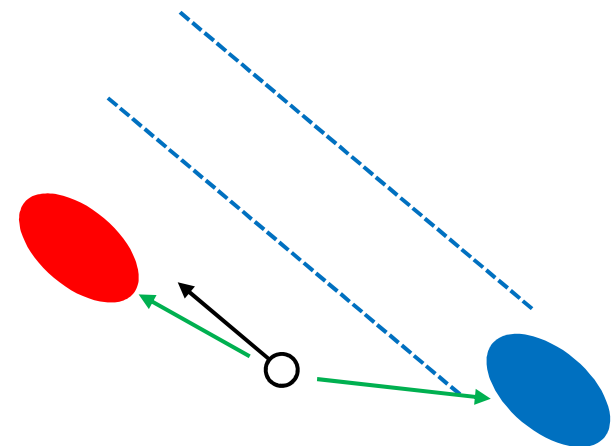
Rotation near
contact foot

Leg twisted
balanced
etration
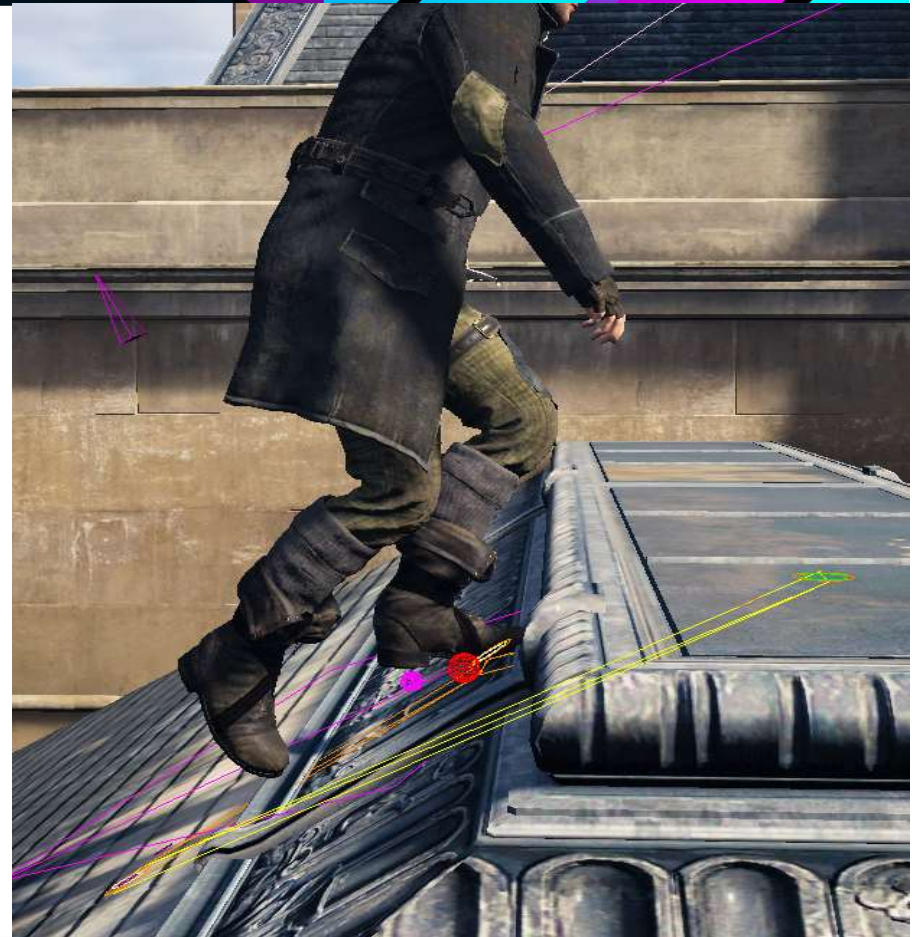
Body almost balanced
No penetration

Rotation
the center of mass
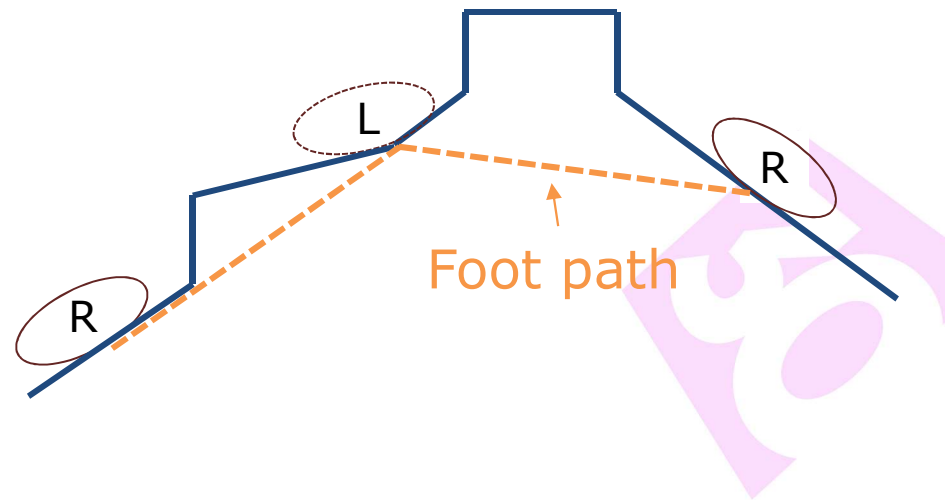
Rotation near
contact foot

Foot Penetration

- Small obstacles
- Stairs and peaks
- Impassible rises

Virtual Ground

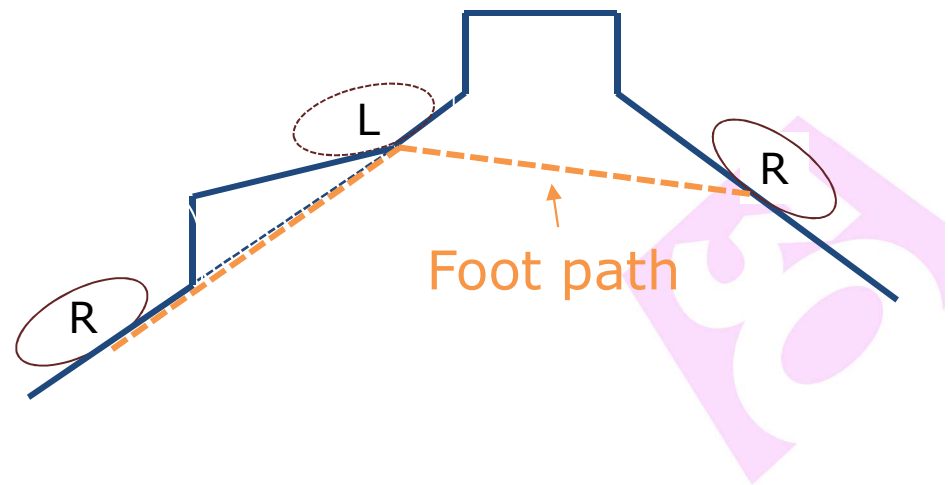- Split path on opposing contact
- Emulates real life
- Helps to clear peaks

Foot path

Ground Envelope

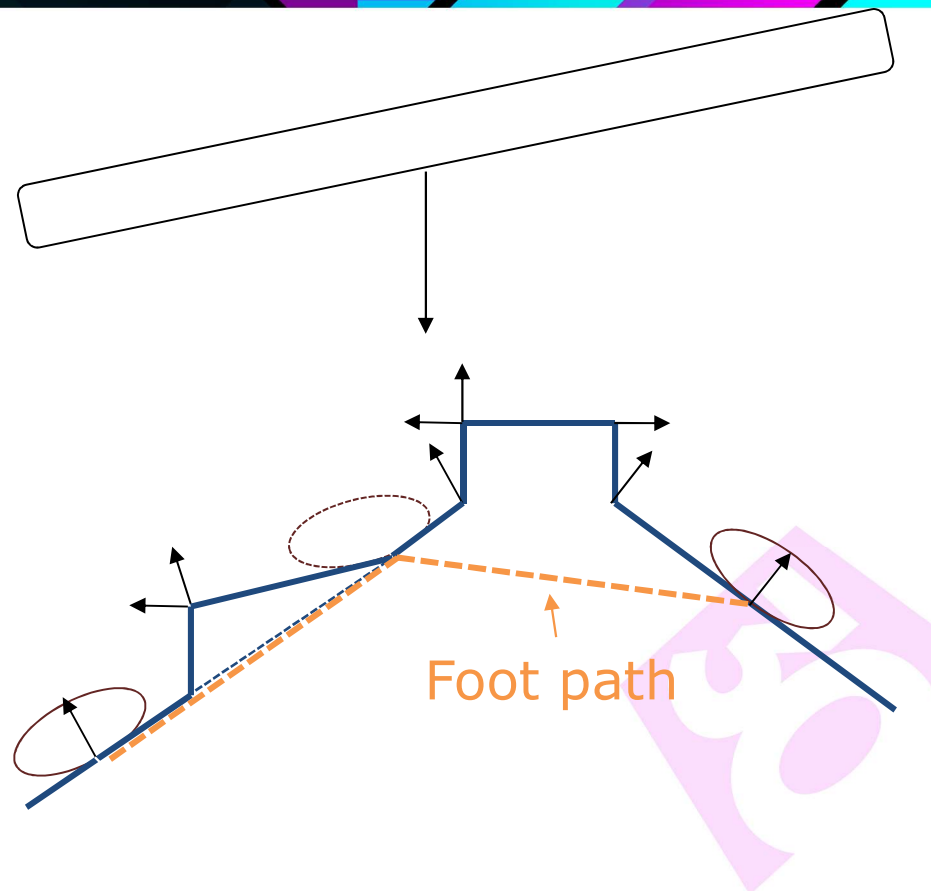- Detect surfaces between steps
- Remove unpassable points
- Convex hull filter

Rooftop Scenario
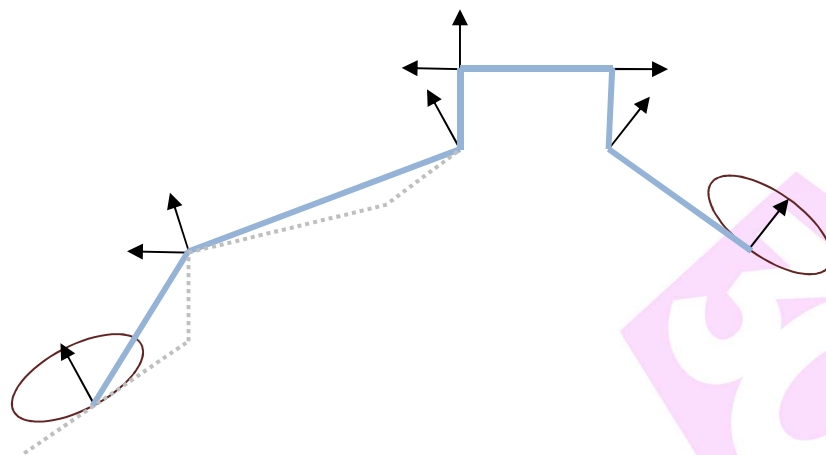
- Prediction on sides of peak
- Does not see top

Foot path

Ground Detection

- Capsule cast path of foot
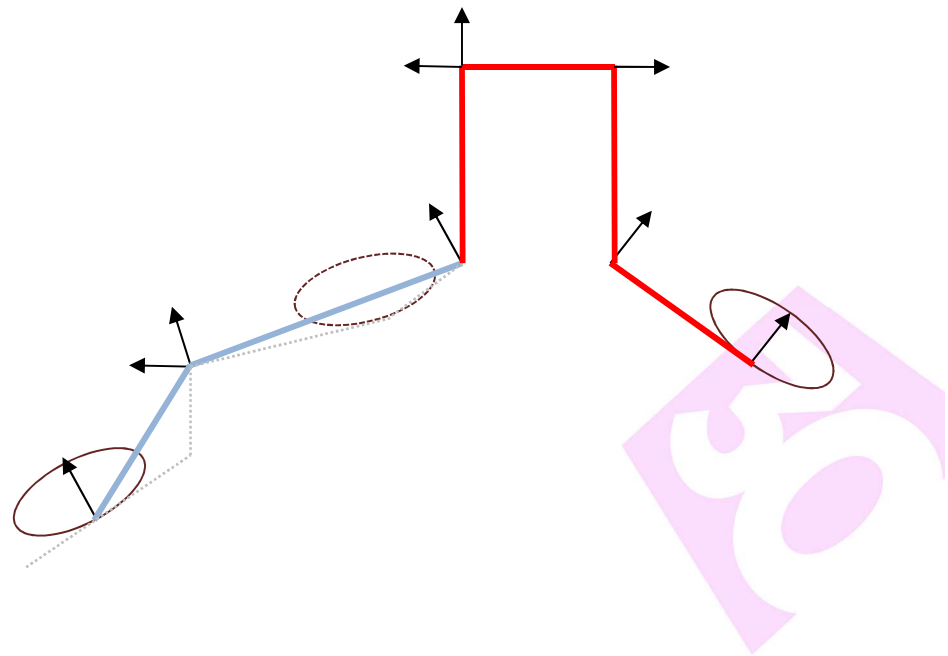- Have positions
- Have normals

Foot path

Ground Path

- Sort near to far
- Sort bottom to top
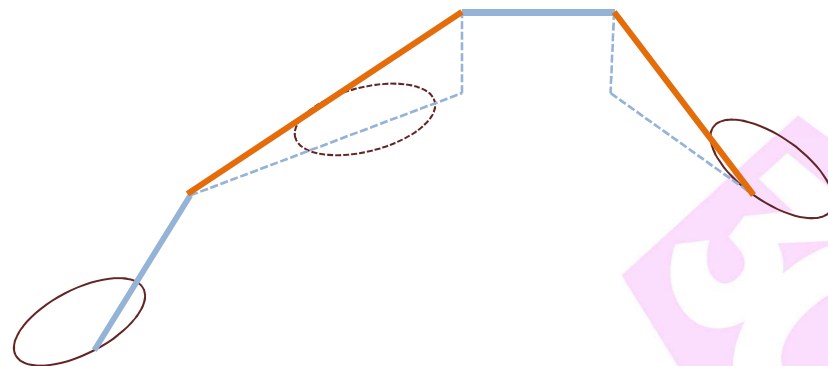- Validate normals
- Define edge planes

Reachability

- Check vertical distance of all edges
- Flag large changes

Ground Envelope

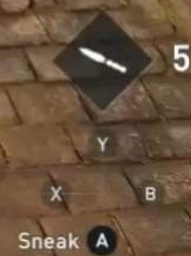- Use convex hull
- Continuous path
- Feet only!

Full Path

Invalid Segment

Out of Bounds: ACVI_Western_OOB(0x484DAAA892)

5

Y

X   B

Sneak A

7

THANK YOU

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Carlos Torres-Cros <carlos.torres-cros@ubisoft.com>