

Crowds in Houdini 15.5

Overview

- Direct FBX Import
- Mocap Biped 3
- Auto-Computed Joint Limits
- Crowd Source 3.0
- Shelf Tool Improvements
- Crowd Solver 3.0
 - Locomotion Improvements
 - Steering behaviour
- Clip Transitions
- Custom Channels in Agent Clips
- Agent CHOP
- Foot Locking
- Terrain Adaptation SOP

Direct FBX Import

- New option for the “Source” parameter on Agent ROP & Agent SOP
- Agent ROP
 - FBX file -> agent definition files (.bclip, shape library, etc)
- Agent SOP
 - FBX file -> agent primitives with in-memory agent definition
- Avoids intermediate conversion to Houdini character rig
- Multiple animation stacks -> multiple clips
- Scale applied to account for default units of meters

Mocap Biped 3

- New character for crowd tests and demos
- Large library of mocap clips
 - Walk / Run cycles
 - Stadium
 - Zombie
 - Inclines
 - Crawling / Jumping

Ragdoll Joint Limits

- Agent Configure Joints SOP
- New options to compute initial joint limits from animation clips
 - Easier setup of hinge joints for elbows
 - Useful starting point for further adjustments
 - Shift+C in the SOP's state will reset joint limit to the auto-computed value

Crowd Source 3.0

- Max Force, Max Turn Rate, and Min/Max Speed parameters moved to DOPs
- Creates fewer point attributes (18 -> 8), some made optional (e.g. group and color)
- Initial State - more forgiving default value
- Improved randomization controls for clip times, layers, initial states, and agent types
- Now optional - can use regular Copy SOP or other methods, if desired, to populate crowds
 - Crowd Solver 3.0 creates any required point attributes along with proper default values

Shelf Tools

- Simulate Tool:
 - Ctrl+Click to create default simulation
 - Prompts for which Crowd State DOPs to create (based on 'state' point attribute & animation clips)
- Path / Look At / Target Position:
 - Simpler to apply to specific states

Crowd State 3.0

- Initial clip time (and random offset)
 - Now optional (can pass through from SOPs)
 - Only applies at start of sim
- Clip randomization uses pattern matching instead of substring search
- New controls for in-place animation
 - Clip speed multiplier (including random variance and/or VEXpressions)
 - Optional clip retiming and speed limits
 - Per-state control over speed variance
- Locomotive animation:
 - Separate controls for clip speed and locomotion speed

Locomotion

- In-Place:
 - Particle driven by forces, optional speed limit around gait speed
 - Animation clip is in-place
 - Clip time updated based on particle speed, (constant) gait speed, clip speed multipliers
- Locomotive:
 - Particle primarily driven by `__locomotion__`: `[rt][xyz]` channels in clip, but can be influenced by forces
 - Animation clip is in-place
 - Allows non-constant speeds and arbitrary orientations

Locomotion

- Setup with Agent ROP / SOP:
 - Use locomotive source animation
 - Convert to In-Place Animation: extract translation from the Locomotion Node into the clip's `__locomotion__` channel
 - Optional: extract orientation based on the vector between the Locomotion Node and the Locomotion Orient node
 - e.g. hip joint and upper leg joint

Crowd Solver 3.0

- New parameter layout
 - Animation Behavior tab removed - all parameters distributed to Crowd State / Transition DOP for per-state / per-transition control, or moved to main tab
- Max Force and Max Turn Rate moved from Crowd Source SOP
- Extra controls for internal POP Solver (aging, reaping, etc)
- Supports agents that aren't down Z or aren't Y-up

Crowd Solver 3.0

- Miscellaneous changes:
 - Diagnostics for agents with invalid states
 - Randomization done by @id, not @ptnum
 - Popsteersolver::2.0
 - Avoidance: guide geometry for particle radius

Crowd Solver 3.0

- New terrain-related parameters
 - Project forces into the plane defined by agent's up vector
 - Adjust up vector to follow terrain normal
 - Better handling of multi-level / double-sided terrain
- Improved steering
 - Use Max Turn Rate to limit how quickly velocity direction changes
 - Less stopping/spinning when obstructed
 - Much easier to steer agents with locomotive clips

Clip Transitions: Review

- Crowd Transition DOP performs transition between states when the trigger activates and agent is in one of the input states
 - Optional random delay
 - Choose clip B based on output state
 - Start playback of clip B at time 0
 - Blend from clip A to clip B over transition duration

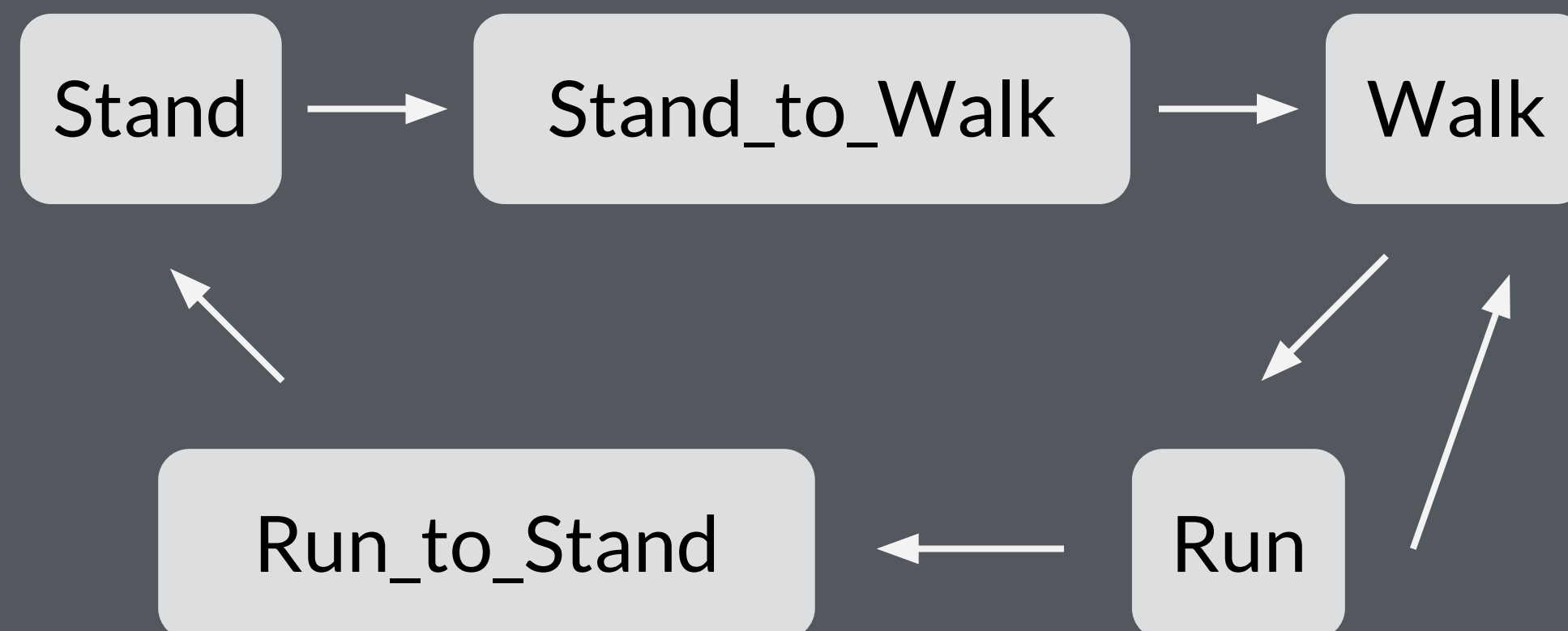
Clip Transitions

- Goal: provide more controls over the transition between animation clips:
 - Delay state transition until reaching a particular region of clip A
 - Specify where playback should start in clip B
 - Allow transition clip(s) in between clips A & B
 - Specify which clips can be transitioned to from clip A (important if “Randomize Clips” is enabled for the destination state)

Clip Transitions

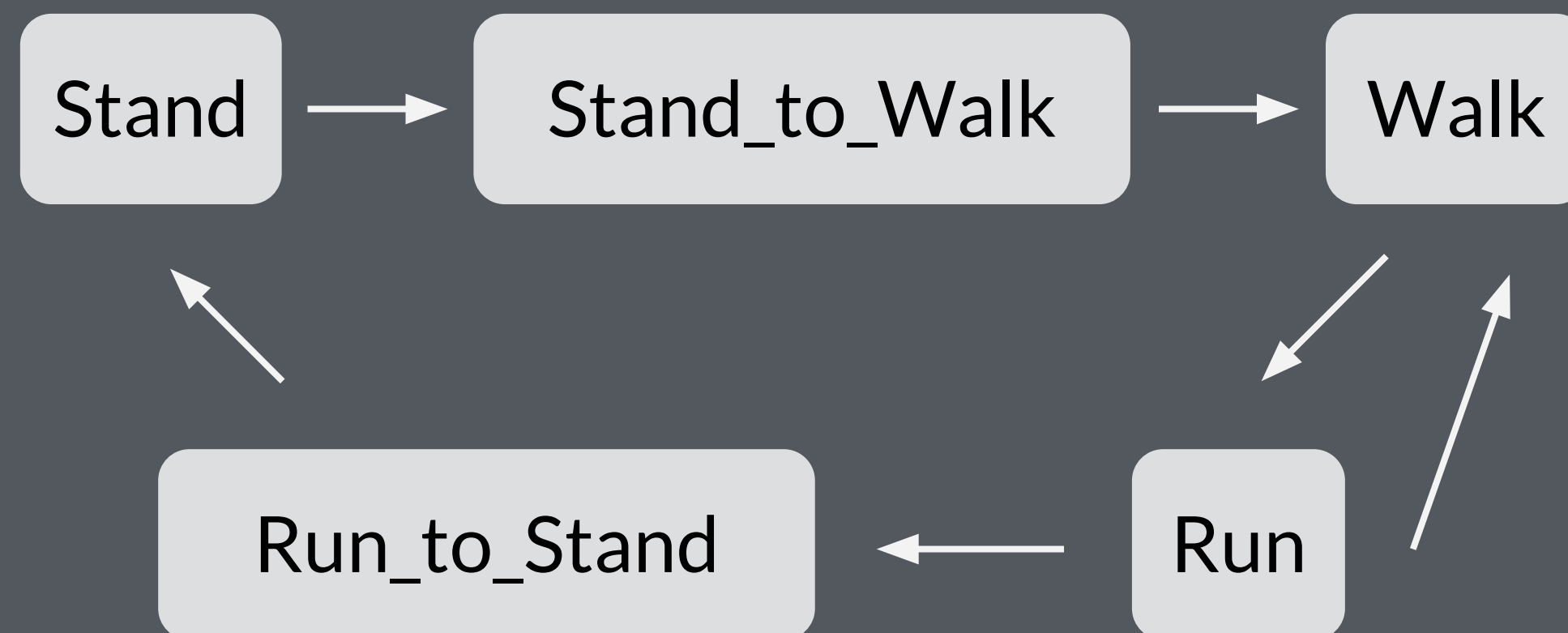
- Problem:
 - Crowd Transition DOP allows multiple input states
 - Each state could have multiple animation clips that agents are using
 - Clip-specific controls need to be separate from the state transition controls on the Crowd Transition DOP

Clip Transitions



- Solution:
 - Set up info about possible clip transitions and their properties ahead of time, and reference this in the Crowd Transition DOP
 - Attached to the crowd object as subdata
 - This information describes a *directed graph*, which can conveniently be represented as geometry
 - Bonus: set up in SOPs -> easy to preview and reuse across sims

Clip Transitions



- Geometry format:
 - Each point represents an animation clip
 - Two-point polygons represent (one-way) transitions between those clips
 - Primitive attributes describe transition's properties
 - For each pair of clips, there can be one or more regions in clip A where a transition can occur -> array attributes
 - See help page for Crowd Transition DOP
- Can build with Agent Clip Transition Graph SOP, or custom tools

Clip Transitions

- Crowd Transition DOP: new option to use the clip transition graph to control the transition between animation clips
- When a state transition is triggered:
 - Choose a clip B from the destination state that is reachable from clip A
 - Find shortest path from clip A to clip B
 - For each pair of clips along path:
 - Wait until clip time is in a transition region
 - Use sync point to choose the initial clip time for new clip
 - Blend into new clip over specified duration
- Preview / test: use the Test Simulation: Crowd Transition SOP

Channels in Agent Clips

- Loading .bclip files in 15.0 for agents:
 - Search for channels named transform_name: [srt][xyz]
- 15.5:
 - Also load all other channels into memory
 - VEX: agentclipsample()
 - Python: hou.AgentClip.sample()
- When creating clip via Agent ROP / Agent SOP:
 - New “Additional Channels” parameter - provide a CHOP containing extra channels to add into the generated clip

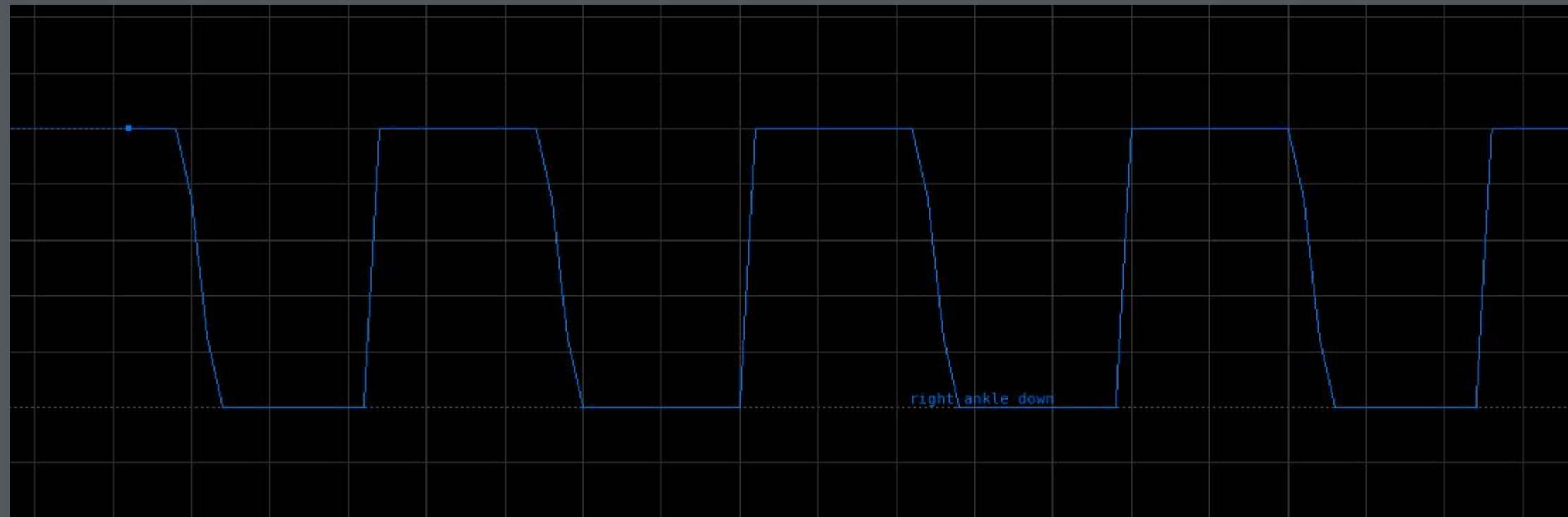
Agent CHOP

- Brings a clip from an agent primitive into CHOPs for modification / analysis
- Optionally convert transform channels from local space to world space
- Round-tripping:
 - Cache .bclip to disk and load with Agent SOP or Agent Clip SOP
 - Or, use Agent Clip SOP to load clip from a CHOP node

Foot Locking

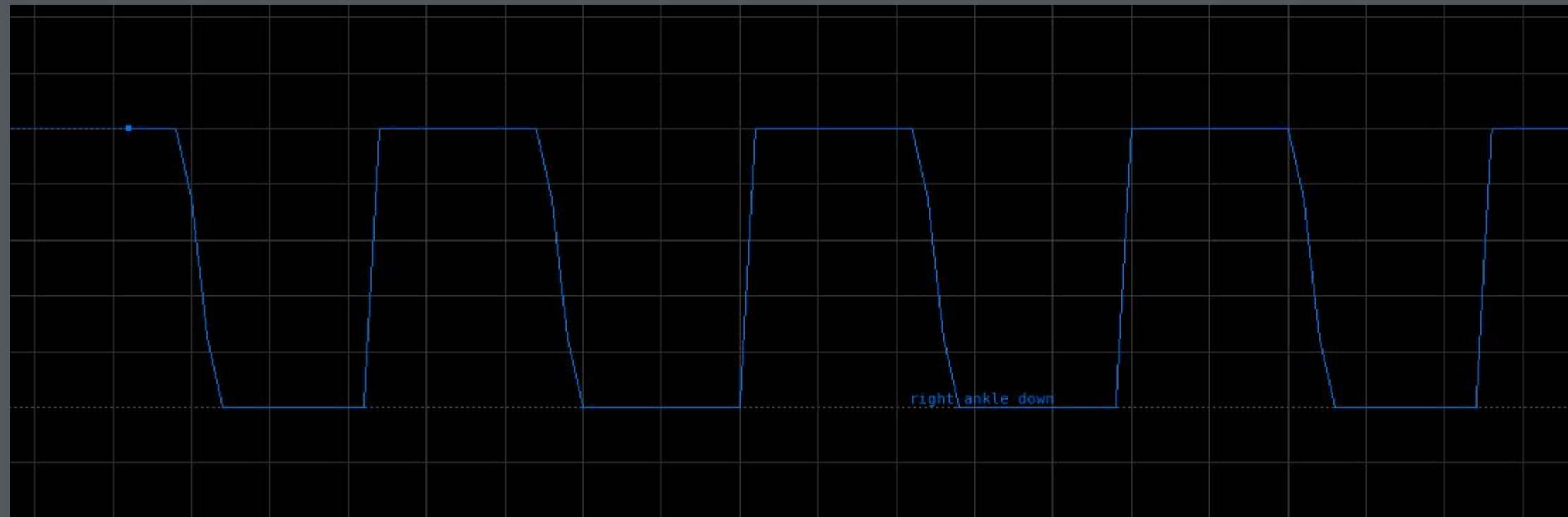
- Review: Terrain Adaptation in 15.0
 - No information about when foot should be planted
 - Push up foot if below terrain, IK to adjust leg
 - If foot is above terrain -> left as-is
- If solver knows when foot should be planted:
 - Can ensure that foot is always on the terrain at the appropriate times
 - Can lock foot in place to prevent sliding (e.g. turning while following a path, or blending between clips)

Foot Locking



- Uses extra channel(s) in the clip that describe when the ankles and toes should be planted:
 - 0 -> not planted
 - 1 -> planted and locked
 - Increasing from 0 to 1 -> blend down toward terrain
 - Decreasing from 1 to 0 -> blend out of locked position
- Agent Prep SOP: specify which channels to use
- Crowd Solver: enable foot locking

Foot Locking



- › Foot Plant CHOP can be used to generate the foot down channels
- › Inputs: choose from input channels, object from a character rig, or a clip from an existing agent primitive
- › Different methods to compute when feet are planted:
 - › Speed threshold
 - › Distance to terrain geometry or a plane
- › Specify number of frames to blend in/out

Foot Locking

- Adding channels to agent's clip:
 - Additional Channels parameter on Agent ROP or Agent SOP
 - Supported by Bake Agent shelf tool
- Load modified clip with Agent Clip SOP
- Agent Prep SOP - Additional Channels tab
 - Convenient options to create a CHOP network based on the specified lower limbs and then load the modified clip

Foot Locking

- During sim: enable foot locking on Crowd Solver (or Agent Terrain Adaptation DOP)
- Post-sim or SOP-only: enable foot locking on (new) Agent Terrain Adaptation SOP
- Debugging: turn on guide geometry
- Note: if there is no terrain, foot locking can still be enabled to prevent sliding



THANK YOU

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