Next Generation Characters for Massively Multiplayer Online Games

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Game production challenges

- Runtime
  - Memory
  - Performance
  - Network bandwidth
  - Client/server specific constraints
- Content
  - Creation
  - Quality
- Especially difficult for MMOs
- Many more issues…
  - …but we have only 60 minutes!

Runtime Challenges – potential solutions

- Memory
  - Animation compression
  - Just-in-time animation loading
- Performance
  - SIMD-optimized math (x86 SSE, ARM NEON)
  - Multithreaded
  - Sample character root motion only
    - Useful on server to control position and velocity
  - Level-of-detail animation and (cloth) simulation
    - Useful on client to control performance load
- Conserve network bandwidth
  - Cannot afford to send full animation pose
    - Client animation needs to be driven by simple messages

Content Creation Challenges

- Modern MMOs
  - Multiple player character races
    - Elf, orc, human, dwarf…
  - Multiple player character classes
    - Warrior, healer, rogue…
  - Choice of male or female player characters
  - Player character customization
  - Player mounts/steeds
    - Horse, warg, dragon…
  - Player pets/familiars
    - Cat, dog, bird…
  - Non-player characters...
- Animation content creation is burdensome, costly

Content Creation – potential solutions

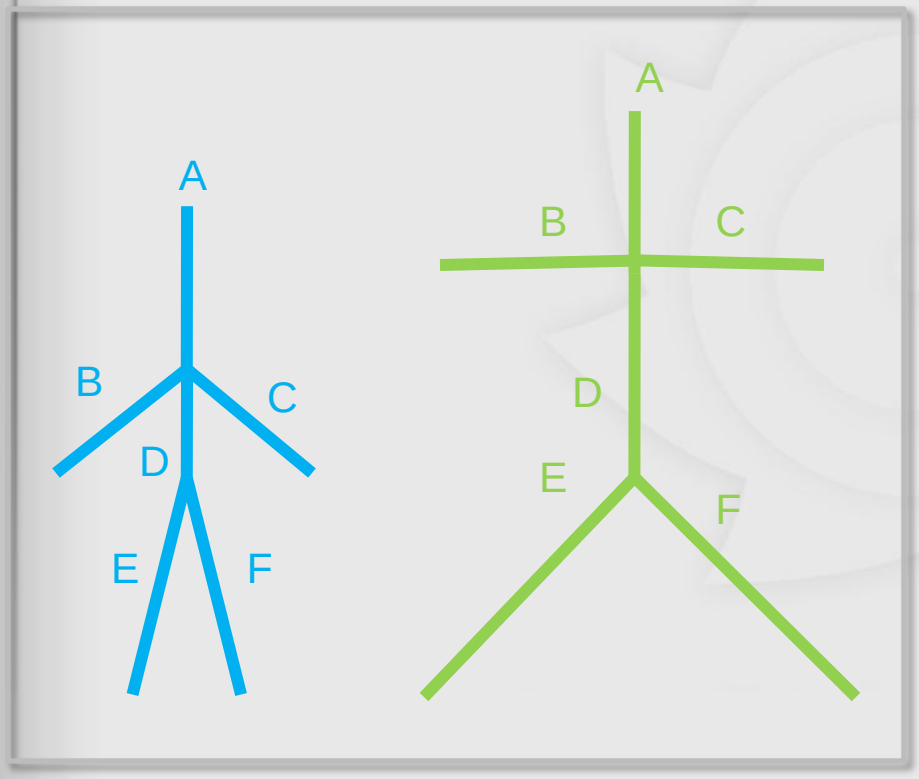
- Share one animation skeleton
  - Uniformly scale animation, skeleton, ragdoll
  - Non-uniform scale
    - Workarounds, too restrictive for some
- Re-use animation assets
  - Mirroring**
    - Flip around specific axes
  - Retargeting
    - One animation, multiple skeletons
    - *Mystic EMotion FX, Autodesk HumanIK, Havok Animation*
  - Procedural changes
    - Inverse kinematics, *Havok Behavior* Docking Generator
  - Also reduces memory consumption, but costs more CPU

Havok Animation – Retargeting (1 of 3)

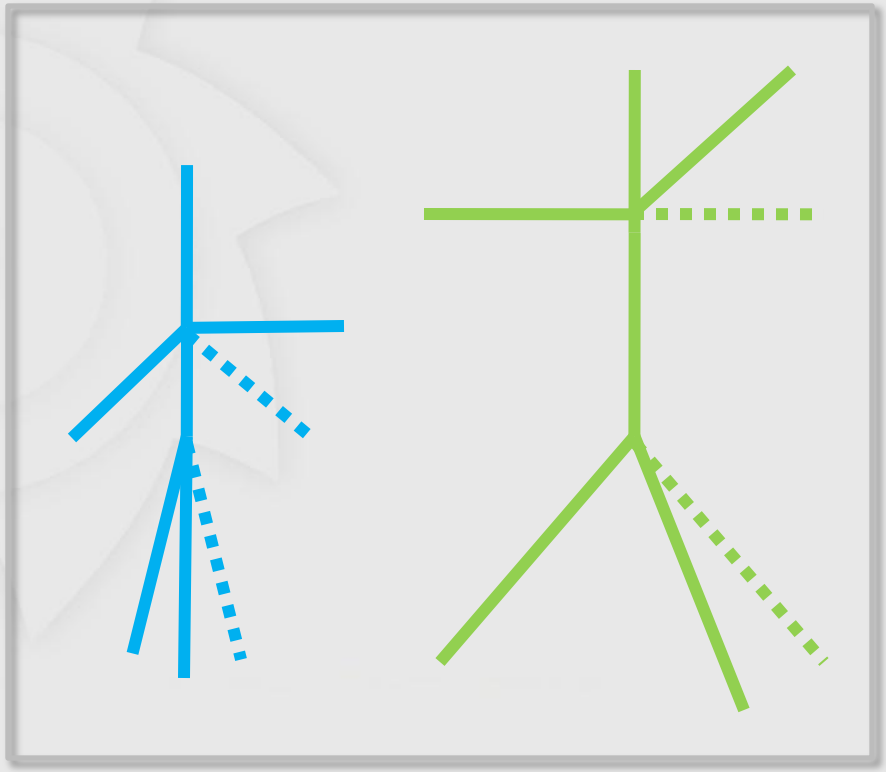
- Provide a correspondence in structure and pose between an original and a retargeted character
- Bone offsets between the characters poses are computed at setup time
- Bone offsets are applied to the original pose at runtime to create the retargeted pose

Havok Animation – Retargeting (2 of 3)

Setup



Result



Havok Animation – Retargeting (3 of 3)

- Five skeletons, one animation

- Character customization…
  - Bone subset, bone superset
  - Partial animation

- Very different characters…
  - Robust and fast but…
  - …sometimes no substitute for Animator expertise
  - Maybe useful as content-filler during production

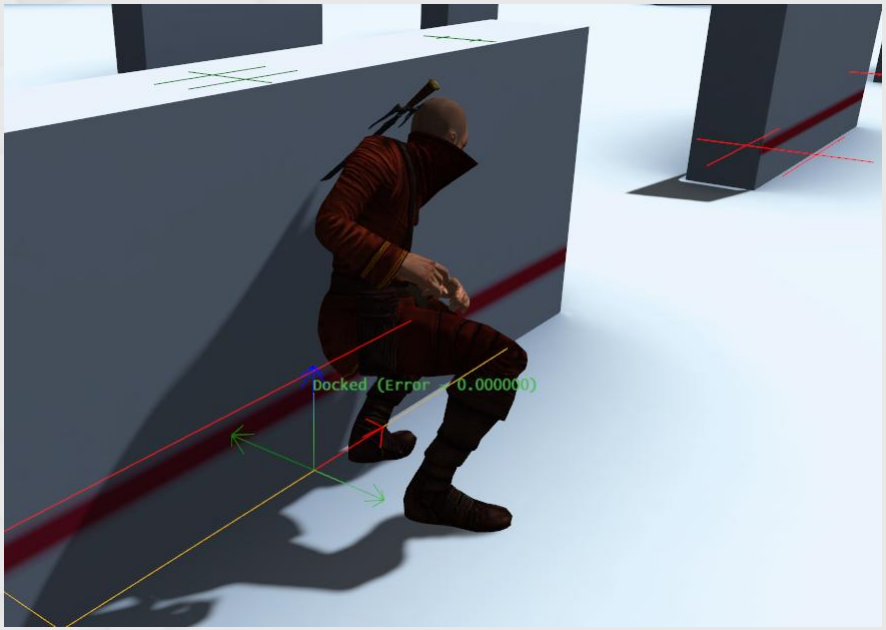
Inverse Kinematics

- Solutions
  - *Autodesk HumanIK, Natural Motion Morpheme, Rad Granny*
  - *Havok Animation*
- Foot IK
  - Uneven ground
  - Stairs
  - Dynamic objects
    - Seesaw (aka teeter-totter)
- Look-at IK
  - Head faces camera or objects of interest
- Hand IK
  - Hand connects with stair bannister

Havok Behavior – Docking Generator

- Controls character-environment interaction

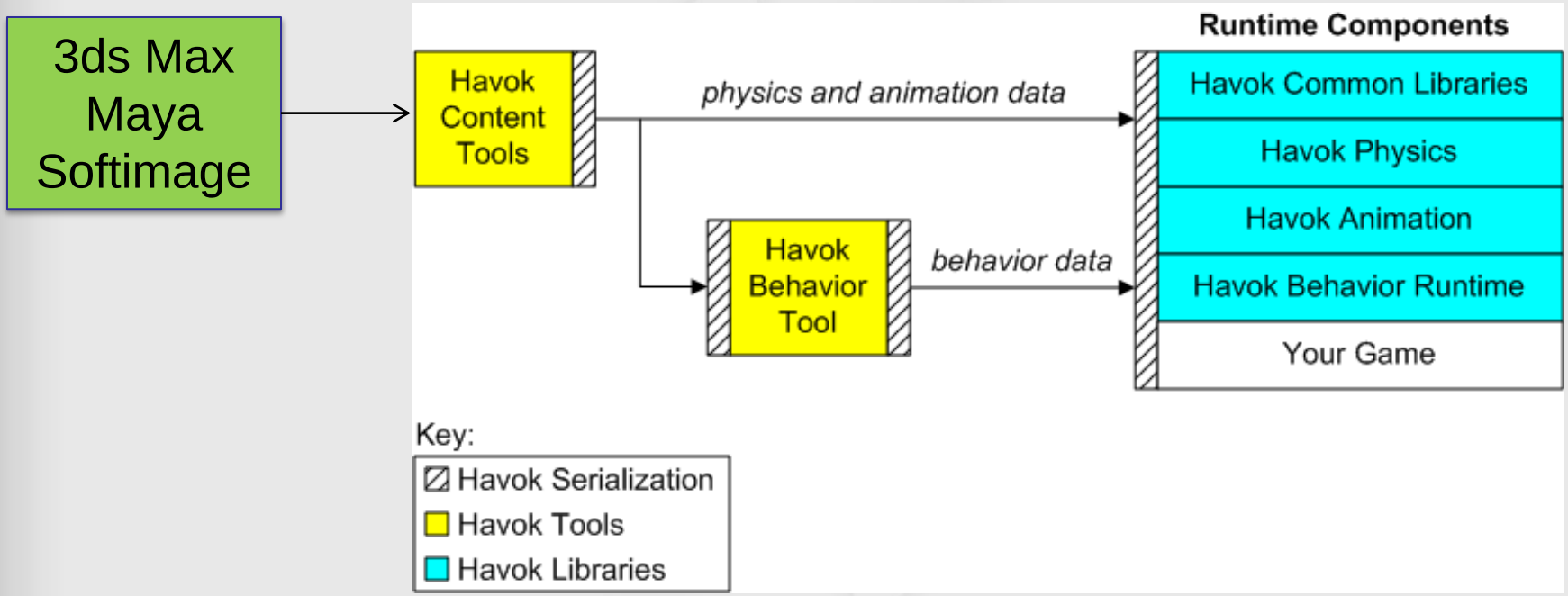
- Hanging from ledge
  - One jump, many heights
- Constrained motion
- Moving target



Content Quality – animation management

- How to manage animations in runtime
  - C or C++ code directly
    - Must be written by Programmer
    - Works but compile/link-times can be restrictive
  - Script e.g. Lua, Squirrel
    - No need to compile/link
    - Possibly written by Designer
    - Runtime performance and/or memory concerns
  - GUI tool that produces data for C++ runtime
    - Visual preview
    - Usable by Designer, Programmer, or Technical Animator
    - *Mystic Emotion FX, Rad Granny, Natural Motion Morpheme*
    - *Havok Behavior*

Havok Behavior Tool – content pipeline



Havok Behavior Tool – demo

- TCP/IP connection
- Record, playback, debug
- Idle, Run, Idle-to-Run
- Run in many directions
- Run and turn
- All together

Content Quality – character simulation

- Collision detection and physical simulation
  - Character controller
  - Inverse Kinematics e.g. raycast for feet
  - Ragdoll
  - *Nvidia PhysX, Havok Physics*
- Clothing or soft tissue (skin, fat or muscle) simulation
  - *Nvidia PhysX Apex*
  - *Havok Cloth*
    - Trousers: setup in 3ds Max, Maya or Softimage
    - Trousers: runtime
    - Level of detail: many characters
    - Hair, customization: one-layer**, ponytail**
    - Soft tissue and clothing: troll

Questions?

- Questions?
- Feedback?
- Concerns?

Thank you!

Thank you very much!