OVERVIEW — SUCKER PUNCH FACIAL PIPELINE
WHAT WE HAD BEFORE

- Real-Time Cutscenes
- Hand Keyed Animations
- Joint Only Face Rigs
WHAT WE WANTED FOR I:SS

- Impactful BackStory
  - Realistic Characters and Animations
- Facial Motion Capture
  - Bodies/Faces/Eyes/Audio - Simultaneous
  - Multiple Actors – Simultaneous
- Real-time Cutscenes
• Hand Keyframed
• 3d Scan Capture Per Frame Performance
• Muscle-Based/Simulation
• Data Driven/Example Based
- Requires a Data Set of known example input to output
- Enough data to make a generalized representation
- Data-Set
  - Facial Scans (F.A.C.S) (Paul Ekman)
  - Consistent Facial Marker Set (scans/mocap)
- New Inputs
  - Tracking (same marker set)
- Solver (Applies Mocap Data to Rig/Shapes)
- Motion Retarget to Game Characters
Pre-Captured (One time setup cost)
70 Facial Pose Scans per actor
Scan Re-mesh to consistent Topology
Scan Hardware Used
  • 2 linked structured light field Scanners
Captured in Static Volume
Stabilize/Align Scans
• Consistent Topology/Blendable
  • Consistent Marker Correspondence
  • Custom Vacuform Masks
  • Track Markers/Warp Fit/ Subdivide/Snap
  • Combine Faces with Entire Head
  • Model Tweaks (Noisy/Missing Scan Data Eyes/Mouth)
Head Mounted Camera Rigs (HMR)
Simultaneous Capture – Face/Body/Eyes/Audio
  • Timecode Hardware Sync
Multiple Actors
Projection Mask Animation
Marker Tracking
• Methods (2d vs 3d)
  • Optical Flow
  • Feature Recognition
  • Triangulation Software
• Noise Reduction
• Stabilization
  • Moving helmets/Day to Day/Shot to Shot align
• Missing Marker Data/ Occlusion
• Lighting Conditions
RE-TARGET TO GAME CHARACTERS

• Methods
  • Game Character Face Rig, trained to use Drivers from actor for Blend Weights
  • Transfer Blend Weight results (Shape Weight Correspondence between character poses if needed)
  • Hint Based Scalars On Base Scaffold
  • Proportion Constraint (method we used)
    • Shape Re-target
    • Marker Motion Re-target
    • Easily Tie motion to joints
• Linear BlendShapes
  • Easy to Animate Weights
  • Over-Adding Issues-need to normalize
  • “Posey” results
• Pose Space Deformation (PSD) as solver
  • A method of deriving shape weights from marker data
  • Uses Radial Basis Function (RBF)
  • Applied as Deformer node, shapes driven indirectly though a face rig- controls will get automatic shape interpolation
  • Markers as Drivers / Motion Vectors
  • Setting up Matrix/ Single Value Decomposition (SVD)
  • Shapes Converted to PreSkinCluster – Relative to Default
SKINCLUSTER ONLY
KEY DRIVERS

LOCAL OFFSET VECTORS
LID ROTATIONS
EYE DIRECTION
DISTANCES
JAW ROTATION

REGION SPECIFIC DRIVERS
• Fine Tuning PSD Attributes
  • Input Width Regularization
  • Balance Pose Space (Gaps/Shape Overlap)
  • Drop poses too close
  • Testing Drivers – ROM test/ BlendShape test
• Expose Solver Attributes to Animators
• Using Multiple PSDs with normalized deformer weights
  • Fewer Drivers for Independent Regions
  • Like Weighted PSD
POSE SPACE DEFORMER/ RBF SOLVER
• Pose Training Phase (One Time) – surface locators
• PSD Deformer applied Pre-SkinCluster
  • Joints per Facial Marker
  • Track Drives Skin and Vertex Level Deformations
  • Efficient Streaming – No Dense Shape Memory
  • Smooth Natural Arcs in Motion
WARPED SOLVE – SNAP TO 3D TRACK

TRAINED POSES

MARKER PATH

POSE SPACE PATH
• 2D versus 3D Tracking
  • 2D requires only 1 camera per head rig
  • 3D requires 4 cameras per head rig
  • 3D track can use the 3D data to verify accuracy
  • 3D track gives better visualization/sillhouette
  • 3D track can be used to warp/fit results tighter
  • 3D track provides extra dimensionality for lips
2D TRACKING ERROR
FACIAL RIGS

- Variety of Animation Controls (Gross and Fine Control)
- Gross Controls - Directly Manipulate Key Drivers
- Fine Controls - Directly Manipulate each joint
- UI – Picture per actor pose with multiple Region Sliders
- Automatic Shape Interpolation with all controls
• **Animator Attributes**
  - RBF, input widths, Shape Influence, Drop Shapes
  - Per Joint control weight – From Pure Pose Space to exact 3d track
  - Additive versus Animation Over-takes Mocap automatically
  - Sticky Lips Attributes
  - Eye Drag Multiplier Attributes
Compression and Stretch – Independent across face
Ddetects Local Volume changes relative to Default
Low Res Cage associates connectivity of high res
  •  Faster Calculation
  •  Smoother Falloff
  •  Art Direct which Areas to be Driven Together (cage shape)
Created the Normal Maps using depth difference between Raw dense FACS scans and final resolution
Deformer Applied Pre-SkinCluster – Better Compression with small range offsets
Joint Animation as Animation L.O.D.
GPU Decompression during streaming
Normal Recalculation Required
Seam Fixing (shared edges)
  • Snag GPU round-off versus Maya skin Weights
In Engine Wrinkle/Crease – matches anim rig
• Tracking Issues
  • Stabilization, Camera Calibration
  • Requires Fast Feedback loop applied to “actor-only Rig”, for iteration to verify track
• Retarget – some room for improvement
• Infer Jaw Motion/Teeth – aimed at center of two lower jaw markers-(not perfect so allow offset animation)
• Attention to deformations of neck where join PSDs
References

“Facial Action Coding System”,

“Pose Space Deformations: a unified approach to shape interpolation”
[J.P. Lewis, Matt Cordner, Nickson Fong, Siggraph 2000]

“Realtime Facial Animation with On-the-fly Correctives”
[Hao Li, Jihun Yu, Yutin Ye, Chris Bregler, Siggraph 2013, ACM 2013]

“Animating Blendshape Faces by Cross-Mapping Motion Capture Data”
Zhigang Deng/USC, Pei-Ying Chiang/USC, Pamela Fox/USC, Ulrich Neumann †/USC

WPSD- “Modeling Deformable Human Hands from Medical Images”
Tsuneya Kunihara1 and Natsuki Miyata2

“A Brief Introduction to Statistical Shape Analysis”
Mikkel B. Stegmann and David Delgado Gomez†/Informatics and Mathematical Modelling, Technical University of Denmark
Richard Petersens Plads, Building 321, DK-2800 Kgs. Lyngby, Denmark

“Interactive Region-Based Linear 3D Face Models”
[J. Rafael Tena, Fernando De la Torre, Ian Mathews, Siggraph 2012]


“Dense 3d motion capture for human faces. “
In 2009 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2009), 20-25
June 2009, Miami, Florida, USA, IEEE, 1674–1681
Co-Contributor

Adrian Bentley – Lead Engine and Render Team

Additional Contributions

Josh Jersild – Senior Programmer
Shuai Liu – Senior Programmer
Stephen White - Co-Lead Tools & Engine Team
THANK YOU!!

...And special Thanks to the GDC Committee!
...and GDC mentor Ru Weer

Questions?

email: spencera@suckerpunch.com
twitter: spensa3d