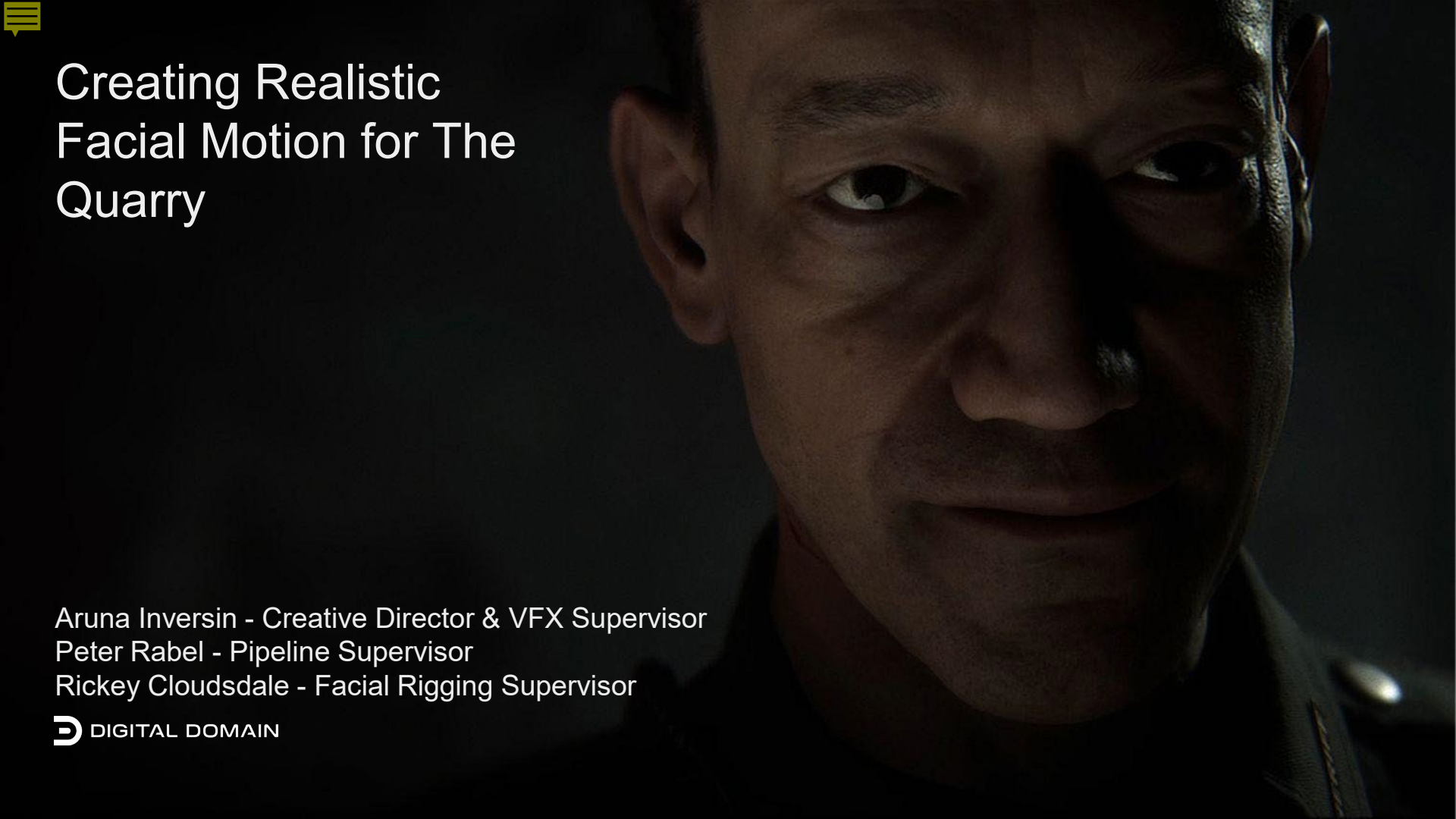
Creating Realistic Facial Motion for The Quarry



Aruna Inversin - Creative Director & VFX Supervisor
Peter Rabel - Pipeline Supervisor
Rickey Cloudsdale - Facial Rigging Supervisor

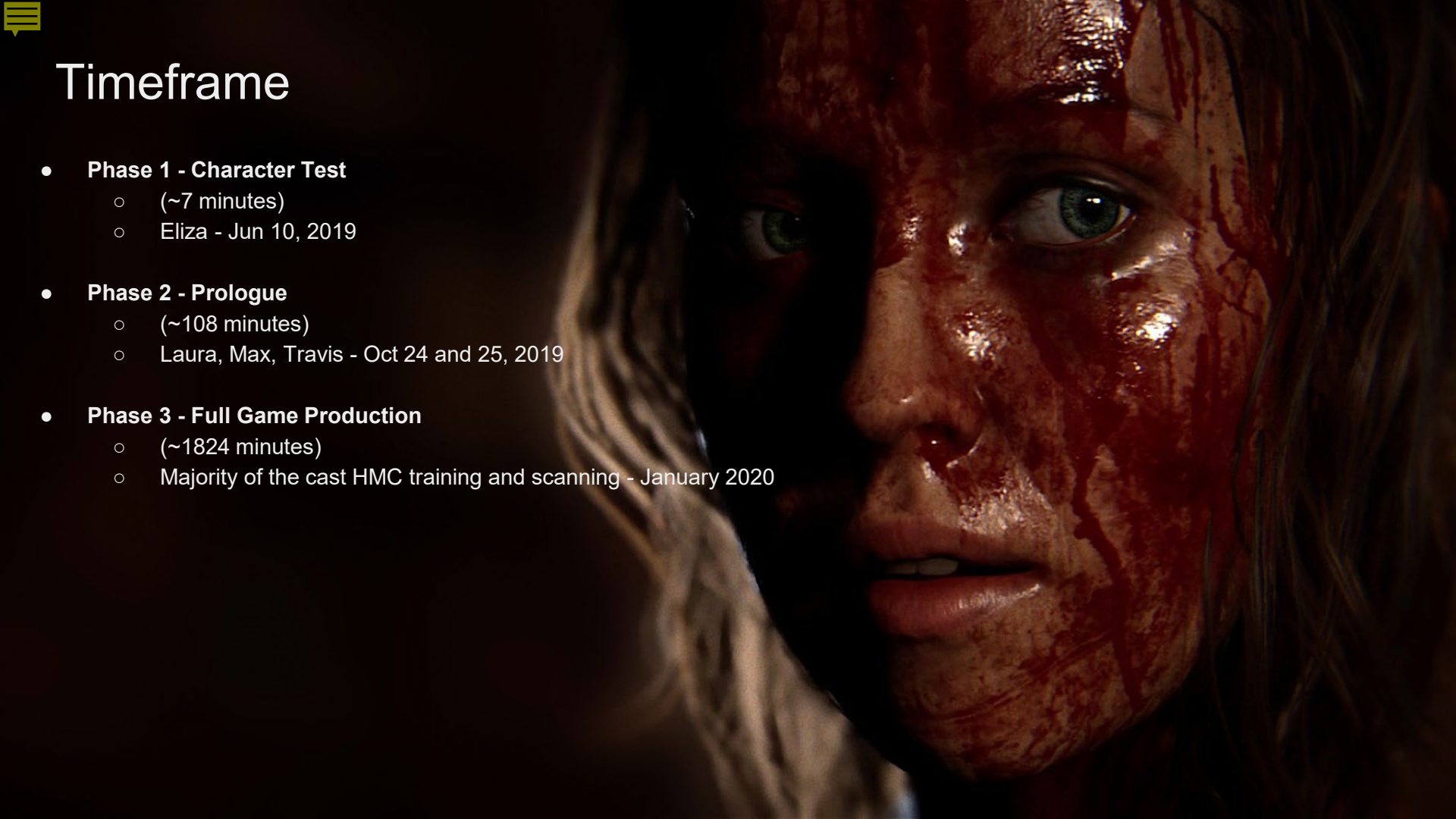
DIGITAL DOMAIN


THE QUARRY
BAFTA
2023 NOMINEE
PERFORMER IN A LEADING ROLE
TIGA
Representing the Games Industry
GAME OF THE YEAR 2022
EXP SHARE+
BEST HORROR - GAME AWARDS 2022
VES
Visual Effects Society
2023 NOMINEE - OUTSTANDING VFX
IN A REAL-TIME PROJECT
ON 2022 TOP 10 LISTS
BLOODY DISGUSTING
CNN
GQ
npr
PRIDE
The Verge
VICE
GAMEREVOLUTION
TIME
GAMERANT
DualSHOCKERS
THE LOADOUT




Timeframe

- **Phase 1 - Character Test**
  - (~7 minutes)
  - Eliza - Jun 10, 2019
- **Phase 2 - Prologue**
  - (~108 minutes)
  - Laura, Max, Travis - Oct 24 and 25, 2019
- **Phase 3 - Full Game Production**
  - (~1824 minutes)
  - Majority of the cast HMC training and scanning - January 2020

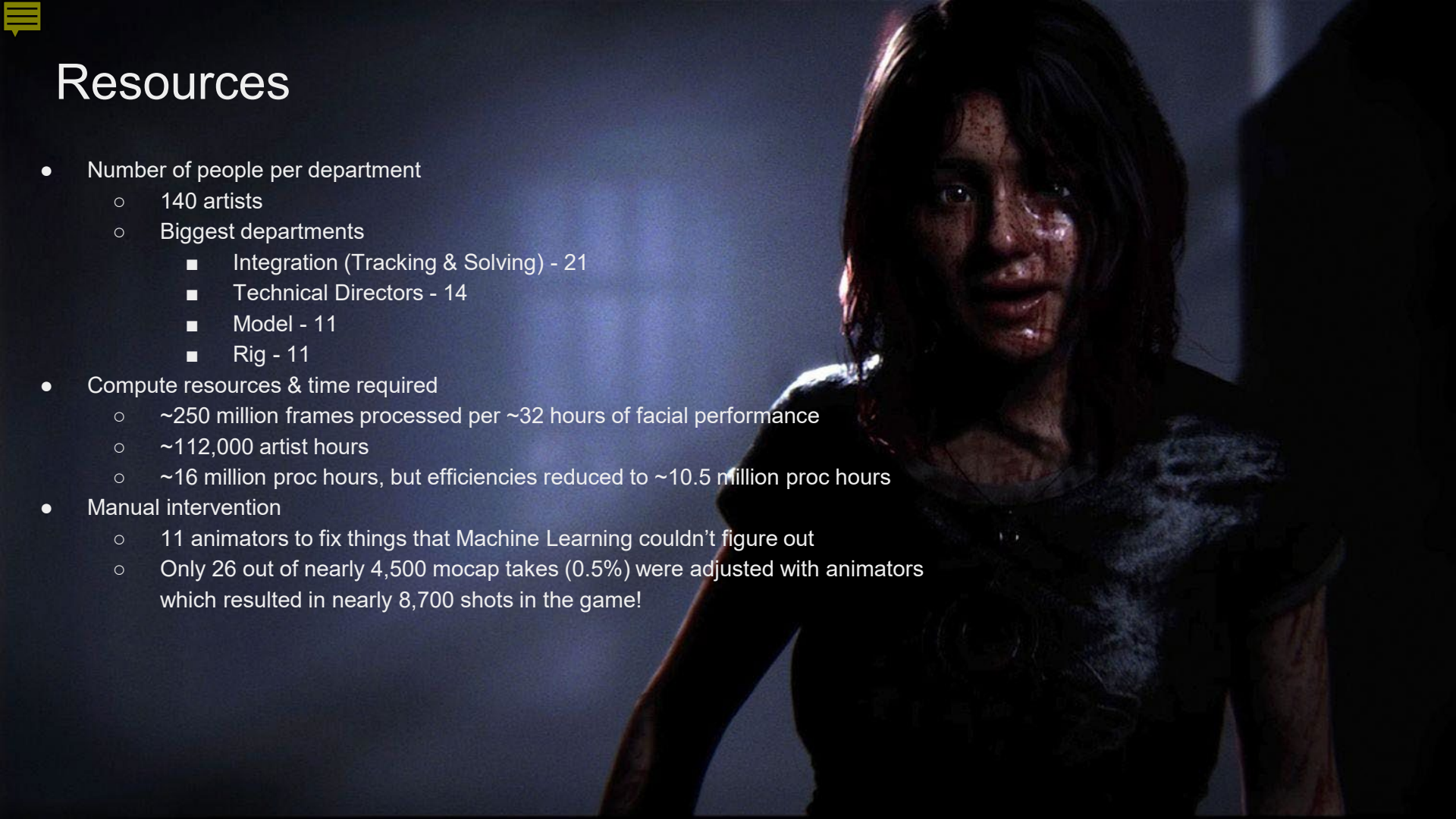


Timeframe

- Phase 3 - Full Game Production 2020-2021
  - COVID!!!
  - Remote test shoot - June 2020
  - 1st Hackett Shoot (with on-site crew) - Nov 2020
  - 2nd Counselor shoot (with on-site crew) - January and February, 2021
  - 3rd Pickups (with on-site crew) - April and June 2021
  - Final delivery of all facial performances - Feb 2022
  - Game release - June 2022

Resources

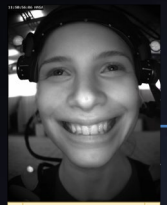
- Number of people per department
  - 140 artists
  - Biggest departments
    - Integration (Tracking & Solving) - 21
    - Technical Directors - 14
    - Model - 11
    - Rig - 11
- Compute resources & time required
  - ~250 million frames processed per ~32 hours of facial performance
  - ~112,000 artist hours
  - ~16 million proc hours, but efficiencies reduced to ~10.5 million proc hours
- Manual intervention
  - 11 animators to fix things that Machine Learning couldn't figure out
  - Only 26 out of nearly 4,500 mocap takes (0.5%) were adjusted with animators which resulted in nearly 8,700 shots in the game!

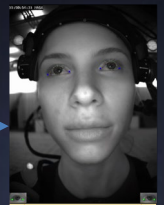


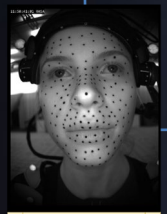
Masquerade 2.0

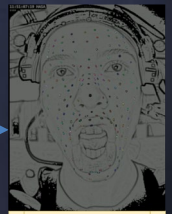
- HMC Markerless Tracking
- ML Marker Removal
- ML Feature Tracking
- HMC Marker Tracking
- Marker Cleanup
- Marker Uprez
- Direct Drive
- Copycat
- Chatterbox

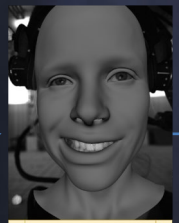
Masquerade 2.0


CycleGAN

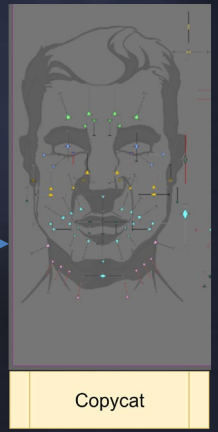

GazeML

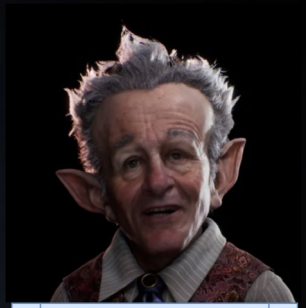

HMC Footage

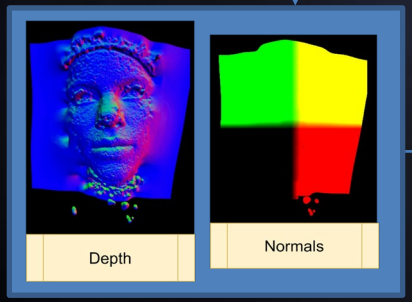

Bullseye Markers


Masquerade

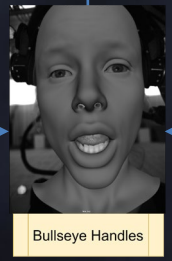

Direct Drive

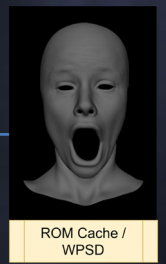

Copycat

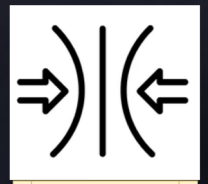

Vray


Depth

Normals

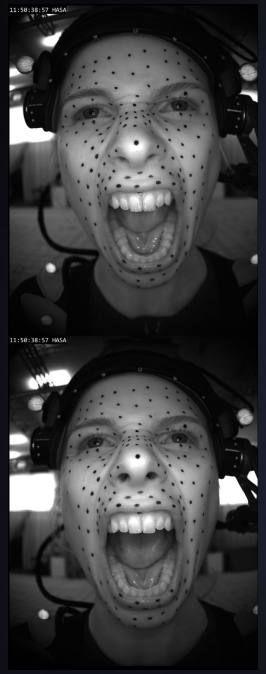

Bullseye Handles

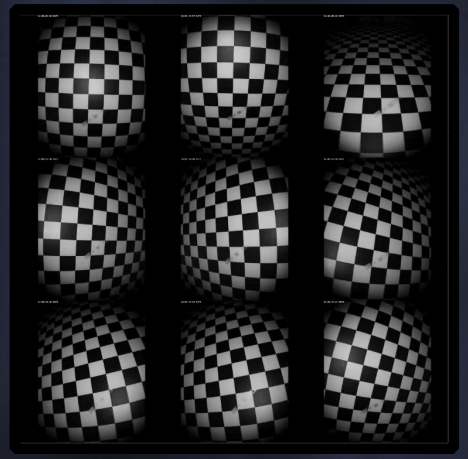

ROM Cache / WPSD

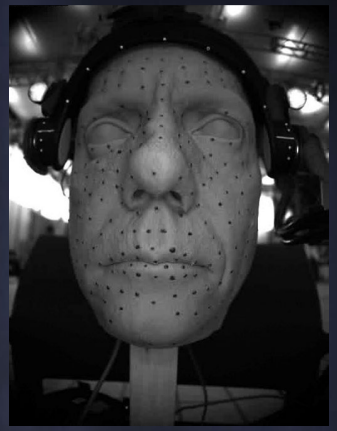

Chatterbox / PCA Compression


Unreal

On Set Shoot and Calibration

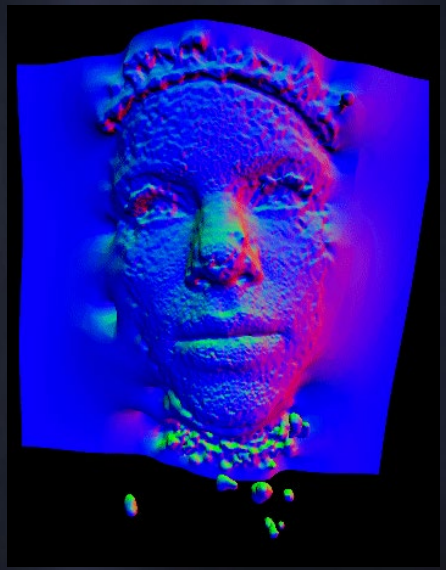






- HMC
- Depth/Normals
- Bullseye Handles
- Bullseye Markers
- CycleGAN
- GazeML
- Masquerade
- Direct Drive
- Copycat
- Chatterbox

Depth/Normal Renders - AOVs



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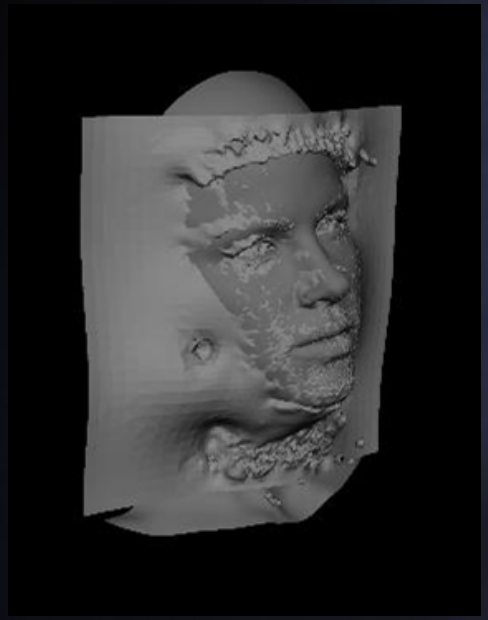

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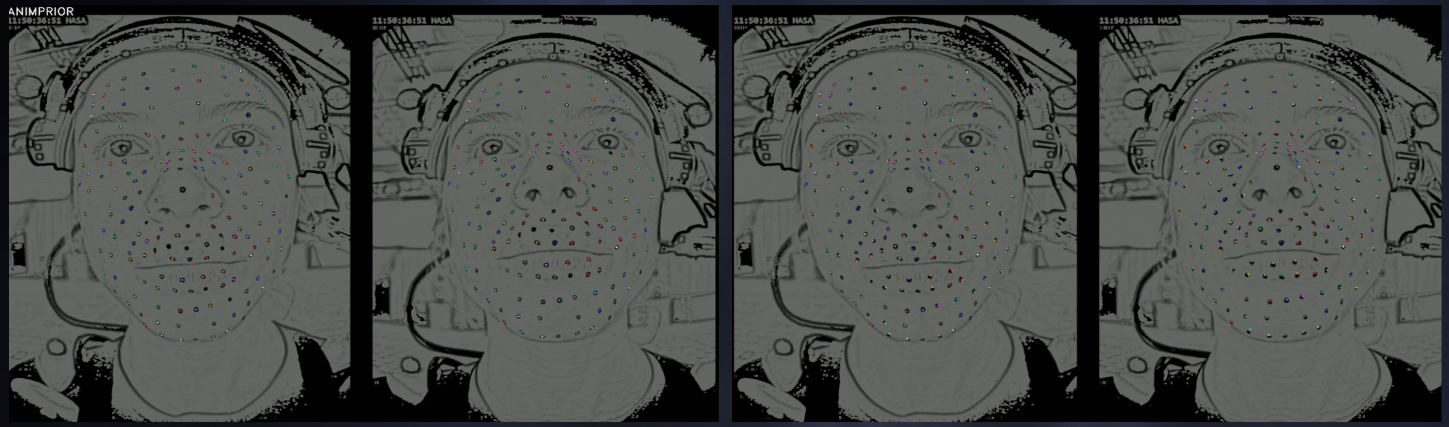
Jose Serra, Lucio Moser, David McLean, and Doug Roble. 2021. Simplified facial capture with head mounted cameras. In Special Interest Group on Computer Graphics and Interactive Techniques Conference Talks (SIGGRAPH '21 Talks), August 09-13, 2021. ACM, New York, NY, USA, 2 pages.

Bullseye Markers



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Lucio Moser, Mark Williams, Darren Hendler, and Doug Roble. 2018. High-quality, cost-effective facial motion capture pipeline with 3D Regression. In Proceedings of SIGGRAPH '18 Talks. ACM, New York, NY, USA, 2 pages.

CycleGAN

- HMC
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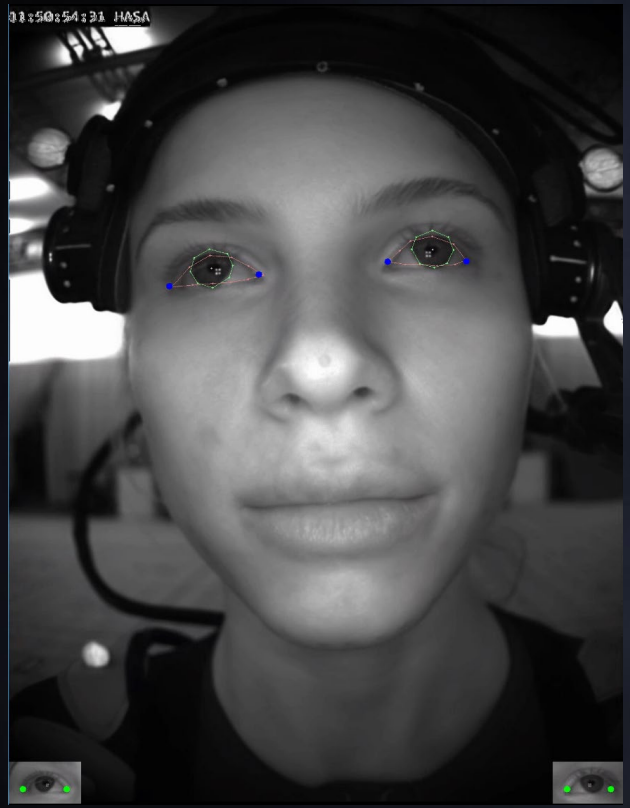
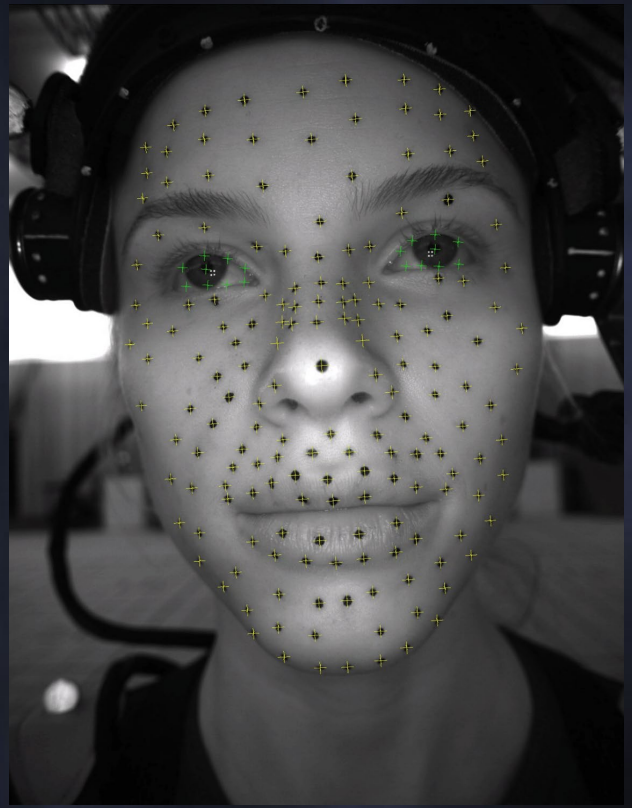
GazeML





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  - Masquerade
  - Direct Drive
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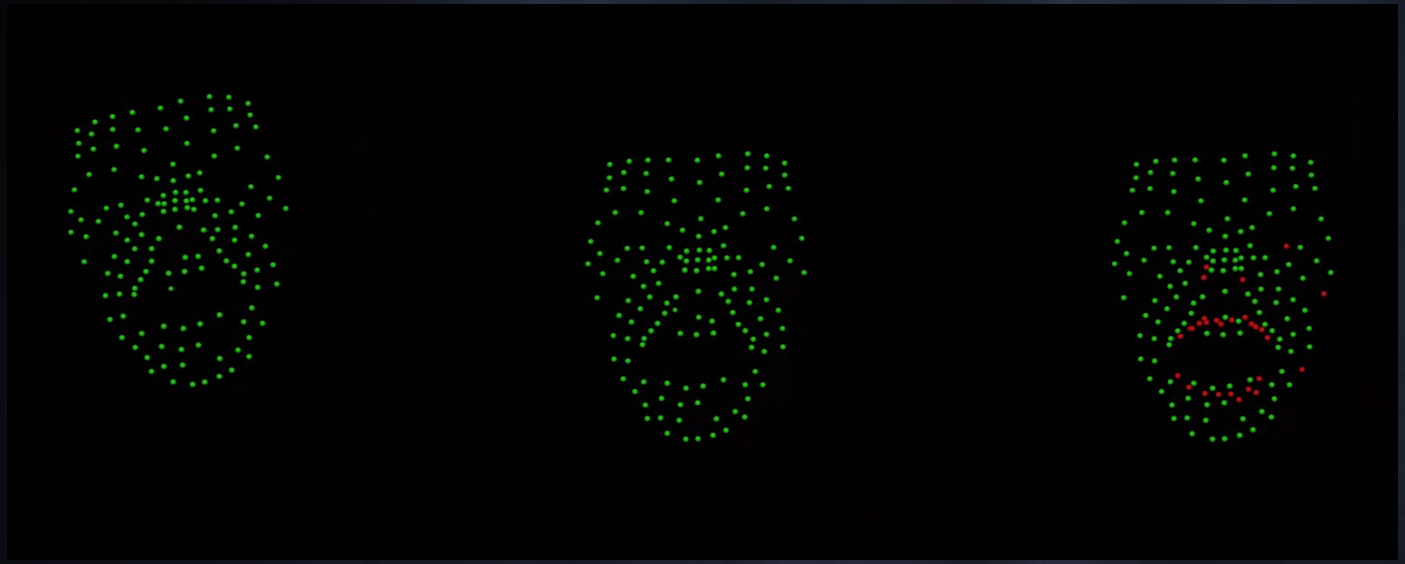
Masquerade Cleanup



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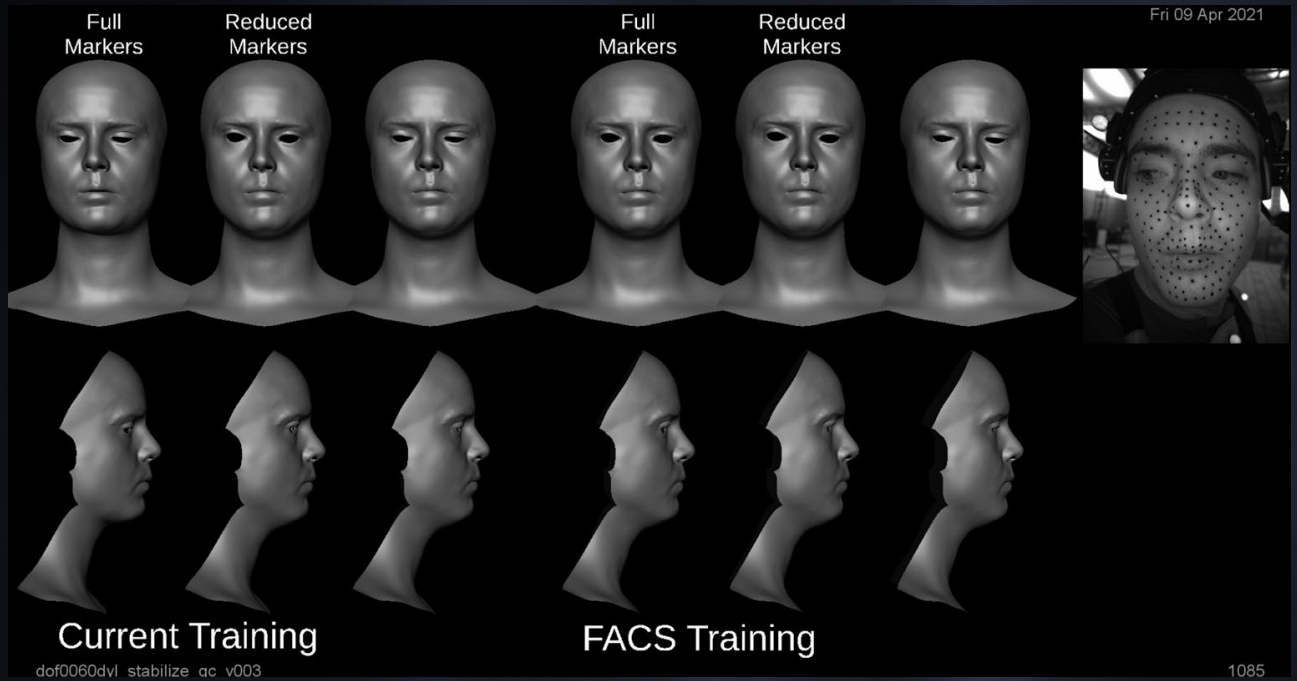
Masquerade Cleanup - Stabilization



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  - Direct Drive
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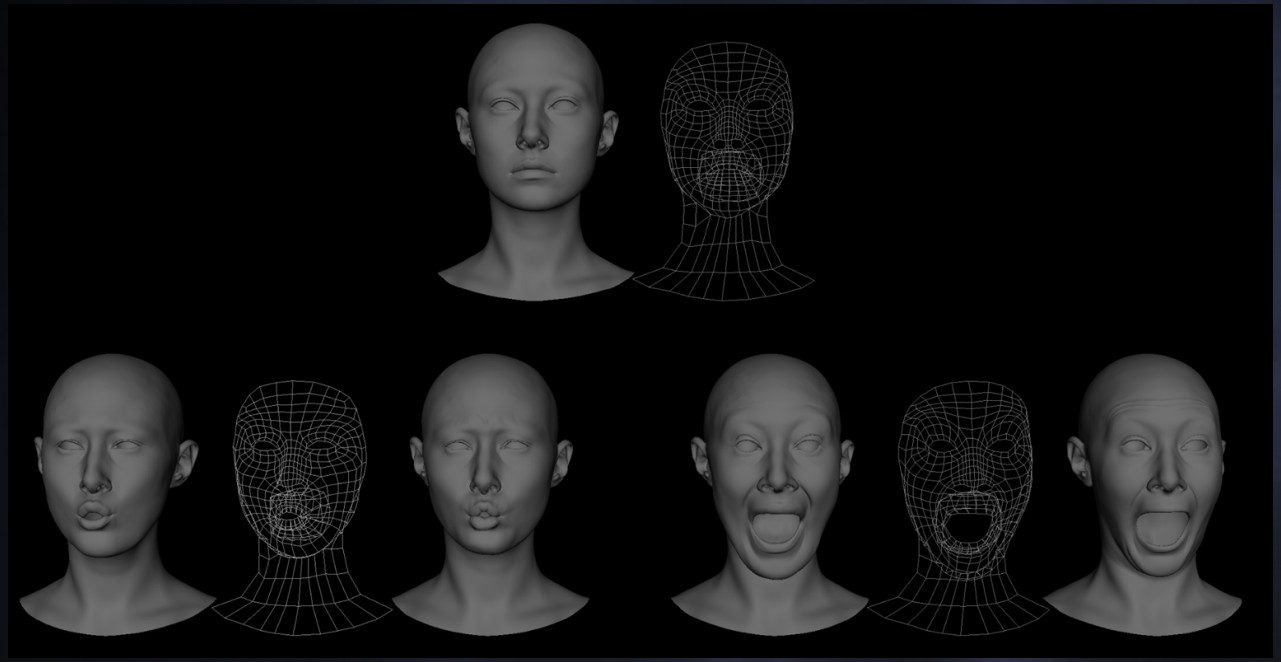
WPSD



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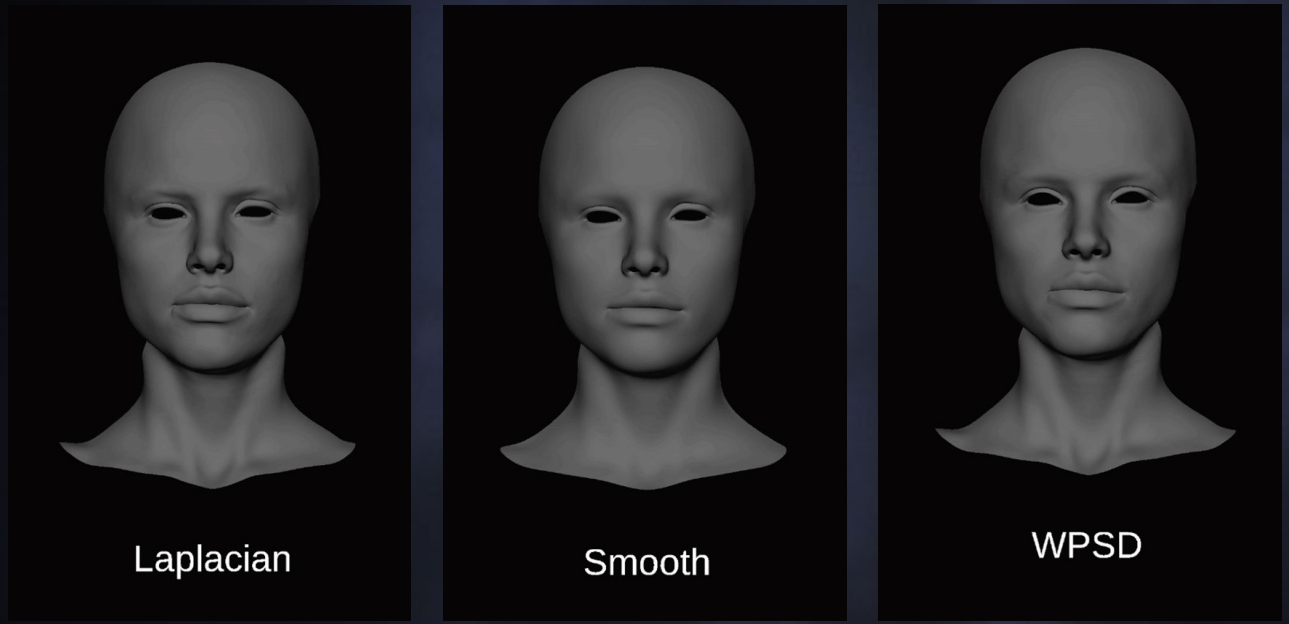
Masquerade Uprez



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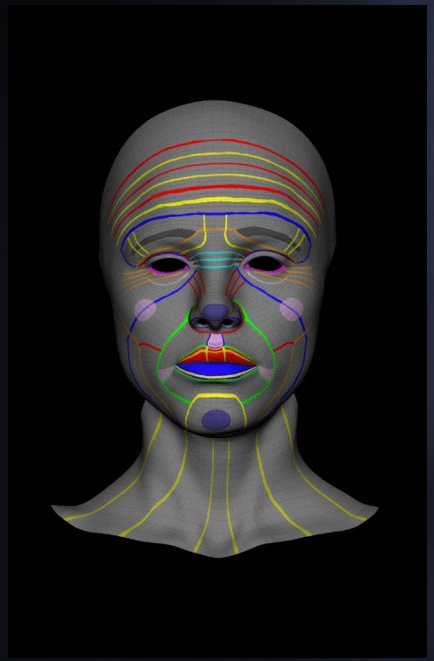
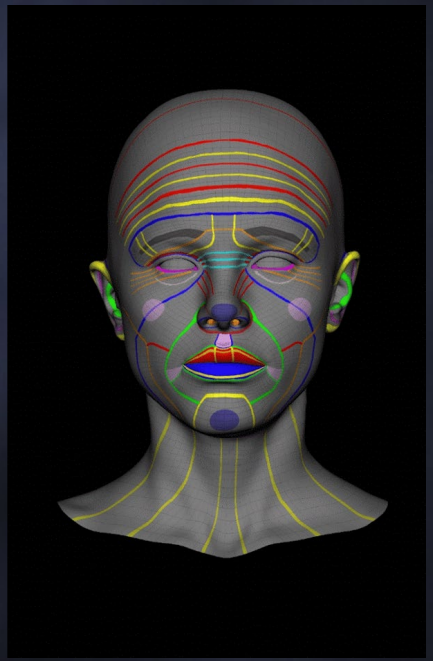
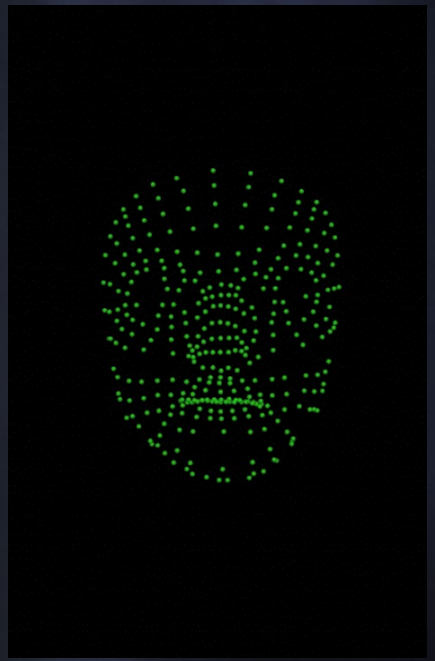
Lucio Moser, Darren Hendler, and Doug Roble. 2017. Masquerade: Fine-scale details for head-mounted camera motion capture data. In Proceedings of SIGGRAPH '17 Talks, Los Angeles, CA, USA, July 30 - August 03, 2017, 2 pages.

Direct Drive







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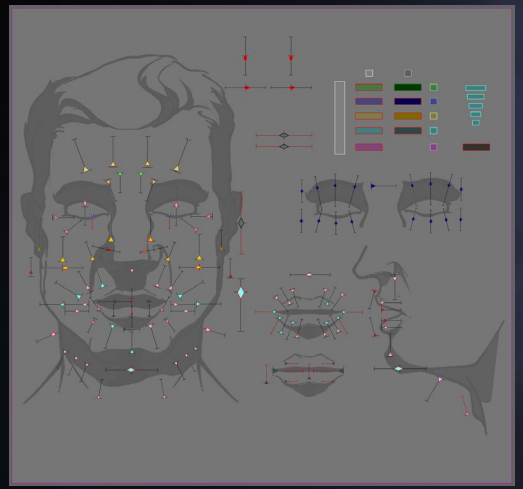
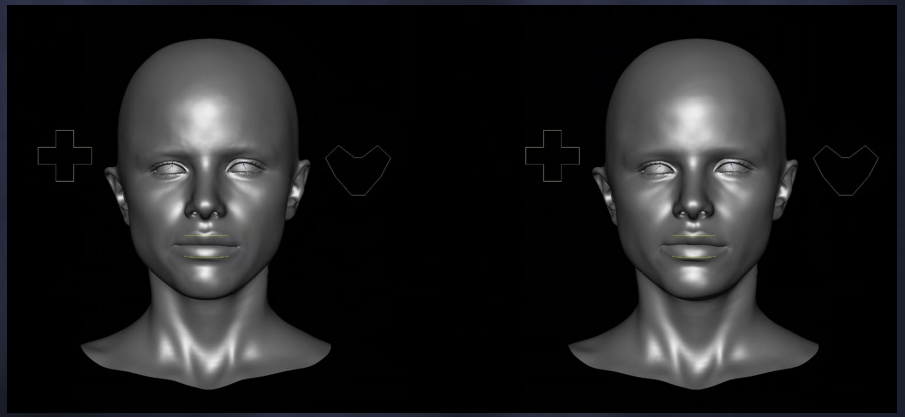
Copycat





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Chatterbox

- HMC
- Depth/Normals
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- Bullseye Markers
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Chatterbox - Unreal

- HMC
- Depth/Normals
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- Bullseye Markers
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- Copycat
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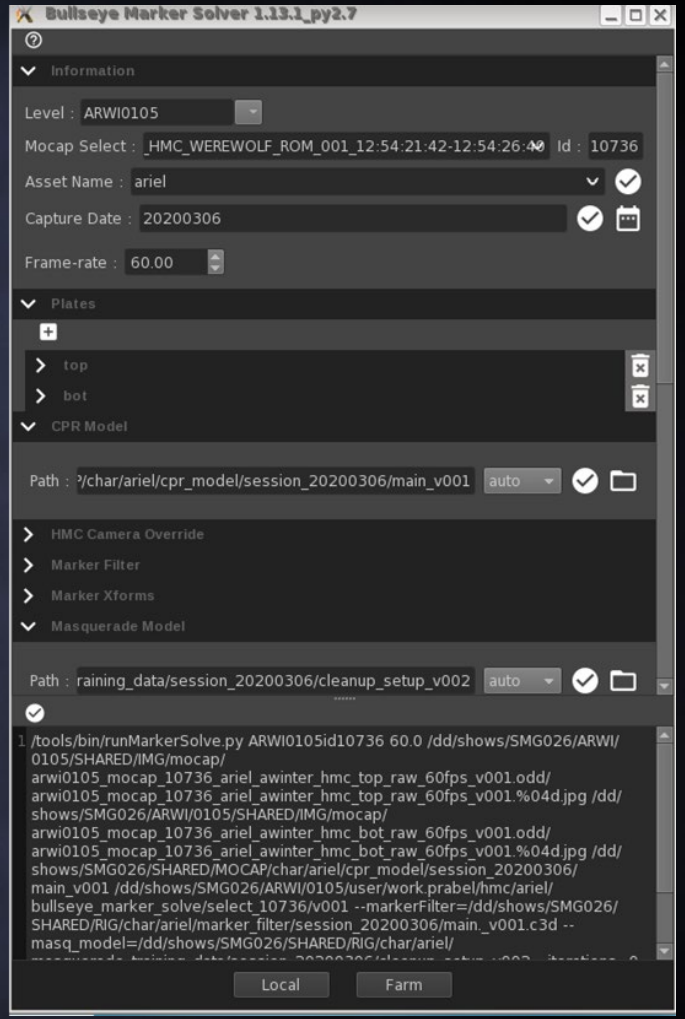
Pipeline

- Scale
- Adaptability
- Troubleshooting
- Rapid integration

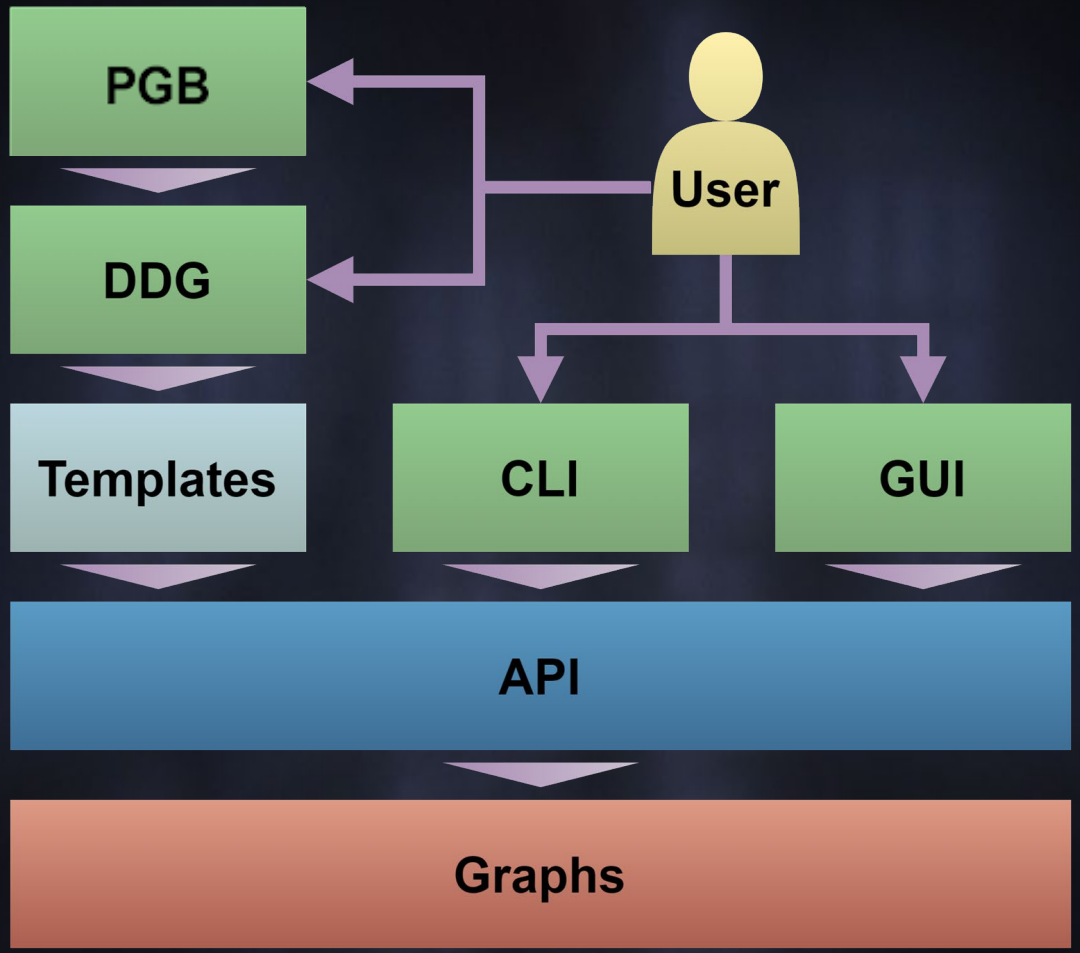
Original Pipeline

- Basic pipeline after Infinity War
  - Limited resources
  - Low demand for automation
  - Hesitance to formalize changing parts of the workflow
- Solid foundation
- Rudimentary front-end
  - Many stand-alone GUI's
  - Step-by-step process
  - Sufficient for most features work



New Pipeline

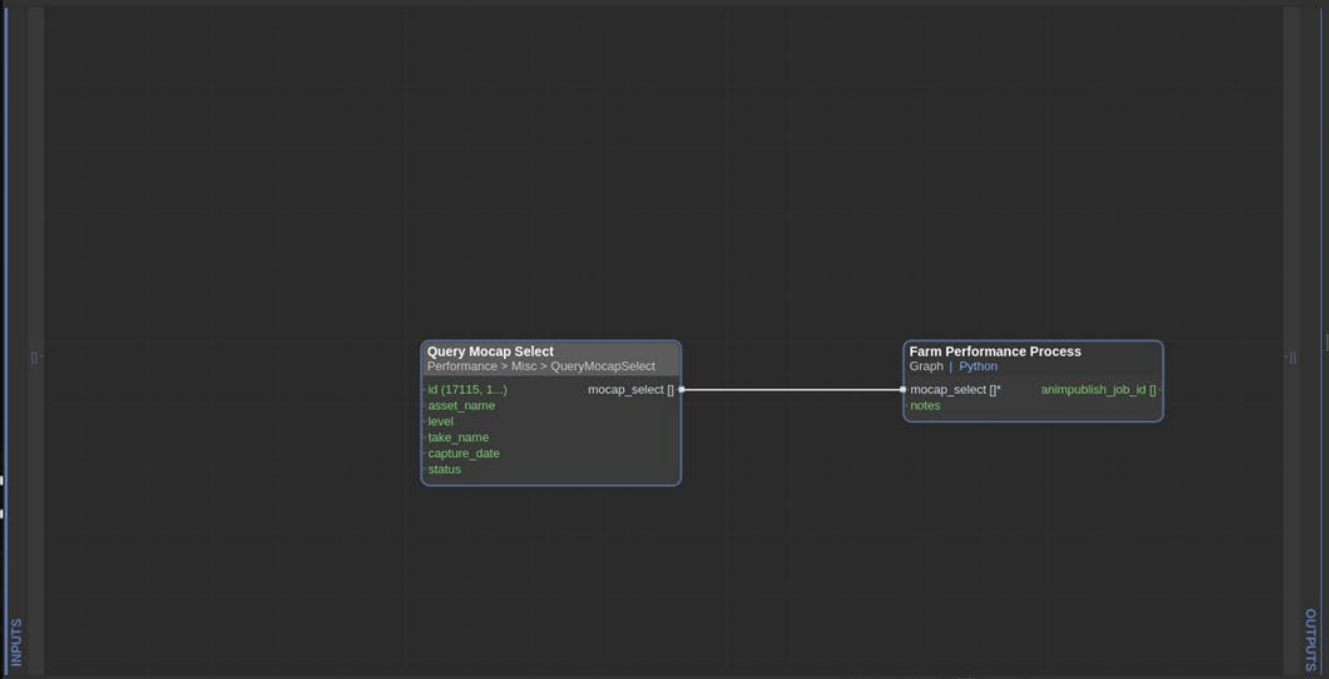
- Scale
  - Thanos - 29 minutes with 30 animators.
  - The Quarry - 1,933 minutes (7,732%) with 9*.
- Mantra
  - Automate everything
  - Work in bulk
- Rapid integration
  - Prototype
  - Testing and workflow conception
  - Pipeline development
- Big red button
- Layers of configuration
  - Encapsulated in a nested graph
  - Bulk interface


PGB
DDG
User
Templates
CLI
GUI
API
Graphs

DDGraph 8.28.0 [SMG026 =rig] untitled*

Edit Navigate Window Help | Assets CFX GraphBuilder Developer Environment Houdini Layouts Maya Performance Rig WAM

graph



Inspector

Query Mocap Select

id: 17115, 17116, 17113, 17114, 17112

asset_name: (Optional) Filter by the asset name associated to the mocap select.

level: (Optional) Filter by the shot associated to the mocap select.

take_name: (Optional) Filter by take name.

capture_date: (Optional) Filter by capture date. The capture date format needs to be YYYYMMDD

status: (Optional) Filter by status.

Farm Performance Process

Parameters Process | Python

notes: description

Debugger > Farm Performance Process

Inputs

mocap_select:

notes:

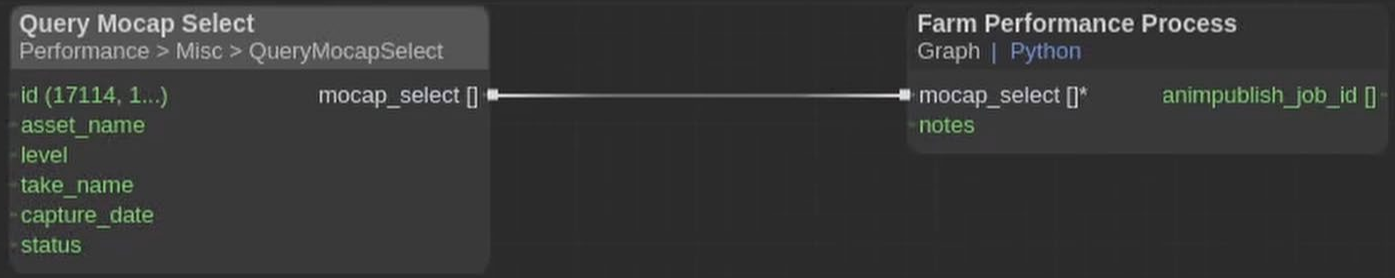
Outputs

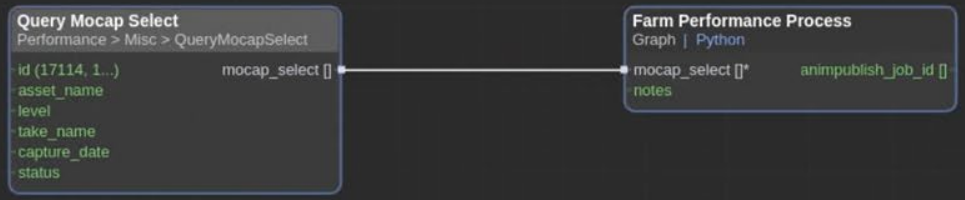
animpublish_job_id:

Execution

status: NOT_EXECUTED, result: NONE

Log Console Debugger > Farm Performance Process


Query Mocap Select
Performance > Misc > QueryMocapSelect
id (17114, 1...)
asset_name
level
take_name
capture_date
status
mocap_select []
Farm Performance Process
Graph | Python
mocap_select []*
notes
animpublish_job_id []



id: 17114, 1
asset_name: (Optional
level: (Optional
take_name: (Optional
capture_date: (Optional
status: (Optional

OUTPUTS

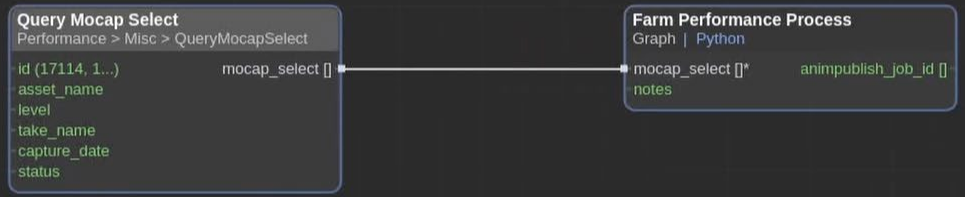
Debugger > Query Mocap Select

Outputs

mocap_select:

Execution

status: NOT_EXECUTED, result: NONE



id: 17114, 1
asset_name: (Optional
level: (Optional
take_name: (Optional
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status: (Optional

OUTPUTS

Debugger > Query Mocap Select

Outputs

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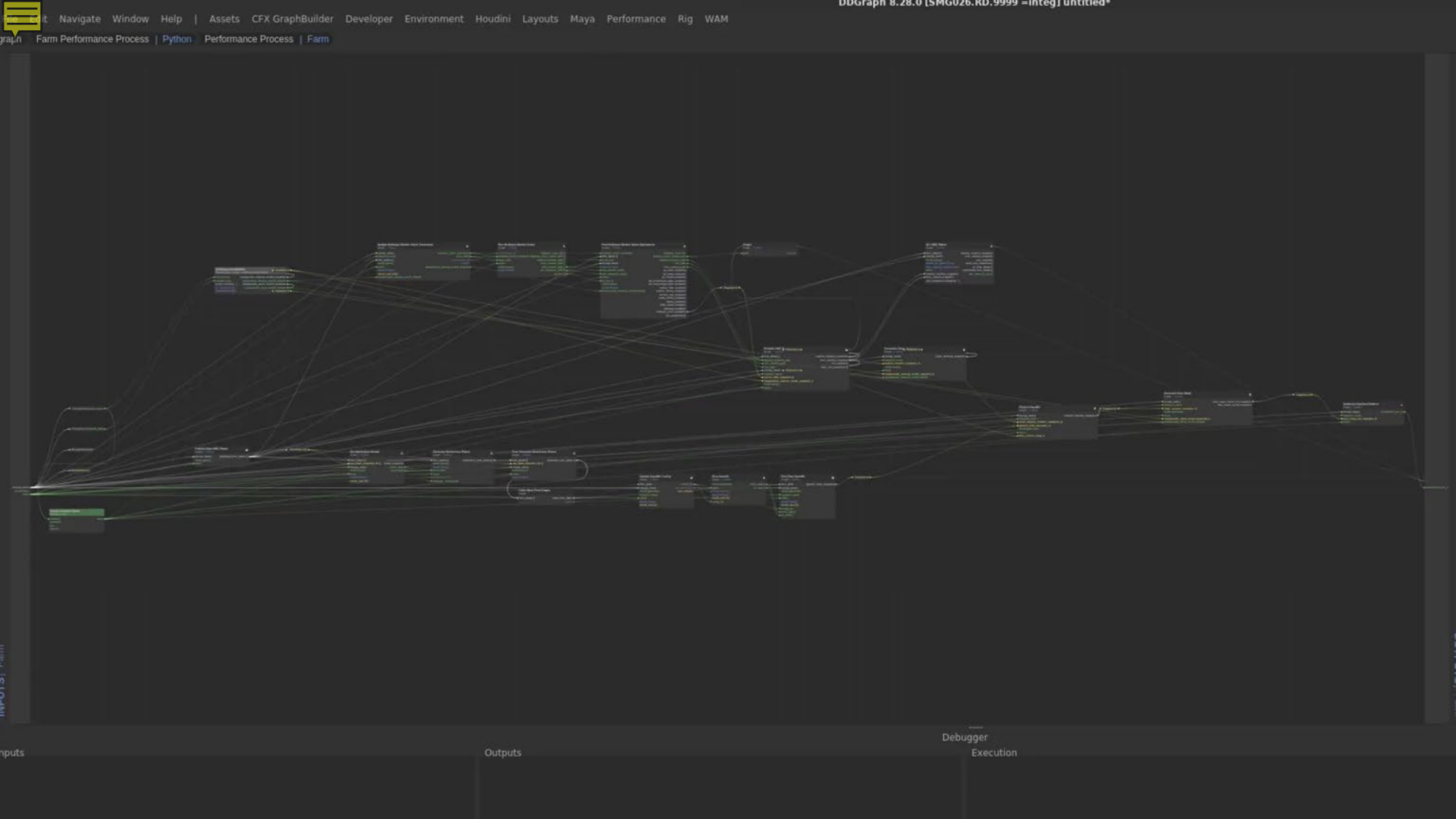
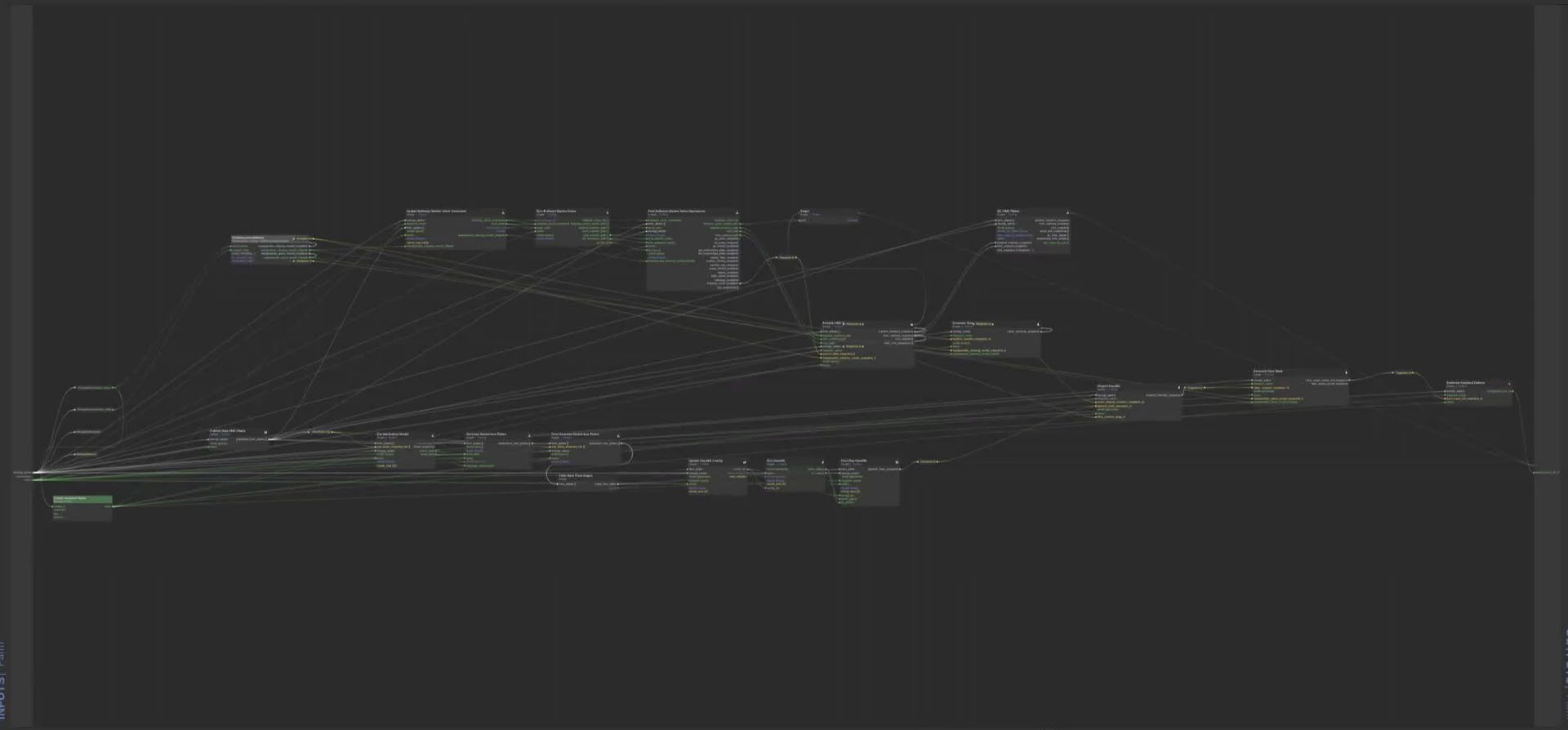

Navigate Window Help | Assets CFX GraphBuilder Developer Environment Houdini Layouts Maya Performance Rig WAM
DDGraph 8.28.0 [SMG026.RD.9999 =integ] untitled*
Farm Performance Process | Python Performance Process | Farm
Debugger
Outputs
Execution

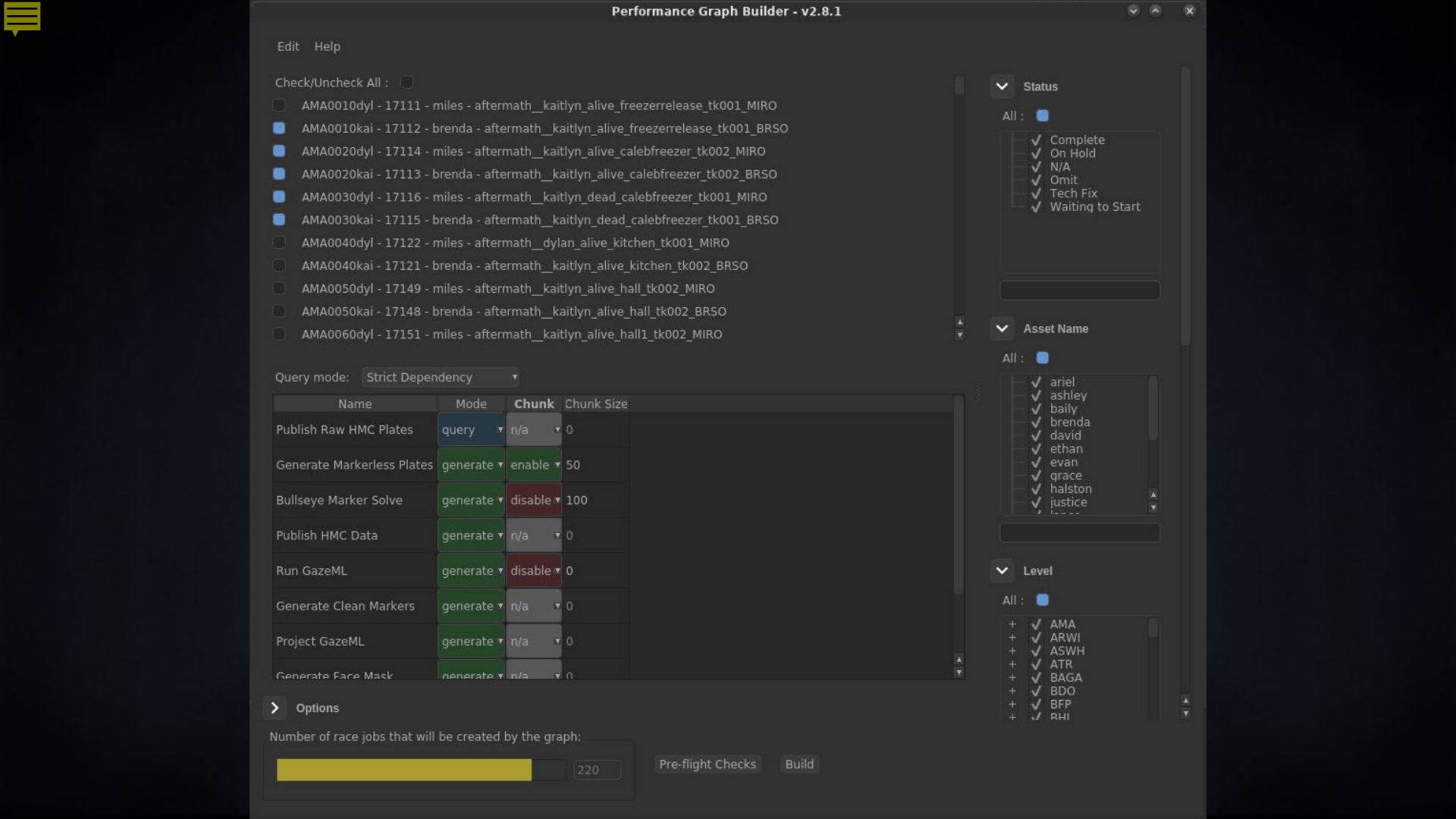
DDGraph 8.28.0 [SMG026.RD.9999 =Integ] untitled*

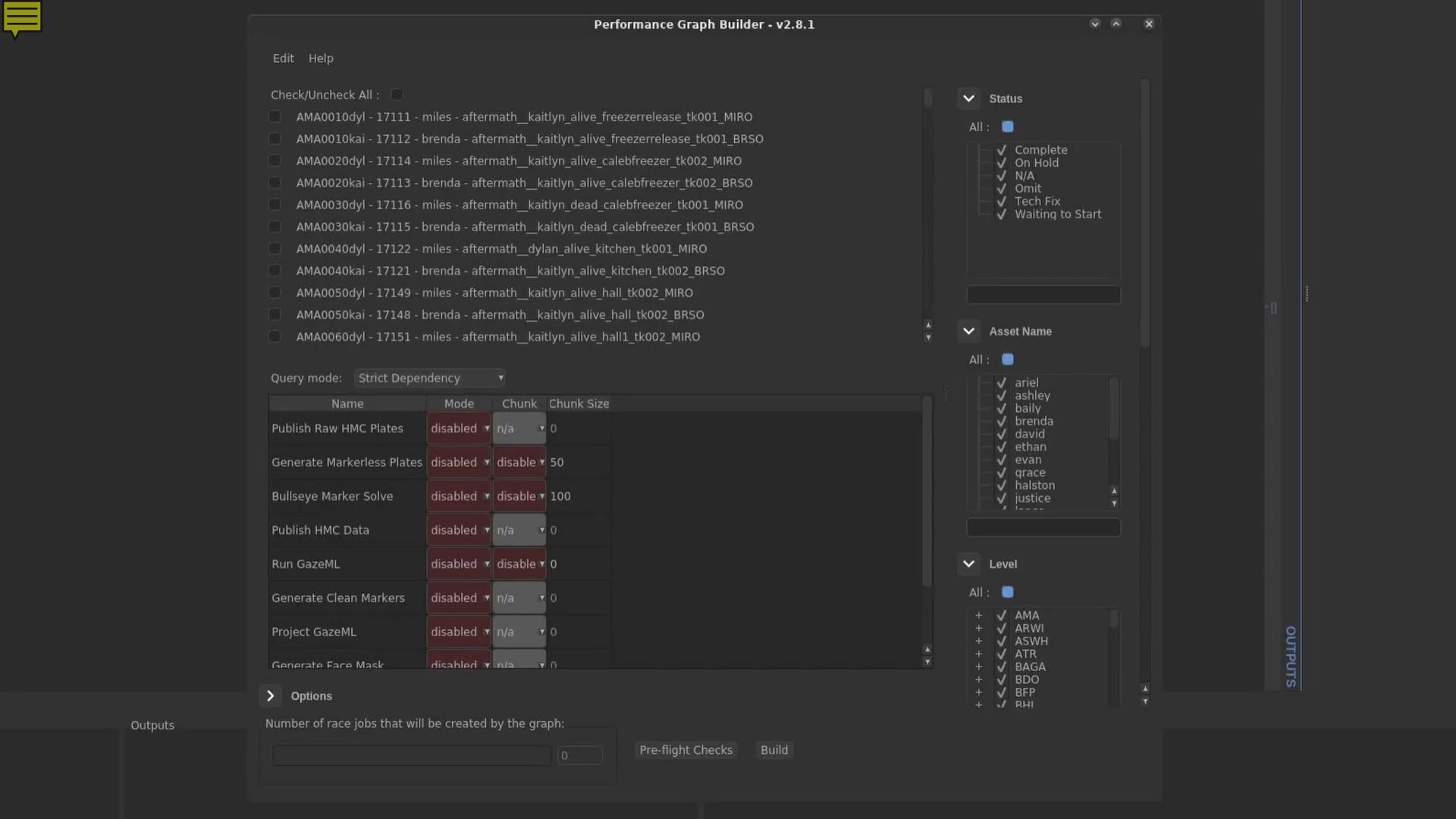


Debugger

nputs Outputs Execution


Merge x2e
Description
Publish Bullseye QCs
Description
HMC Camera Names
Description
Merge tracked_markers
Description
get agisoft_markers
Description
Publish Bullseye Solve Command
Description
Get Chunked Bull
Description
Get Unchunked
Description
Query
Description
Get xe2 Path
Description
Get tracked_markers Path
Description
Get hmc_camera Path
Description


Performance Graph Builder - v2.8.1
Edit
Help
Check/Uncheck All :
AMA0010dyl - 17111 - miles - aftermath__kaitlyn_alive_freezerrelease_tk001_MIRO
AMA0010kai - 17112 - brenda - aftermath__kaitlyn_alive_freezerrelease_tk001_BRSO
AMA0020dyl - 17114 - miles - aftermath__kaitlyn_alive_calebfreezer_tk002_MIRO
AMA0020kai - 17113 - brenda - aftermath__kaitlyn_alive_calebfreezer_tk002_BRSO
AMA0030dyl - 17116 - miles - aftermath__kaitlyn_dead_calebfreezer_tk001_MIRO
AMA0030kai - 17115 - brenda - aftermath__kaitlyn_dead_calebfreezer_tk001_BRSO
AMA0040dyl - 17122 - miles - aftermath__dylan_alive_kitchen_tk001_MIRO
AMA0040kai - 17121 - brenda - aftermath__kaitlyn_alive_kitchen_tk002_BRSO
AMA0050dyl - 17149 - miles - aftermath__kaitlyn_alive_hall_tk002_MIRO
AMA0050kai - 17148 - brenda - aftermath__kaitlyn_alive_hall_tk002_BRSO
AMA0060dyl - 17151 - miles - aftermath__kaitlyn_alive_hall1_tk002_MIRO
Status
All :
Complete
On Hold
N/A
Omit
Tech Fix
Waiting to Start
Asset Name
All :
ariel
ashley
baily
brenda
david
ethan
evan
grace
halston
justice
Level
All :
AMA
ARWI
ASWH
ATR
BAGA
BDO
BFP
Query mode:
Strict Dependency
Name
Mode
Chunk
Chunk Size
Publish Raw HMC Plates
query
n/a
0
Generate Markerless Plates
generate
enable
50
Bullseye Marker Solve
generate
disable
100
Publish HMC Data
generate
n/a
0
Run GazeML
generate
disable
0
Generate Clean Markers
generate
n/a
0
Project GazeML
generate
n/a
0
Generate Face Mask
generate
n/a
0
Options
Number of race jobs that will be created by the graph:
220
Pre-flight Checks
Build


Performance Graph Builder - v2.8.1
Edit
Help
Check/Uncheck All :
AMA0010dyl - 17111 - miles - aftermath__kaitlyn_alive_freezerrelease_tk001_MIRO
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Mode
Chunk
Chunk Size
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n/a
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Generate Markerless Plates
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Bullseye Marker Solve
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N/A
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Waiting to Start
Asset Name
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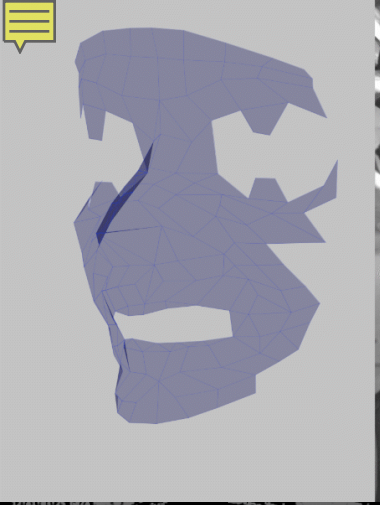
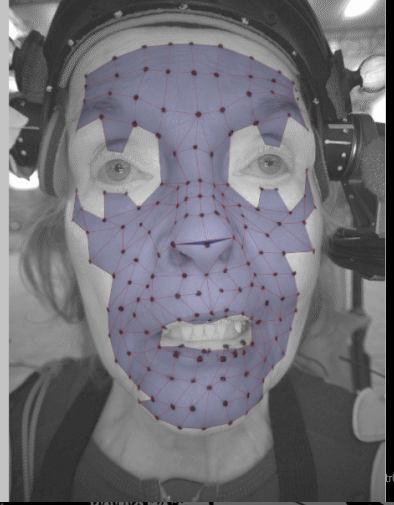
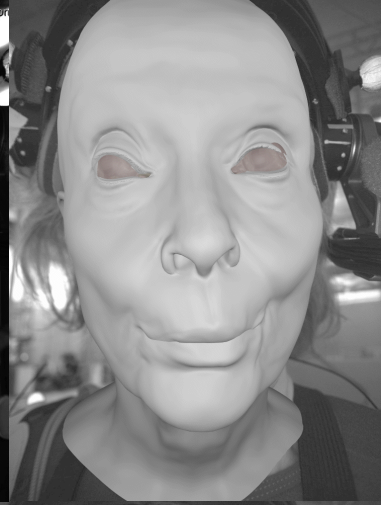
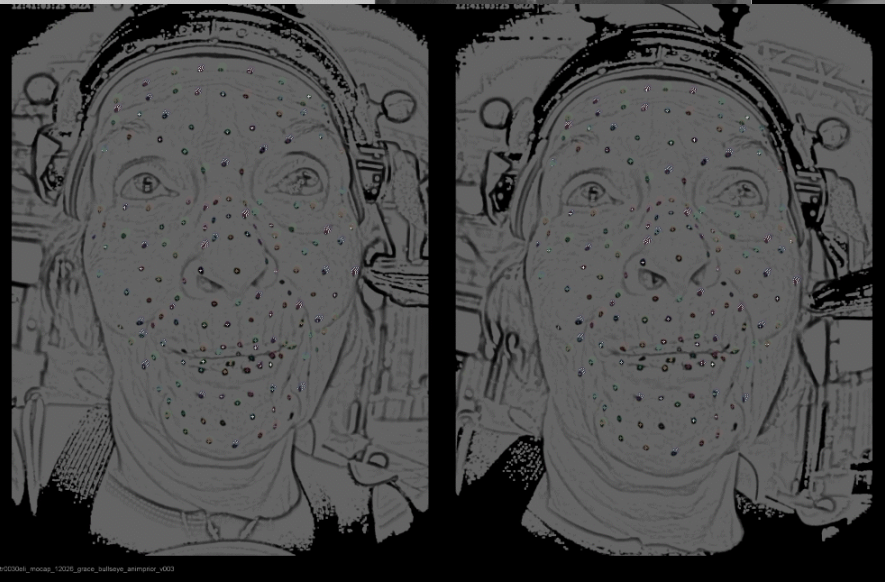
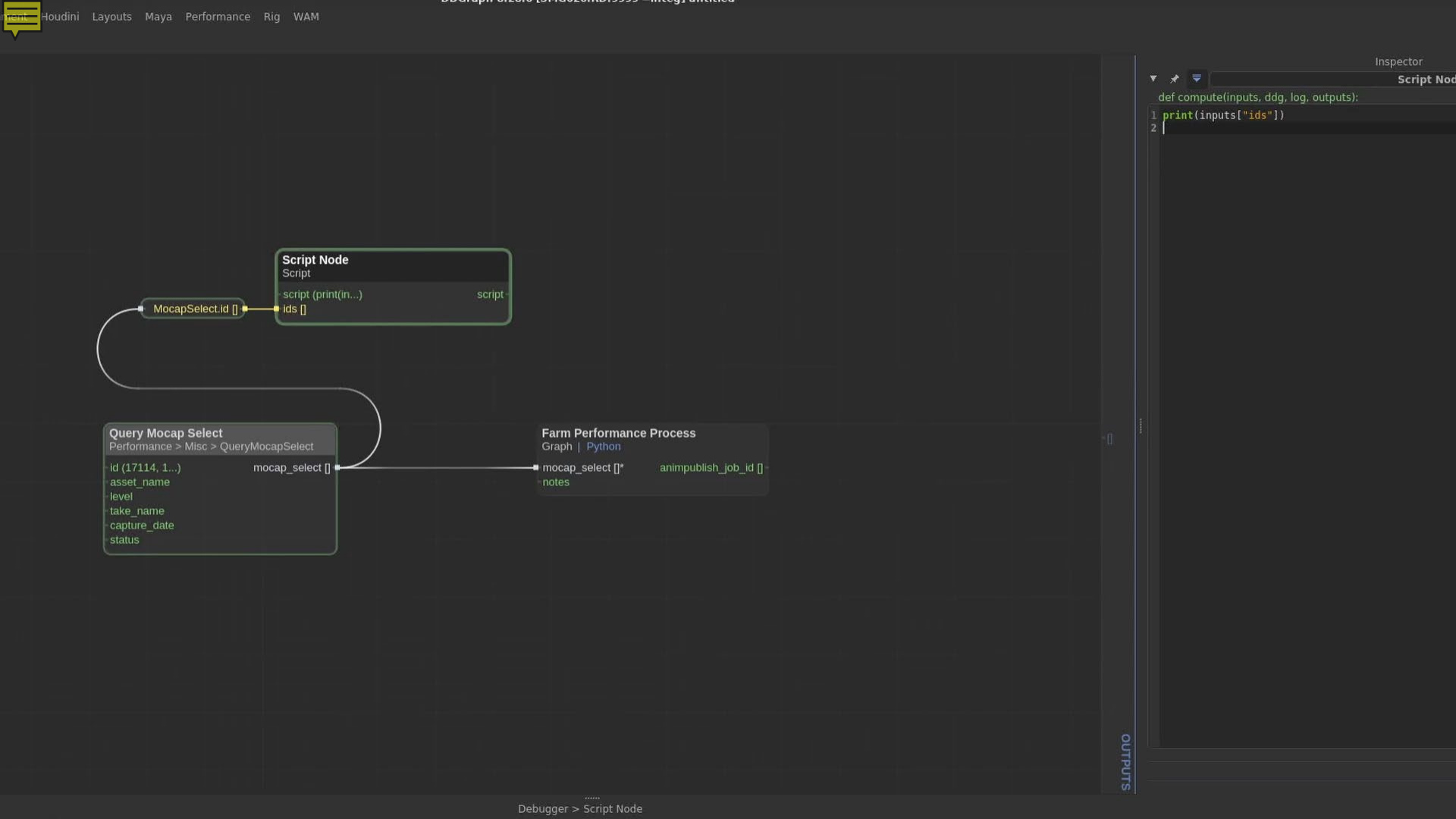
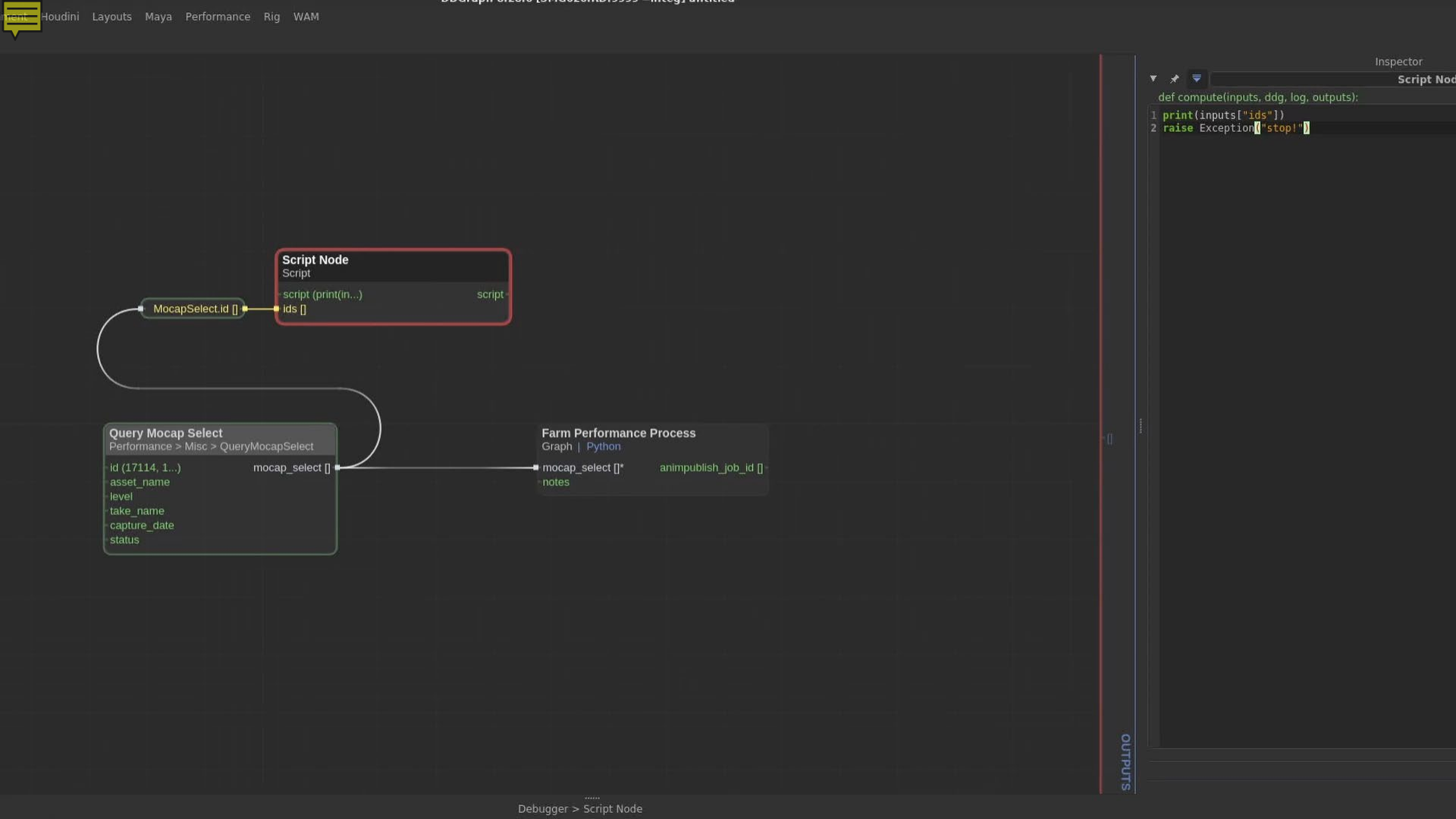
Level
All :
AMA
ARWI
ASWH
ATR
BAGA
BDO
BFP
Options
Number of race jobs that will be created by the graph:
0
Pre-flight Checks
Build
Outputs
OUTPUTS

12:46:28:07

12:46:28:07




Houdini
Layouts
Maya
Performance
Rig
WAM
Inspector
Script Node
Script
script (print(in...)
script
MocapSelect.id []
ids []
def compute(inputs, ddg, log, outputs):
print(inputs["ids"])
Query Mocap Select
Performance > Misc > QueryMocapSelect
id (17114, 1...)
mocap_select []
asset_name
level
take_name
capture_date
status
Farm Performance Process
Graph | Python
mocap_select []*
animpublish_job_id []
notes
OUTPUTS
Debugger > Script Node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status
Farm Performance Process
Graph | Python
mocap_select []*
animpublish_job_id []
notes
def compute(inputs, ddg, log, outputs):
1 print(inputs["ids"])
2 raise Exception("stop!")
OUTPUTS
Debugger > Script Node

OUTPUTS

Debugger: Script Node

Execution

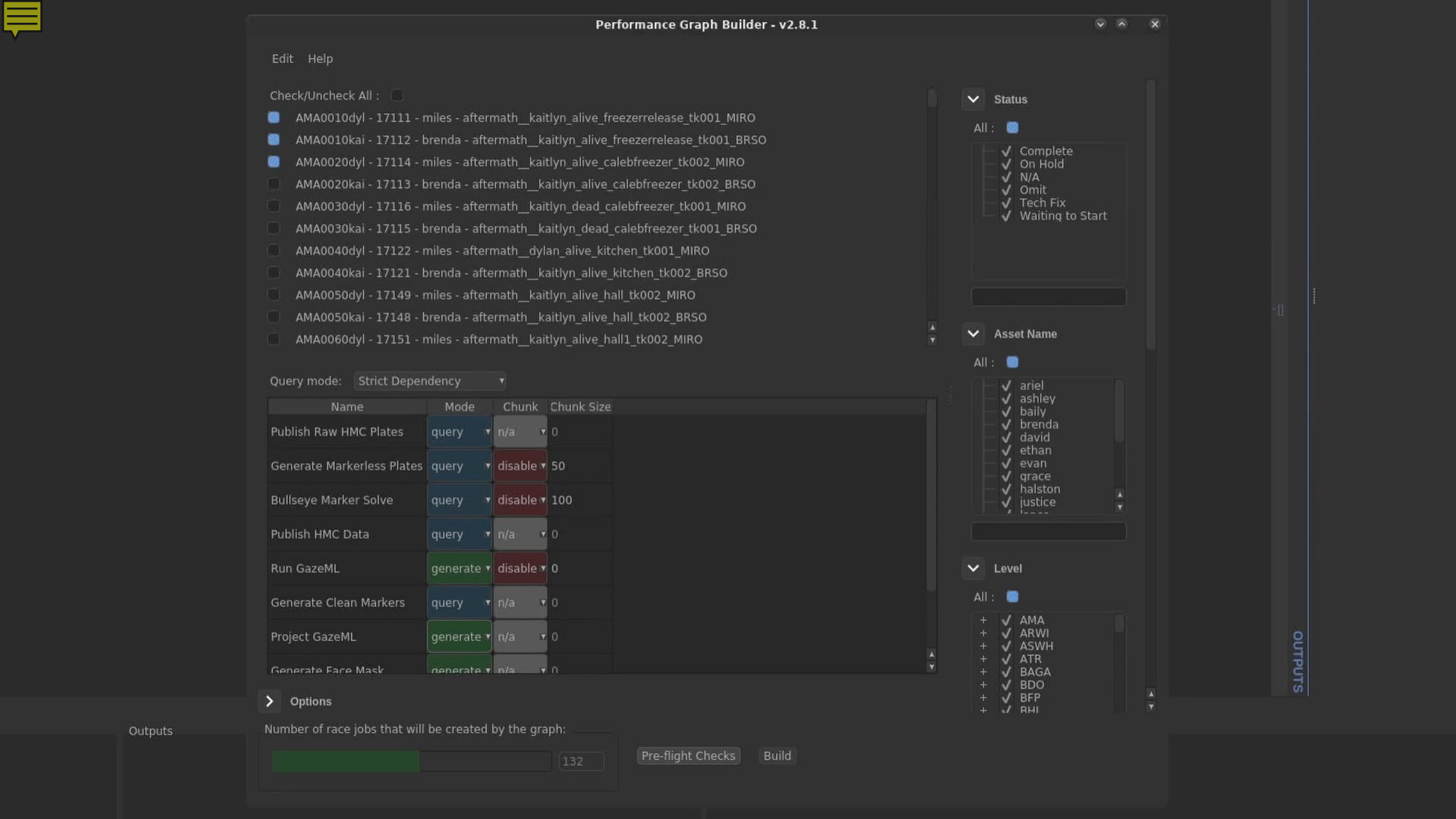
status: ENTERED, result: FAIL

Exception: stop! while running Script node '/graph/Script Node' at **line** 2:
[1] print(inputs["ids"])
> [2] raise **Exception**("stop!")

time: 0.02
cpu time user: 0.01
cpu time sys: 0.00
cpus: 0.8
ram: 2338 MB (0 delta)
faults: 1027 minor, 0 major
swaps: 0
io blocks: 0 in / 8 out

Debugging

Avoiding Failures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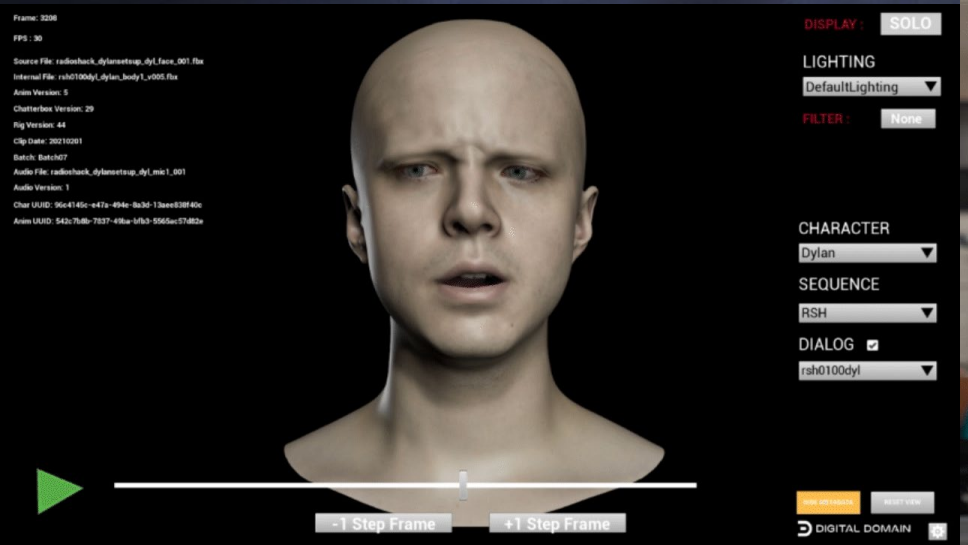
On Hold
N/A
Omit
Tech Fix
Waiting to Start
Asset Name
All :
ariel
ashley
baily
brenda
david
ethan
evan
grace
halston
justice
Level
All :
AMA
ARWI
ASWH
ATR
BAGA
BDO
BFP
Options
Number of race jobs that will be created by the graph:
132
Pre-flight Checks
Build
Outputs
OUTPUTS

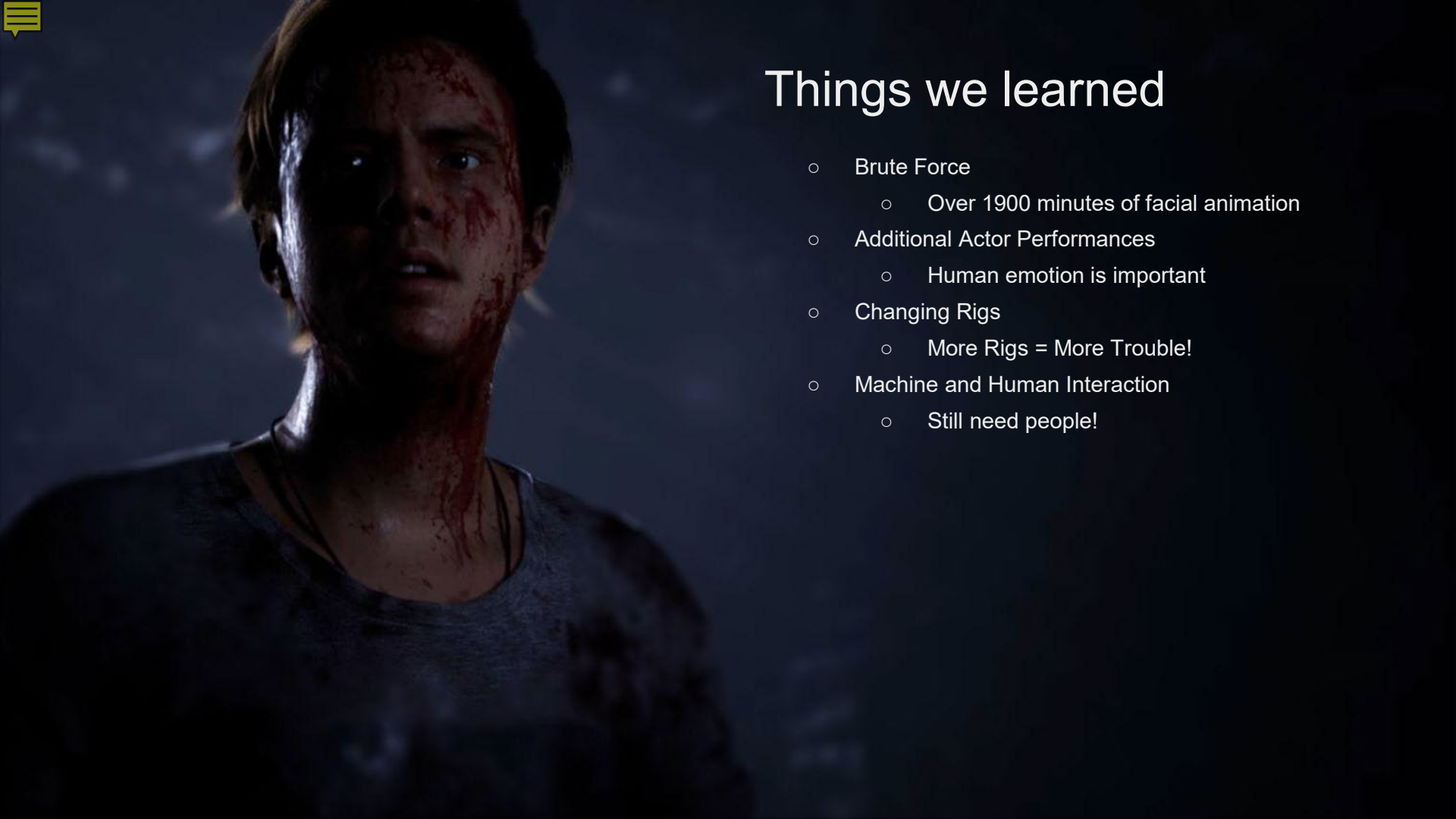
Adaptation

- Asset-centric workflow
  - 3d deliverables
  - Production tracking
- Versionless files
  - Sidecar manifest files
  - Embedded UUID’s
- Frame count
  - Parallelize operations
    - Bullseye marker solve
    - CycleGAN marker removal
    - GazeML projection
  - Frame padding
- Windows-centric
  - Cross-platform testing
  - Deployment

What went well

- Solving 30+ hours of Performance Capture.
- Acquisition of model data ahead of mocap shoots to prepare motion capture.
- Chatterbox QC Anim Tools in UE4.



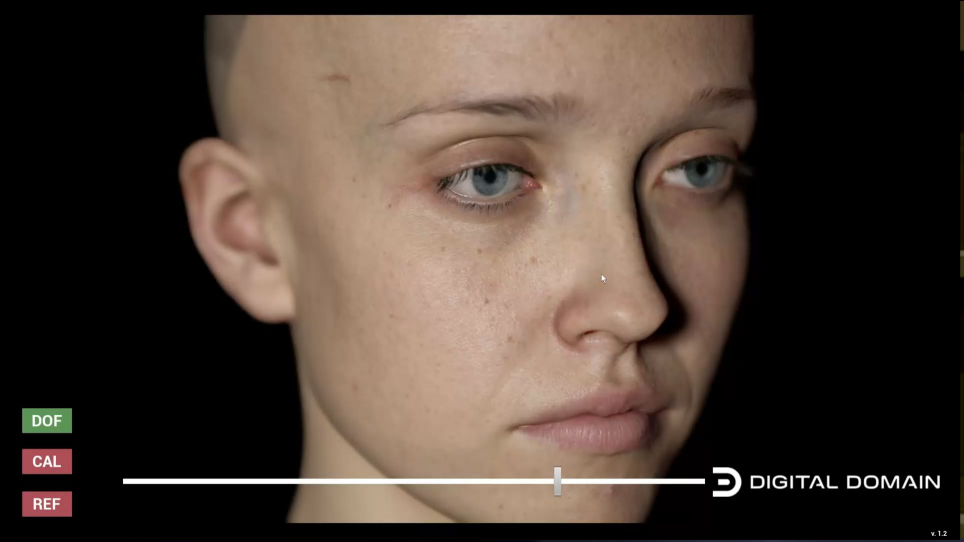


Things we learned

- Brute Force
  - Over 1900 minutes of facial animation
- Additional Actor Performances
  - Human emotion is important
- Changing Rigs
  - More Rigs = More Trouble!
- Machine and Human Interaction
  - Still need people!

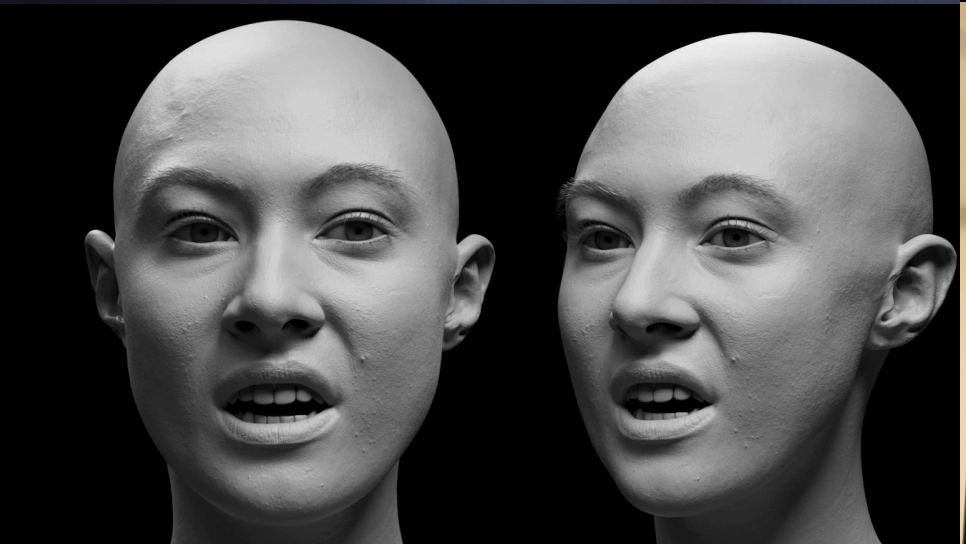
Things to improve

- More Actor Performances
- Facial Fidelity
  - Optimization & Overhead
  - Characters on screen
  - Facial Shapes
  - Platform Delivery
- Review in Game Context



Future Work

- Markerless Tracking
- Daily photogrammetric rig
- Chatterbox 2.0




DIGITAL DOMAIN
WE ARE HIRING!
RECRUITING@D2.COM – mention GDC2023 / The Quarry
Aruna – inversin@d2.com
Peter – prabel@d2.com
Rickey – rickeyc@d2.com