

Sorting through the Rubble: A Review of Destruction Techniques

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Overview

- Preparation
- In game destruction
 - Swap
 - Fracture
 - VFX Parameters
- Third party destruction
 - Sequencer







My Other Talk

- JC3 Free Reign talk (2016)
 - Destruction
 - RBD built destruction
 - Havok destruction
 - Forces
 - Chain reactions





Preparation



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Preparation: Communication

- Project questions
 - Big dreams for destruction!
 - Help manage the big dream.
 - So how do you do that?





Preparation: Communication

- Design and Art questions
 - Scope: How many destruction objects are we looking at?
 - Design: Is there an overall design in place for destruction?
 - Simple or detailed?
 - How does destruction add to the game play loop?
 - Are there destruction set pieces?
 - AD: What is the visual language











Preparation: Communication

• Engineering questions!!

- What does the engine do well?
- Will engineers be creating a system?
- How is damage being calculated?
 - Make sure damage makes sense!!!
- How much budget do we have for destruction and physics?
- Debris??





Preparation: Debris

- More engineering questions
- Debris Clean-up?
 - Live physics pieces can become expensive
 - Disappear?
 - Rest?
 - VFX to remove?
 - Game Logic specific removal
 - Or not?







Preparation: Research

- R&D
 - No destruction in place
 - Research Tools
 - Don't get stuck with a favorite lacksquare
- New destruction tech
 - Be an active participant
 - Templates for solved problems







Preparation: Kick the tires

- If destruction system exists
 - Get some time to break the system
 - Make tests
 - Be responsible by being irresponsible.
 - Create scenarios





Preparation: There are 4 tanks!





TETHER THE BARREL TO THE GATE

CHECKPOINT -0/2-

Preparation: Surface Types

- VFX questions
- Identify your surfaces
 - By type •
 - Concrete
 - Wood
 - Glass
 - Metal
 - Special Cases







CONCRET

ROCIES



Preparation: Destro Method

- Identify how you might break each type
 - Examples
 - Props: (Swap)
 - Concrete (Voronoi fracture)
 - Wood (Voronoi fracture)
 - Glass (Radial Fracture)
 - Metal (Hide/Show/New Tech/electronics?)
 - Armor (Skel mesh constraint/Voronoi hybrid)
 - Vehicles (custom system)
 - Cinematic (off line third party for in game play or spectacle)







Preparation: VFX

- Identify your destruction VFX needs.
 - Please remember sound
 - General needs (per surface type)
 - Critical Break VFX
 - Fracture VFX
 - Slides VFX
 - Impacts
 - Trails
 - Special case VFX







Preparation: Specific objects

• Consider the potted plant...







Preparation: Version 1

- More than one way to break a potted plant
- Middle distance and 3rd person.
 - Here's Simple plan.
 - Hide the mesh
 - Play an effect.
 - You can then use this plan to get a list together of needs and build your stuff.

Potter Plant Simple



POTREP PLANT · DIRT · PLANT/STEMS · ROOTS ?



Hipe SHow DAMASE 2 VFX SWA Leff Mestles · MAKE DIAt · BURST HIT · MAKE Generic POT PIPLER

Preparation: Version 2

- Potted Plant part 2
 - FPS
 - Here's a less simple plan.
 - All elements have different damage
 - Pottery has more states
 - Leaves are using constraints
 - Still play an effect.
 - But its divided into the stages.
 - You can then use this plan to get a list together of needs and build your stuff.





DIRT/ FITS IN POT pAVL: BASE MESH 6 messes CONSTRAINED TO DAT MOSH NOTOS o DMS to Leaves DINT CLUMPS BREAK CONSTRAINT TROCICS pleases mass and U LISHT fx , WOULD BE NICE IF ODINT NEEDS TO TA16 They more connectly more Dug +HAN QUESTIONS / TRANSITION FX How to Clean up?

Preparation: VFX

- VFX Scale
 - Size ranges per type?
 - In Game Data?
 - Can you reuse/scale those FX or will you be scaling dupes?
 - Example: Concrete?
 - Material Variants
 - Scale





Preparation: VFX

- **Consider** interactions
 - What interaction methods will happen lacksquarewith destruction?
 - Bullets (bullets/projectiles)
 - Physical (ramming/punch/etc)
 - Explosive ('instant' radial force)
 - DOT (burn)
 - Specialty methods
 - Try to not work in isolation







Preparation: Remember

- Sometimes things get lost:
 - Preparation Identifies holes (No pun) lacksquare
 - Plan = systems lacksquare
 - You'll need to budget time all this stuff. ullet







Preparation: Wrap up

- Identify the Dream
- Design Questions
- Art Director Questions
- Engineering Questions
- Do your research
- Kick the tires
- VFX Considerations
- Get specific
- Systems are good









Create Overview

- **Base Mesh Rules**
- States
- Constraints
- **Destruction Methods**
 - "Destruction"
 - Fracturing
- Animated destruction
- Data driven destruction VFX (sprinkled)







Create: Base Mesh

- Base Mesh Rules
 - Watertight
 - Cheap-ish lacksquare
 - Create all of the different states (if lacksquareneeded)
 - Create Pieces and parts for assembly (if needed)
 - Debris meshes/pieces
 - Inside surfaces (substance)









- The current condition of the object/actor
 - Initial state
 - Props might have only 2 states
 - More complex objects might have more
 - larger buildings
 - game loop dependent







Potter Plant Simple Hipe SHow DAMAGE 2 VFX SWA · SNAS LEAF MOSHES · MAKE DIRT · BURST HIT · MAKE Generic POT PIPLES

"Destruction"

- Stage Magic: Swap ullet
- in game world destruction
- The destruction is the change to the effect
 - Can have multiple states (DOT)
 - Potentially damage
 - for game play loop







"Destruction"

- Generally fragile props
 - Takes damage and mesh • hides/cleans up
 - Effect covers the 'Hide'
 - The 'Show' is the effect











- Blueprint
 - Clean barrel
 - **Barrel Pieces**
 - Light
 - Effect
 - Sound
 - **Radial Force**
 - Camera Shake







- Event Damage
 - Set Health •
 - < = 0
 - Cond true







- Visibility
 - Hide Clean
 - Show Pieces







- Damage/FX/Push/Camshake
 - Play FX
 - Damage
 - Once
 - Fire Impulse
 - Cam shake





- Light/Sound/Clean up
 - Play Sound
 - Light

GD

• Remove





"Destruction" VFX Params







"Destruction" VFX Params

• Forward Vector Parameter


• Effect without parameters







- In weapon BP
 - Line trace



- Vase BP
 - Cast to...





What does any ulletof that mean?







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Testing the parameter \bullet







No params ${\color{black}\bullet}$



Params











Fracture: PhysX

- PhysX
 - Unreal plug in
 - Single depth in game
 - Muti-depth in PhysX Lab
 - Determine damage
 - Fracture FX and Sound in game
 - https://docs.unrealengine.com/enus/Engine/Physics/Apex
 - https://developer.nvidia.com/apex-destructionphysxlab-tutorials
 - https://docs.unrealengine.com/enus/Resources/ContentExamples/Destructables





Fracture: Blast

• Blast

- GitHub Repository 4.20
- Multi-depth in game
- Damage types
 - Impact and Stress
- VFX are in Blueprint
- https://developer.nvidia.com/nvidiagameworks-and-ue4
- https://docs.nvidia.com/gameworks/content/ gameworkslibrary/blast/1.1/authoring_docs/ Blast_Intro.html





Fracture: Base Mesh

• Flower pot: Not Watertight = gaps

• Vase: probably ok. Inside simplified

• Plate: Yes this is good for pre fracture





Fracture: Pipeline

- 2 ways for depth (physx/blast)
 - Create depths by hand
 - More control
 - Shoot for final depth
 - Debris Clean up
 - And use the Optimize button
 - Creates Quick destruction
 - good for testing!!





Fracture: Depths

- Hierarchy
 - Render
 - Physics •







Fracture: Constraints





Houdini Blast





Fracture: Concrete settings

- Concrete Fracture
 - Default Voronoi
 - Using Health damage
 - Heath 100
 - Hardness

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• 5 depths/states





- What do we want the parameter to do?
 - Couple things
 - Breaks
 - Parameters





• Fracture Params: Velocity and VelDebris







- Params for movement of dust and debris
- The dust is at a + while the debris is at vel





Fracture: VFX setup (Cascade)

- **Initial Velocity Parameters**
 - Bond breaks params push effects in directions

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Reflect Break

bris Burst / Initial Velocity Params









Fracture: Wood Settings

- Wood Settings
 - Voronoi Fracture controlled
 - Narrow settings in X and Y
 - for splintering
 - Still has impact damage
 - Solves in stress
 - 3 depths/states

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Fracture: Glass Settings

- Glass: Voronoi Radial
 - Noise up the radial less perfect
 - angle offset
 - variability
 - Health and stress solve
 - Very low hardness
 - 4 depths/states

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Sequence(r)(s)

• Overview

- Questions and Planning
- Placing/Spawning ullet
 - Triggering
- Attachments
 - Sockets
- Parameters
 - Gotchas
 - Tracks and Curves







Sequence(r)(s)

- Sequence Questions \bullet
 - Final output \bullet
 - Video or Real Time?
 - Aspect?
 - **Resolution?**
 - Run at real time?
 - Cameras locked or not?
 - Get shots early if possible ullet







Sequence(r)(s): Planning







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Sequence(r)(s): Planning

• Trail Attachments



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Sequence(r)(s): Planning

• Impacts









Sequence(r)(s): Add FX

- Placing vs spawning
 - Placing
 - Static world location effects
 - Spawning
 - for attachments
 - Only live in sequence
 - effects you want to unload





Sequence(r)(s): Add World FX

Adding the Explosion lacksquareand Fill Effects

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In world









Sequence(r)(s): Add Spawned FX

- Spawn VFX Track
- Sometimes spawns in a weird place



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Sequence(r)(s): Add FX Gotcha

• Were is my Spawned FX?

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Sequence(r)(s): Add FX Gotchas

- Emitter types icons
 - Placed vs Spawned
- Spawned only in sequence
 - Only in outliner when active.
- Stay organized

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Sequence(r)(s): Toggle Track

Three triggering keys

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Sequence(r)(s): Attachment

1) Attachment track





2) Socket Name

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Sequence(r)(s): Attachment gotcha

- Attachment gotchas
 - Spawned emit will be somewhere
 - Make sure Location is set to
 - 0, 0, 0
 - Whatever is there will be an offset of the socket




Sequence(r)(s): Attachment gotcha

- Attachment gotchas
 - Make sure the attach covers your whole emit
 - It will dethatch if its too short

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Sequence(r)(s): Parameters

- Before you set the effect
 - How do you want to change it?
 - Inits vs over life
 - Color changes?
 - Movement changes?
 - Scale?
 - Emit rates?
 - Locations?
 - Param in cascade you can use it in sequencer.





Sequence(r)(s): Parameters

- Parameters
 - Need to change the effect in time
 - controls in the sequence
 - Prep Effect in Cascade
 - Expose the parameters in the spawned effect
 - Add the effect to the sequence
 - add the parameters to the effect track
 - set your values in the track







Sequence(r)(s): VFX Prep

- EyeLaser
 - Param Names
 - InitEyeColor
 - InitVel
 - AlphaOverLife



11

File

Save

B





Sequence(r)(s): Expose Params

- Expose param button
- Or add manually

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Sequence(r)(s): Add Param Track

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EXP_dirt



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EyeLaser



Sequence(r)(s): Add Param Curves

- Add Parameter Keys
 - Change Init Color •
 - Change Init Velocity •
 - Change Alpha Over Life •







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Sequence(r)(s): Param Curves

• Parameter Curves

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Sequence(r)(s): Curve Gotchas







Sequence(r)(s): Ground Impacts



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Impact Parameter Setups

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Sequence(r)(s): Ground Impacts







Wrap it up!

- Sorting thru the Rubble
 - Preparation
 - In game destruction
 - Hide/show
 - Fracture
 - Animated destruction
 - Sequencer tips and tricks
 - Visual effects parameter uses





Thanks!

- Mark Teare
- Mike Lyndon at SideFX
- The Blast Team
- Epic Games
- The Unreal Marketplace

- Avalanche Studios
- DICE
- Guerrilla Games
- Machine Games
- Naughty Dog
- Volition

Coffee





MOAR Destruction

- Wednesday, March 20 | 11:00am 12:00pm
- CAUSING CHAOS: THE FUTURE OF PHYSICS AND DESTRUCTION IN UNREAL ENGINE (PRESENTED **BY EPIC GAMES)**
- **Sponsor Speakers: Matthias Worch** (Epic Games Special Projects), **Jim Van Allen** (Epic Games), Michael Lentine (Epic Games)
- **Location:** YBCA Theater
- Thursday, March 21 | 12:45pm 1:45pm
- **CREATING A SCALABLE AND DESTRUCTIBLE WORLD IN 'HITMAN 2' (PRESENTED BY IO INTERACTIVE, IN ASSOCIATION WITH INTEL)**
- **Sponsor Speakers: James Vango** (IO Interactive), **Leigh Davies** (Intel)
- **Location:** Room 3009, West Hall





VFX Roundtables

- Wednesday, March 20 | 10:30am 11:30am
- **VISUAL EFFECTS ROUNDTABLE DAY 1**
- **Speaker: Drew Skillman** (Google, Inc.)
- Thursday, March 21 | 2:00pm 3:00pm
- **VISUAL EFFECTS ROUNDTABLE DAY 2: ARTISTIC LENS**
- **Speaker: Jason Keyser** (Riot Games)
- Friday, March 22 | 10:00am 11:00am
- **VISUAL EFFECTS ROUNDTABLE DAY 3: TECHNICAL LENS**
- Speaker: Drew Skillman (Google, Inc.)





Location: Room 208, South Hall









