March 21-25, 2022 San Francisco, CA

How To Think Like A Scripted Particle

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"Who even are you?"

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The Conundrum

Why should I use scripted particles to make FX?

It doesn't have all the modules I'm used to.

It takes longer to get set up.

The Tech Demos I've seen are way beyond what I need for my game.

Scripted Particle tools seem like they're just for controlling lots of tiny GPU particles.



Scripted Particles

- They've always been there, hiding behind the modules and the sliders.
- Puts you in full control over how particles spawn and simulate.
- Allows for linking and manipulation of external data.
- "With great power comes great responsibility."

Scripted Particles Overview

On Spawn: Runs once when particle spawns

- Initialize variables that the particle needs to simulate
- Read incoming data once
- Create custom parameters
- Assign coefficients

On Update: Runs every tick after spawn

- Modify variables over time/life
- Read incoming data every tick
- Use coefficients to modify behavior
- Run custom timers

General Expense

Frequ	iency: Oi	nce	Per-	Tick	Per-	Tick
	System Spawn Emitter Spawn	Particle Spawn	System Update Emitter Update	Particle Update	Per- Vertex	Per-Pixel

Least Expensive

Most Expensive

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Common Parameters - Example #1

On Spawn

On Update

- Lifetime Lifetime
- Color Color
- Size Size
- Velocity Velocity
- Rotation Rotation
- Position Position
 - Draw Position
- Draw Position





Common Parameters - Example #2

On Spawn On Update Shapes * 😝 Emitter Settings Lifetime CPU Emitter Properties Emitter Spawn 🐬 Emitter Update Emitter State Color Color Spawn Rate Particle Spawn Initialize Particle Cylinder Location Size Size Add Velocity Apply Initial Forces Set: PARTICLES RotationRate Sub UVAnimation Velocity Velocity 🐬 Particle Update Particle State Sprite Rotation Rate Rotation Scale Sprite Size Rotation Linear Force Solve Forces and Velocity Add Event Handler

- Position Position
 - Draw Position -

- Draw Position

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🗳 Render

💥 Sprite Renderer

Input Data

Common External User Defined Data

- Float
- Vector
- Bool
- Float 4 (Vector4 / Linear Color)

Make New	
▲Common	
bool	bool
float	float
int32	int32
Linear Color	Linear Color
Matrix	Matrix
Mesh Tri Coordinate	Mesh Tri Coordinate
Niagara ID	Niagara ID
Niagara Rand Info	Niagara Rand Info
Quat	Quat
Spawn Info	Spawn Info
Vector	Vector
Vector 2D	Vector 2D
Vector 4	Vector 4
▲Data Interface	
2D Array Texture Sample	2D Array Texture Sample
Audio Oscilloscope	Audio Oscilloscope
Audio Player	Audio Player
Audio Spectrum	
Bool Array	
Camera Query	
Chaos Destruction Data	
Collision Query	
Color Array	
Cube Texture Sample	
Curl Noise	
Curve for Colors	
Curve for Floats	
Curve for Vector2D's	
Curve for Vector3's	
Curve for Vector4's	
DebugDraw	
Export particle data	
Float Array	
GBuffer	GBuffer 🕕
Grid2D Collection	
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Leveraging Input Data - Examples

Float

- Size of Character / Object
- Radius of Explosion
- Duration of AOE
- Vector

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- Velocity of Object
- Location of Bone / Character
 - View Vector

Bool

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- 1st / 3rd Person Switch
- Ally / Enemy Switch
- Condition Switch for Timers

Float 4 (Vector4 / Linear Color)

Per-Instance Color



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Practical Applications

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1. "I want to let design change the radius of my effect "

What can we use?

- Any Particle Type
- Input Float
- Custom Parameters
 - Spawn Rate
 - Position
 - Weighted Distribution

~	Fire	
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H	Emitter Settings	
CPU	Emitter Properties	
0	Emitter Spawn	+
7	Emitter Update	+
••	Emitter State	
•	Spawn Rate	
0	Particle Spawn	+
•••	Initialize Particle	
	Set: PARTICLES StartTimeOffset PARTICLES Scale	
	Cylinder Location	
7	Particle Update	÷
	Sub UVAnimation	
	Particle State	
	Dynamic Material Parameters	
	Color	
	Scale Sprite Size	
•	Scale Sprite Size Add Event Handler	+
•	Scale Sprite Size Add Event Handler Render	+ + 🛛





1. "I want to let design change the radius of my effect "

Weighted Distribution





🔺 💿 Set (PARTICLE	S) WeightedDistance	+ 🛍 🗹
PARTICLES Weighter	🛃 Float from Curve	
▲ FloatCurve	😝 Curve for Floats	
✓ Curve	è- 🛛 🛄 📁	
Templates		
2 4 4	+ 🖻 Key Data 0.0 🔹 0.7	2 5
CurveIndex	🛃 Random Range Float	د •
Minimum	0.0	
Maximum	1.0	
Scale Curve	% USER Radius	

Formula

float3(sin(Rand2pi) * RandDistance, cos(Rand2pi) * RandDistance, 0.0)

Niagara Specific Example

float3(sin(Particles.Random2Pi) * Particles.WeightedDistance, cos(Particles.Random2Pi) * Particles.WeightedDistance, 0.0)



2. "I want to connect an electric effect between two characters "

What can we use?

- Ribbon/Beam
- Two Vectors
 - System and Character Positions
- Spawn Coefficient
 - Lerp Between Start and End
 - Curve Base Pinning / Arc
 - Custom UVs
- Material Parameters







2. "I want to connect an electric effect between two characters "

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7	Emitter Update	÷
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0	Particle Spawn	÷
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	Set: PARTICLES ExecIndex	
	Set: PARTICLES RibbonLinkOrder	
	Set: PARTICLES NoiseCoeff	
7	Particle Update	÷
	Particle State	
	Set: PARTICLES ExpectedPosition	
	Curl Noise Force	1
	Set: (PARTICLES) Position	
·m	Add Event Handler	÷
¥	Render	+
2	Ribbon Renderer	





What can we use?

- Any Particle Type
- Particle Position and an Input Vector
- Custom Position and Velocity
- Material Parameters





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	Emitter Update	÷
••	Emitter State	
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	Grid Location	
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7	Particle Update	+
•	Particle State	
	Set: PARTICLES DistanceToPlayer	
	PARTICLES NormalizedPos PARTICLES NormalizedExpectedPos	
	Set: PARTICLES ExpectedPosition	
	Set: PARTICLES Velocity	
•	Curl Noise Force Custom	î 🖸
	Set: PARTICLES Position	
	Set: PARTICLES ToExpectedPos	
	Set: PARTICLES DistanceToExpectedPos	
	Set: PARTICLES Position	
•	Color	
•	Scale Sprite Size	
	Sprite Facing and Alignment	
	Add Event Handler	+
*	Render	+
*	Sprite Renderer	



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	Emitter Settings	
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	Emitter Update	+
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	Spawn Particles in Grid	5
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•	Initialize Particle	5
	Grid Location	5
	Set: PARTICLES Speed PARTICLES Radius PARTICLES ExpectedPosition	C
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	Particle State	5
	Set: PARTICLES DistanceToPlayer PARTICLES NormalizedPos PARTICLES NormalizedExpectedPos	8
	Set: PARTICLES ExpectedPosition	5
	Set: PARTICLES Velocity	5
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	Set: PARTICLES Position	5
	Set: PARTICLES ToExpectedPos	2
	Set: PARTICLES DistanceToExpectedPos	5
	Set: PARTICLES Position	5
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•	Scale Sprite Size	5
	Sprite Facing and Alignment	5
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	Grid Location		C
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	Set: PARTICLES DistanceToPlayer PARTICLES NormalizedPos PARTICLES NormalizedExpectedPos		C
	Set: PARTICLES ExpectedPosition		C
	Set: PARTICLES Velocity		C
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	Set: PARTICLES Position		E
	Set: PARTICLES ToExpectedPos		C
	Set: PARTICLES DistanceToExpectedPos		C
	Set: PARTICLES Position		E
	Color		E
	Scale Sprite Size		E
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	Add Event Handler		+
¥	Render		+
∗	Sprite Renderer		E





Empty ¥ 🔘 😝 Emitter Settings GPU Emitter Properties Emitter Spawn **7** Emitter Update Emitter State Spawn Particles in Grid Particle Spawn Initialize Particle Grid Location Set: PARTICLES Speed PARTICLES Radius PARTICLES ExpectedPosition 7 Particle Update Particle State Set: PARTICLES DistanceToPlayer PARTICLES NormalizedPos PARTICLES NormalizedExpectedPos Set: PARTICLES ExpectedPosition Set: PARTICLES Velocity Curl Noise Force Custom ÷ 🗹 Set: PARTICLES Position Set: PARTICLES ToExpectedPos Set: PARTICLES DistanceToExpectedPos Set: PARTICLES Position Scale Sprite Size 🔊 Add Event Handler ՝ Render 💥 Sprite Renderer

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A 3 Color		
Color	Lerp Linear Colors	· •
StartColor	A 1.0 2	
EndColor	R 100.0 G 10.0 B 100.0	
LerpFactor	>saturate(Particles.DistanceToExpectedPos / 500)	- 5
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Non-Uniform Curve Scale	<u>x 1.0 P 1.0 D</u>	.
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Sprite Facing		
Sprite Alignment	Liser Player - Particles Position	
Alignment Coordinate Space	Simulation -	
Angriment Coordinate Space		



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4. "I want to conform my particles to the terrain but I don't have distance fields in my game "

What can we use?

- Any Particle Type
- Input Render Target
- Position Based UV Sample
- Position Offset

	Fire	
¥	None	
Ø	Emitter Settings	
GPU	Emitter Properties	
0	Emitter Spawn	+
7	Emitter Update	+
••	Emitter State	
	Spawn Rate	
0	Particle Spawn	+
•••	Initialize Particle	
	Set: PARTICLES StartTimeOffset PARTICLES Scale	Ø
	Cylinder Location	
	Sample Texture	
	Set: PARTICLES Position	
7	Particle Update	+
	Sub UVAnimation	
	Particle State	
	Dynamic Material Parameters	
	Color	
	Scale Sprite Size	
•11	Add Event Handler	÷
Ÿ	Render	+
∗	Sprite Renderer	





4. "I want to conform my particles to the terrain but I don't have distance fields in my game "











Timers

What can we use?

- Any Particle Type
- Input Float / Int / Bool
- **Custom Conditional Timers**
 - **Curves Sampled By Timers** -
- Any Number of Custom Parameters and Inputs











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PARTICLES LookALStatel >_ normalize(float3(sin(Particles.RotOffset + Engine.Time * Particles.RotSpeed.x), cos(Particles.RotOffset + Engine.Time * Particles.RotSpeed.x), cos(Particles.RotSpeed.x), cos(P

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Thank You!

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