In Frog, 2D particles are a special kind of Sprite. While some particle effects would need to be written in C++, a variety can be created in JSON. Each JSON particle effect consists of one or more emitters, and each emitter has its own group of particles. All the particles of a given emitter share the same settings. The emitters are specified as JSON objects and they are listed in a JSON array. All particles of a given emitter are drawn after the particles of emitters that are listed before it in this array.

Unless otherwise noted, all angles are given in degrees. The angle increases counter-clockwise, and 0 degrees points to the right.

Emitter Parameters

Required

Parameters that must be specified for each emitter.

- ParticleCountMax : Maximum number of particles allowed for the emitter. This must be defined and greater than 0.
- SpriteResourceFilename : Filename of the sprite resource file for the particle's animation. The graphics folder will automatically be added to the beginning of the filename. Do not include the file extension.
- Animation : Name of the sprite animation to use for the particles.

Emission

Parameters that affect when and where particles are emitted.

- EmissionShape : Shape of the area from which particles are emitted. This can be "Point", "Line", or "BoxFilled". If "Point" is used, particles are emitted from the origin of the effect. If "Line" is used, points are emitted at random locations along a line. If "BoxFilled" is used, particles are emitted from random points within a rectangle. (Default: "Point")
- EmissionPoint : When EmissionShape is "Point", this is the point at which particles are emitted, relative to the origin of the effect. (Default: "0|0")
- EmissionLinePointA : When EmissionShape is "Line", this is the first endpoint of the line along which particles are emitted, relative to the origin of the effect. (Default: "0|0")
- EmissionLinePointB : When EmissionShape is "Line", this is the second endpoint of the line along which particles are emitted, relative to the origin of the effect. (Default: "0|0")
- EmissionBox: When EmissionShape is "BoxFilled", this is the rectangle from which particles are emitted, relative to the origin of the effect. (Default: "0|0|0|0")
- EmissionFrequency : Number of chances per second for a particle to be emitted. (Default: 0)
- EmissionChance : Probability of actually emitting a particle each time EmissionFrequency determines that it's time to possibly release one. [0.0 - 1.0] (Default: 1.0)
- EmissionActiveDuration : When the effect begins emitting particles, it will continue to emit them for this many milliseconds. (Default: no time limit)

Life

Parameters that limit the life of a particle.

- LifeBounds : If the origin of the particle leaves this rectangle, in screen coordinates, its life ends. This is not affected by the position of the emitter or the effect as a whole. (Default: no additional limit on the life of a particle.)
- LifeDuration : Duration of the life of a particle in milliseconds before LifeDurationDeviation is applied. This is mutually exclusive with LifeDurationMin and LifeDurationMax. (Default:

particle's life is not limited by time.)

- LifeDurationDeviation : If LifeDuration was explicitly specified, the duration of the life of a particle can vary by this many milliseconds in either direction. This is mutually exclusive with LifeDurationMin and LifeDurationMax. (Default: 0)
- LifeDurationMin : Minimum duration of the life of a particle in milliseconds. Both LifeDurationMin and LifeDurationMax must be explicitly specified for either to work. This is mutually exclusive with LifeDuration and LifeDurationDeviation. (Default: defer to LifeDuration and LifeDurationDeviation)
- LifeDurationMax : Maximum duration of the life of a particle in milliseconds. Both LifeDurationMin and LifeDurationMax must be explicitly specified for either to work. This is mutually exclusive with LifeDuration and LifeDurationDeviation. (Default: defer to LifeDuration and LifeDurationDeviation)

PreSimulation

When a particle effect has been running for a little while, it can look different than when it first started. For example, at the moment you start a rain effect, there are very few raindrops in the air. To make the effect look like it has already been running for a while, you can have the effect simulate a series of updates when it begins. This is controlled by the following parameters.

- PreSimulateDuration : How much time to simulate when an emission begins, in milliseconds. (Default: 0)
- PreSimulateStepSize : Duration of a single step of a presimulation, in milliseconds. This is like the length of a frame, but for presimulation. (Default: 33)
- PreSimulateOnInit : True if presimulation should happen automatically when the effect is initialized. (Default: true)

Linear Velocity

Parameters that affect the initial velocity of a particle.

- LinearVelocity : Initial velocity of a particle in pixels/second. This is mutually exclusive with LinearSpeed, LinearSpeedDeviation, LinearSpeedMin, LinearSpeedMax, LinearVelocityAngle, LinearVelocityAngleDeviation, LinearVelocityAngleMin, and LinearVelocityAngleMax. (Default: "0|0")
- LinearSpeed : Initial speed of a particle in pixels/second before LinearSpeedDeviation is applied. This is mutually exclusive with LinearVelocity, LinearSpeedMin, and LinearSpeedMax. (Default: defer to LinearVelocity)
- LinearSpeedDeviation : If LinearSpeed was explicitly specified, the initial speed of a particle can vary by this much in either direction in pixels/second. This is mutually exclusive with LinearVelocity , LinearSpeedMin, and LinearSpeedMax. (Default: 0)
- LinearSpeedMin : Minimum initial speed of a particle in pixels/second. Both LinearSpeedMin and LinearSpeedMax must be explicitly specified for either to work. This is mutually exclusive with LinearVelocity, LinearSpeed, and LinearSpeedDeviation. (Default: defer to LinearVelocity)
- LinearSpeedMax : Maximum initial speed of a particle in pixels/second. Both LinearSpeedMin and LinearSpeedMax must be explicitly specified for either to work. This is mutually exclusive with LinearVelocity, LinearSpeed, and LinearSpeedDeviation. (Default: defer to LinearVelocity)
- LinearVelocityAngle : Angle of the initial velocity of a particle in degrees, before LinearVelocityAngleDeviation is applied. This is mutually exclusive with LinearVelocity, LinearVelocityAngleMin, and LinearVelocityAngleMax. (Default: 0)
- LinearVelocityAngleDeviation : If LinearVelocityAngle was explicitly specified, the angle of the

initial velocity of a particle can vary by this many degrees in either direction. This is mutually exclusive with LinearVelocity, LinearVelocityAngleMin, and LinearVelocityAngleMax. (Default: 0)

- LinearVelocityAngleMin : Minimum angle of the initial velocity of a particle in degrees. Both LinearVelocityAngleMin and LinearVelocityAngleMax must be explicitly specified for either to work. This is mutually exclusive with LinearVelocity, LinearVelocityAngle, and LinearVelocityAngleDeviation. (Default : Defer to LinearVelocityAngle and LinearVelocityAngleDeviation if LinearSpeed, LinearSpeedMin, or LinearSpeedMax were specified. Otherwise, defer to LinearVelocity.)
- LinearVelocityAngleMax : Maximum angle of the initial velocity of a particle in degrees. Both LinearVelocityAngleMin and LinearVelocityAngleMax must be explicitly specified for either to work. This is mutually exclusive with LinearVelocity, LinearVelocityAngle, and LinearVelocityAngleDeviation. (Default : Defer to LinearVelocityAngle and LinearVelocityAngleDeviation if LinearSpeed, LinearSpeedMin, or LinearSpeedMax were specified. Otherwise, defer to LinearVelocity.)

Linear Acceleration

Parameters that affect the initial linear acceleration of a particle.

- LinearAcceleration : Initial linear acceleration of a particle in pixels/second squared. This is mutually exclusive with LinearAccelerationAngle, LinearAccelerationAngleDeviation, LinearAccelerationAngleMin, LinearAccelerationAngleMax, LinearAccelerationMagnitude, LinearAccelerationMagnitudeDeviation, LinearAccelerationMagnitudeMin, and LinearAccelerationMagnitudeMax. (Default: "0|0")
- LinearAccelerationMagnitude : Magnitude of the initial linear acceleration of a particle in pixels/second squared, before LinearAccelerationMagnitudeDeviation is applied. This is mutually exclusive with LinearAcceleration, LinearAccelerationMagnitudeMin, and LinearAccelerationMagnitudeMax. (Default: defer to LinearAcceleration)
- LinearAccelerationMagnitudeDeviation : If LinearAccelerationMagnitude was explicitly specified, the magnitude of the initial linear acceleration of a particle can vary by this much in either direction in pixels/second squared. This is mutually exclusive with LinearAcceleration, LinearAccelerationMagnitudeMin, and LinearAccelerationMagnitudeMax. (Default: 0)
- LinearAccelerationMagnitudeMin : Minimum magnitude of the initial linear acceleration of a particle in pixels/second squared. Both LinearAccelerationMagnitudeMin and LinearAccelerationMagnitudeMax must be explicitly specified for either to work. This is mutually exclusive with LinearAcceleration, LinearAccelerationMagnitude, and LinearAccelerationMagnitudeDeviation. (Default: defer to LinearAcceleration)
- LinearAccelerationMagnitudeMax : Maximum magnitude of the initial linear acceleration of a particle in pixels/second squared. Both LinearAccelerationMagnitudeMin and LinearAccelerationMagnitudeMax must be explicitly specified for either to work. This is mutually exclusive with LinearAcceleration, LinearAccelerationMagnitude, and LinearAccelerationMagnitudeDeviation. (Default: defer to LinearAcceleration)
- LinearAccelerationAngle : Angle of the initial linear acceleration of a particle in degrees, before LinearAccelerationAngleDeviation is applied. This is mutually exclusive with LinearAcceleration, LinearAccelerationAngleMin, and LinearAccelerationAngleMax. (Default: defer to LinearAcceleration)
- LinearAccelerationAngleDeviation : If LinearAccelerationAngle was explicitly specified, the angle of the initial linear acceleration of a particle can vary by this

many degrees in either direction. (Default: 0)

- LinearAccelerationAngleMin : Minimum angle of the initial linear acceleration of a particle in

degrees. Both LinearAccelerationAngleMin and LinearAccelerationAngleMax must be explicitly specified for either to work. (Default: defer to LinearAccelerationAngle, LinearAccelerationAngleDeviation, and LinearAcceleration)
- LinearAccelerationAngleMax : Maximum angle of the initial linear acceleration of a particle in degrees. Both LinearAccelerationAngleMin and LinearAccelerationAngleMax must be explicitly specified for either to work. (Default: defer to LinearAccelerationAngle, LinearAccelerationAngleDeviation, and LinearAcceleration)

Linear Damping

Parameters that affect the rate at which a particle slows down. This is in terms of how much of a particle's speed is lost after each second. Linear damping must always be within the range [0 - 1].

- LinearDamping : Initial linear damping of a particle before LinearDampingDeviation is applied. This is mutually exclusive with LinearDampingMin and LinearDampingMax. (Default: 0)
- LinearDampingDeviation : Initial linear damping of a particle can vary by this much in either direction. This is mutually exclusive with LinearDampingMin and LinearDampingMax. (Default: 0)
- LinearDampingMin : Minimum initial linear damping of a particle. Both LinearDampingMin and LinearDampingMin must be explicitly specified for this for either to work. This is mutually exclusive with LinearDamping and LinearDampingDeviation. (Default: defer to LinearDamping and LinearDampingDeviation.)
- LinearDampingMax : Maximum initial linear damping of a particle. Both LinearDampingMin and LinearDampingMin must be explicitly specified for this for either to work. This is mutually exclusive with LinearDamping and LinearDampingDeviation. (Default: defer to LinearDamping and LinearDampingDeviation.)

Rotation

Parameters that affect the initial angle to which a particle is rotated.

- Rotation : Initial angle of a particle before RotationDeviation is applied. This is mutually exclusive with RotationMin and RotationMax. (Default 0)
- RotationDeviation : The initial rotation of a particle can vary by this much in either direction. This is mutually exclusive with RotationMin and RotationMax (Default: 0)
- RotationMin : Minimum angle of rotation for a particle when emitted, in degrees. Both RotationMin and RotationMax must be explicitly specified for either to work. This is mutually exclusive with Rotation and RotationDeviation. (Default: defer to Rotation and RotationDeviation)
- RotationMax : Maximum angle of rotation for a particle when emitted, in degrees. Both RotationMin and RotationMax must be explicitly specified for either to work. This is mutually exclusive with Rotation and RotationDeviation. (Default: defer to Rotation and RotationDeviation)

Angular Velocity

Parameters that affect the initial speed at which a particle is spinning.

- AngularVelocity : Initial angular velocity of a particle in degrees/second before AngularVelocityDeviation is applied. This is mutually exclusive with AngularVelocityMin and AngularVelocityMax. (Default: 0)
- AngularVelocityDeviation : The initial angular velocity of a particle can vary by this much in either direction in degrees/second. This is mutually exclusive with AngularVelocityMin and AngularVelocityMax. (Default: 0)

- AngularVelocityMin : Minimum initial angular velocity of a particle in degrees/second. Both AngularVelocityMin and AngularVelocityMax must be explicitly specified for either to work. This is mutually exclusive with AngularVelocity and AngularVelocityDeviation. (Default: defer to AngularVelocity and AngularVelocityDeviation.)
- AngularVelocityMax : Maximum initial angular velocity of a particle in degrees/second. Both AngularVelocityMin and AngularVelocityMax must be explicitly specified for either to work. This is mutually exclusive with AngularVelocity and AngularVelocityDeviation. (Default: defer to AngularVelocity and AngularVelocityDeviation.)

Angular Acceleration

Parameters that accelerate the spinning of a particle.

- AngularAcceleration : Initial angular acceration of a particle in degrees/second squared before AngularAccelerationDeviation is applied. This is mutually exclusive with AngularAccelerationMin and AngularAccelerationMax. (Default: 0)
- AngularAccelerationDeviation : The initial angular acceleration of a particle can vary by this much in either direction in degrees/second squared. This is mutually exclusive with AngularAccelerationMin and AngularAccelerationMax. (Default: 0)
- AngularAccelerationMin : Minimum initial angular acceleration of a particle in degrees/second squared. Both AngularAccelerationMin and AngularAccelerationMax must be explicitly specified for either to work. This is mutually exclusive with AngularAcceleration and AngularAccelerationDeviation. (Default: defer to AngularAcceleration and AngularAccelerationDeviation)
- AngularAccelerationMax : Maximum initial angular acceleration of a particle in degrees/second squared. Both AngularAccelerationMin and AngularAccelerationMax must be explicitly specified for either to work. This is mutually exclusive with AngularAcceleration and AngularAccelerationDeviation. (Default: defer to AngularAcceleration and AngularAccelerationDeviation)

Angular Damping

Parameters that affect the rate at which a particle's spin slows down. This is in terms of how much of a particle's spin is lost after each second. Angular damping must always be within the range [0 - 1].

- AngularDamping : Initial angular damping of a particle before AngularDampingDeviation is applied. This is mutually exclusive with AngularDampingMin and AngularDampingMax. (Default: 0)
- AngularDampingDeviation : The initial angular damping of a particle can vary by this amount in either direction. This is mutually exclusive with AngularDampingMin and AngularDampingMax. (Default: 0)
- AngularDampingMin : Minimum initial angular damping of a particle. Both AngularDampingMin and AngularDampingMax must be explicitly specified for either to work. This is mutually exclusive with AngularDamping and AngularDampingDeviation. (Default: defer to AngularDamping and AngularDampingDeviation)
- AngularDampingMax : Maximum initial angular damping of a particle. Both AngularDampingMin and AngularDampingMax must be explicitly specified for either to work. This is mutually exclusive with AngularDamping and AngularDampingDeviation. (Default: defer to AngularDamping and AngularDampingDeviation)

Scale

Parameters that affect the scale of a particle. See also: ScaleLinear modifier

- Scale : Initial scale of a particle. This is mutually exclusive with ScaleBegin, ScaleEnd, ScaleMin, ScaleMax, ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax. (Default: "1|1")
- ScaleMin : Minimum initial scale of a particle. Both ScaleMin and ScaleMax must be explicitly specified for either to work. This is mutually exclusive with Scale, ScaleBegin, ScaleEnd, ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax. (Default: defer to Scale).
- ScaleMax : Maximum initial scale of a particle. Both ScaleMin and ScaleMax must be explicitly specified for either to work. This is mutually exclusive with Scale, ScaleBegin, ScaleEnd, ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax. (Default: defer to Scale).

Color

Parameters that affect the color of a particle. See also: ColorLinear modifier

- Color : Initial color of a particle. This is mutually exclusive with ColorBegin and ColorEnd. (Default: "255|255|255|255" (opaque white))

Additive Blending

Parameters that affect the additive blending setting of a particle. A value of 0 requests normal alpha blending, 1 requests additive blending, and values in between use a mix. See also: AdditiveBlendingLinear modifier

- AdditiveBlending: Initial additive blending setting of a particle. This is mutually exclusive with AdditiveBlendingBegin and AdditiveBlendingEnd. (Default: 0 (normal alpha blending))

Random Numbers

- Seed : Number to use as the seed for this emitter's random numbers. (Default: use the shared random seed.)

Modifiers

The ParticleEffect2D system is not limited to the parameters listed above. Individual games can extend the system by adding modifiers that can be specified in an emitter's "Modifiers" section. For example, the following section would cause the particles to go from white to black over the course of their life.

```
"Modifiers":
[
   {
      "Type": "ColorLinear",
      "ColorBegin": "255|255|255|255",
      "ColorEnd": "0|0|0|255"
   }
]
```

The modifiers listed below are available in all games.

AdditiveBlendingLinear

This linearly changes the additive blending of individual particles over the course of their lives.

- AdditiveBlendingBegin : Additive blending setting of the particle at the beginning of its life. Both AdditiveBlendingBegin and AdditiveBlendingEnd must be specified for either to work. This is mutually exclusive with AdditiveBlending. (Default: defer to AdditiveBlending)
- AdditiveBlendingEnd : Additive blending setting of the particle at the end of its life's normal duration. Both AdditiveBlendingBegin and AdditiveBlendingEnd must be specified for either to

work. This is mutually exclusive with AdditiveBlending. (Default: defer to AdditiveBlending)

ColorLinear

This linearly changes the color of individual particles over the course of their lives.

- ColorBegin : Color of the particle at the beginning of its life. Both ColorBegin and ColorEnd must be specified for either to work. This is mutually exclusive with Color. (Default: defer to Color)
- ColorEnd : Color of the particle at the end of its life's normal duration. Both ColorBegin and ColorEnd must be specified for either to work. This is mutually exclusive with Color. (Default: defer to Color)

ScaleLinear

This linearly changes the scale of individual particles over the course of their lives.

- ScaleBegin : Scale of a particle at the beginning of its life. This is not valid if the duration of the particle's life is indefinite. Both ScaleBegin and ScaleEnd must be explicitly specified for either to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax. (Default: defer to Scale).
- ScaleEnd : Scale of a particle at the end of its life's normal duration. This is not valid if the duration of the particle's life is indefinite. Both ScaleBegin and ScaleEnd must be explicitly specified for either to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax. (Default: defer to Scale).
- ScaleBeginMin : Minimum scale of a particle at the beginning of its life. This is not valid if the duration of the particle's life is indefinite. ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax must all be explicitly specified for any to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBegin, and ScaleEnd. (Default: defer to Scale).
- ScaleBeginMax : Maximum scale of a particle at the beginning of its life. This is not valid if the duration of the particle's life is indefinite. ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax must all be explicitly specified for any to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBegin, and ScaleEnd. (Default: defer to Scale).
- ScaleEndMin : Minimum scale of a particle at the end of its life's normal duration. This is not valid if the duration of the particle's life is indefinite. ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax must all be explicitly specified for any to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBegin, and ScaleEnd. (Default: defer to Scale).
- ScaleEndMax : Maximum scale of a particle at the end of its life's normal duration. This is not valid if the duration of the particle's life is indefinite. ScaleBeginMin, ScaleBeginMax, ScaleEndMin, and ScaleEndMax must all be explicitly specified for any to work. This is mutually exclusive with Scale, ScaleMin, ScaleMax, ScaleBegin, and ScaleEnd. (Default: defer to Scale).

Automatic Reloading

When the Frog window receives the focus in Debug PC builds, a particle effect will be reloaded automatically if its json file has been modified. For example, you could Alt-Tab from the game to PSPad, change the particle velocity in the JSON file, Alt-Tab back to the game, and the particles would be emitted with the new velocity. This only works if the particle effect was loaded directly from its own JSON file.