

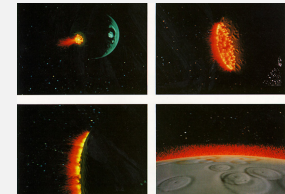
Particle Systems

Particle Systems

<https://www.youtube.com/watch?v=NM1r37ziBOQ>

- pioneered in early 1980s
 - invented by William Reeves at ILM

Star Trek II: The Wrath of Khan
(1982)



- applications
 - "fuzzy" objects without smooth, well-defined surfaces
 - fire, smoke, clouds, fog, fountains, waterfalls, spray of breaking waves, fireworks, ...
 - complex solid objects or solid objects which change shape
 - trees, grass, fur, ...

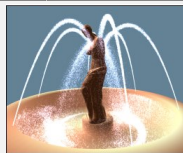
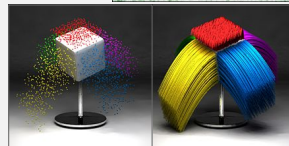
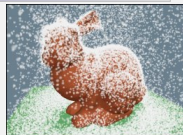
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Particle Systems

https://archive.org/details/sims_particle_dreams_1988

- idea: entity is modeled as a large collection of individual particles
 - particle is (often) subpixel-sized
 - each particle is individually animated
- can be *animated* or *static*
 - for static (or *structured*), entire lifetime of particle is rendered at once
- a different way to model objects
 - cloud of particles defines the volume of the object, rather than modeling the surface
 - objects are not static
 - objects are not deterministic



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https://en.wikipedia.org/wiki/Particle_system
<http://www.2ld.de/gh2004/>

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Some Milestones in Movies

- Cosmos* (1979)
 - use of particles to model galaxies
- Star Trek II: The Wrath of Khan* (1982)
 - invention of particle systems for fuzzy object modeling
- Twister* (1996)
 - 5-10 million particles for the basic tornado
 - a mix of particle systems and hand animation
- The Perfect Storm* (2000)
 - ocean simulation using particle systems
 - at times, billions of particles per frame
- Monsters, Inc.* (2001)
 - developments in algorithms and a physics engine to handle realistic fur and cloth on a large scale (2,320,413 hairs on Sulley's body)

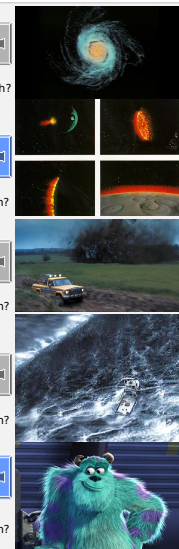
<https://www.youtube.com/watch?v=uWhsLmFFhTl>

<https://www.youtube.com/watch?v=NM1r37ziBOQ>

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<https://www.youtube.com/watch?v=W9TdW5nG4dQ>

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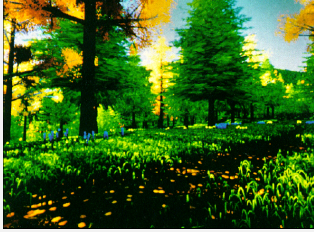


The Adventures of André and Wally B. (1984)

https://www.youtube.com/watch?v=a_9Tsbduk9E



- *structured* particle systems used to model trees and grass



W. Reeves and R. Blau, "Approximate and Probabilistic Algorithms for Shading and Rendering Structured Particle Systems", SIGGRAPH '85

- also first CGI animation with motion blur and squash-and-stretch