Research Options

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Areas of Interest

1) Real-Time Rendering and LOD

2) Simulation of Natural Phenomena
(Erosion, Weathering)

LOD

Challenge:

Millions of illuminated trees
swaying in the wind
@30 fps

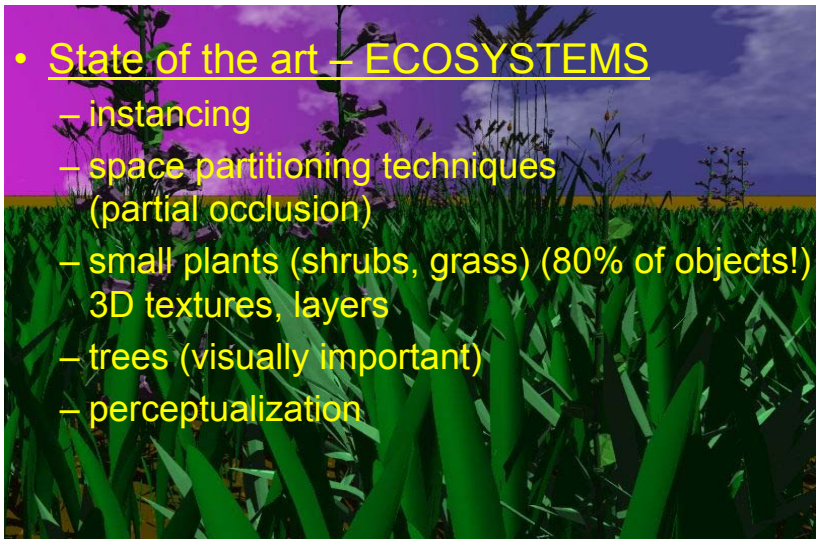
LOD

- State of the art - MODELS
  - models of plants are adaptive
  - multiple LODs
  - point/line based techniques
  - billboards, billboard trees, impostors

LOD

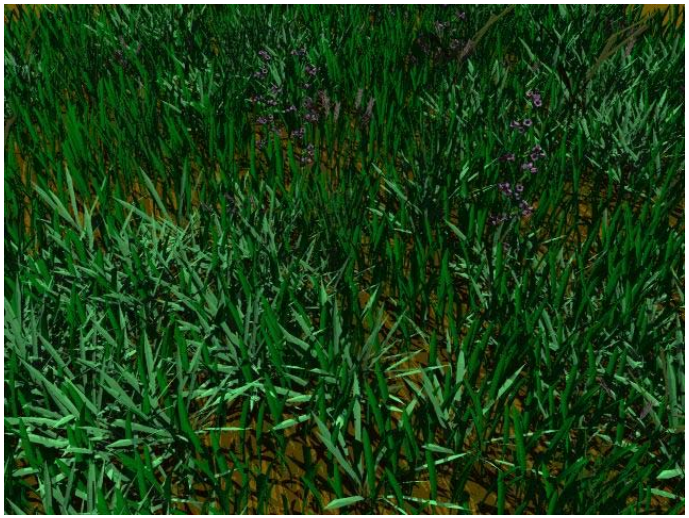
- State of the art – MODELS (contd.)
  - transition?
  - LOD0=geometry,
    LOD1=simplified geometry
    LOD2=billboard cloud,
    LOD3=billboard

LOD



- State of the art – ECOSYSTEMS
  - instancing
  - space partitioning techniques (partial occlusion)
  - small plants (shrubs, grass) (80% of objects!) 3D textures, layers
  - trees (visually important)
  - perceptualization

LOD



LOD

- State of the art – MOTION
  - simplified (branch, damp-spring motion)
  - small trees do not move at all

LOD

- State of the art – ILLUMINATION
  - correct illumination unresolved even for static scenes
  - RT on a cluster of supercomputers (10fps)
  - simplified shader-based techniques (30fps)
  - shadows
  - diffuse-diffuse transport

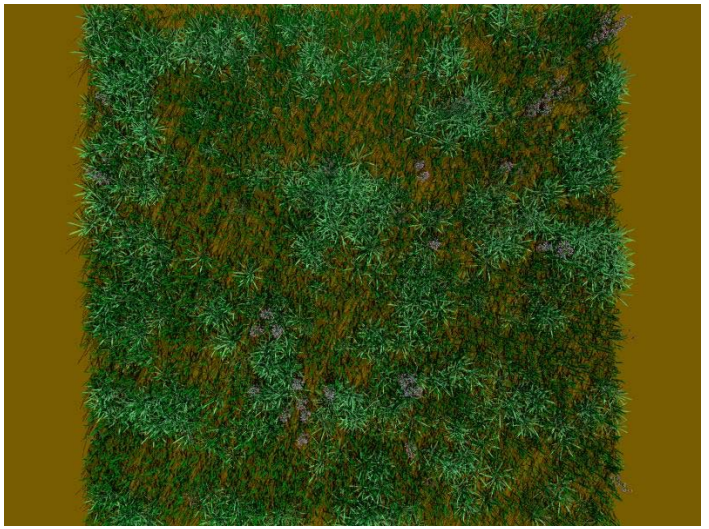
LOD

- Idea 1
  - ***temporal coherence***
  - could we exploit previous frame(s) for impostors?
  - could we warp some parts of scene using FS?
  - perceptualization (saliency maps)

LOD

- Idea 2
  - ***clustering and instancing for illumination***
  - set of hierarchical clusters computed off-line
  - Δt is assigned to illumination evaluation the structure is traversed the best result is used
  - Δt is different for different LODs

LOD



LOD

- Idea 3
  - ***LOD for moving objects***
  - using animated billboards
    - used from previous frames?
    - calculated off-line?
  - Fourier-like analysis of motion?

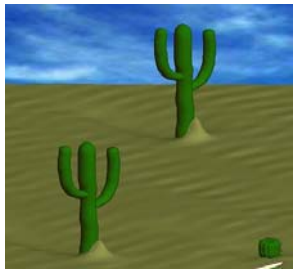
Erosion

- Challenge:

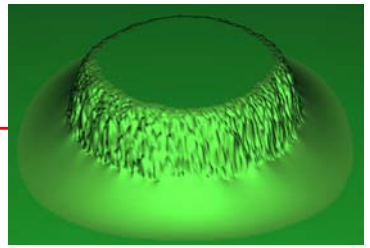
General, user-friendly, physically-based model of aging and weathering

Erosion

- State of the Art
  - dozens of *ad hoc* approaches
  - interactive or off-line
  - no general-purpose approach published



Erosion



- Idea 1 Sand motion
  - ***nano level***
  - simulated as a regular height field
  - coupled with particles

or as fluids

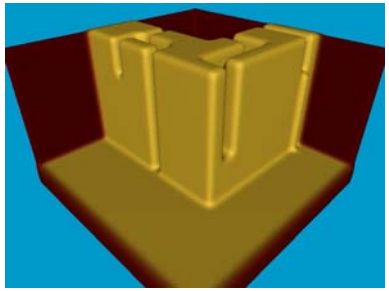
Theory of catastrophes…
Visualization

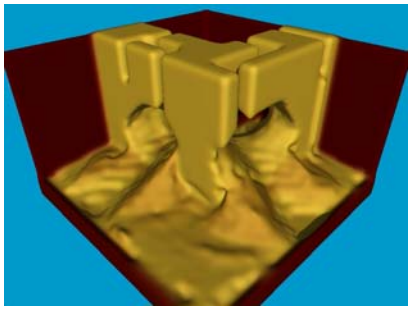
Erosion

- Idea 2 Large/Small scale erosion
  - ***coupling NS-equations with erosion***
  - Navier-Stokes equations provide complete pressure field in fluids
  - Could this be coupled with an erosion model?

Erosion

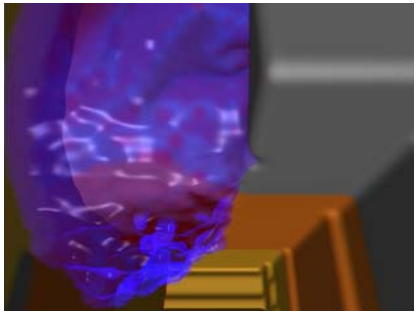
- Idea 2- Large/Small scale erosion

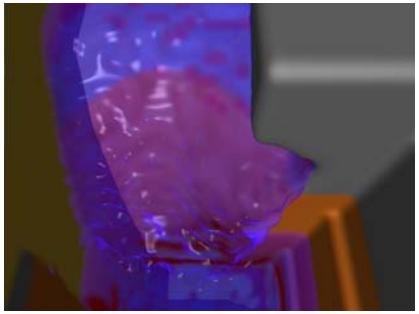




Erosion

- Idea 2 Large/Small scale erosion
  - It can, but…





Erosion

- Idea 2- Large/Small scale erosion
  - Goal - interactive tools (brushes for MAYA)
  - Fast and easy to control erosion simulation
  - Connection to small/large scale…?

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