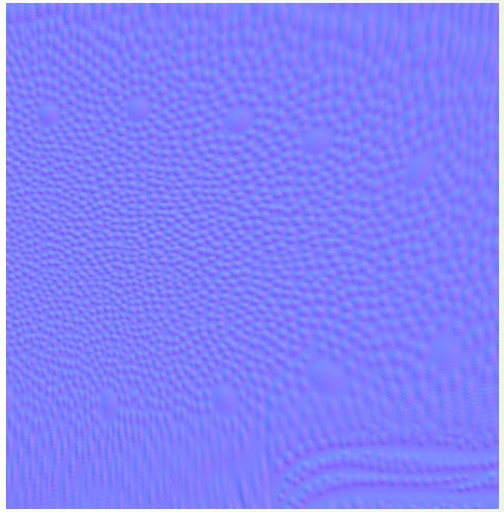
CS451 Texturing 4

Bump mapping continued



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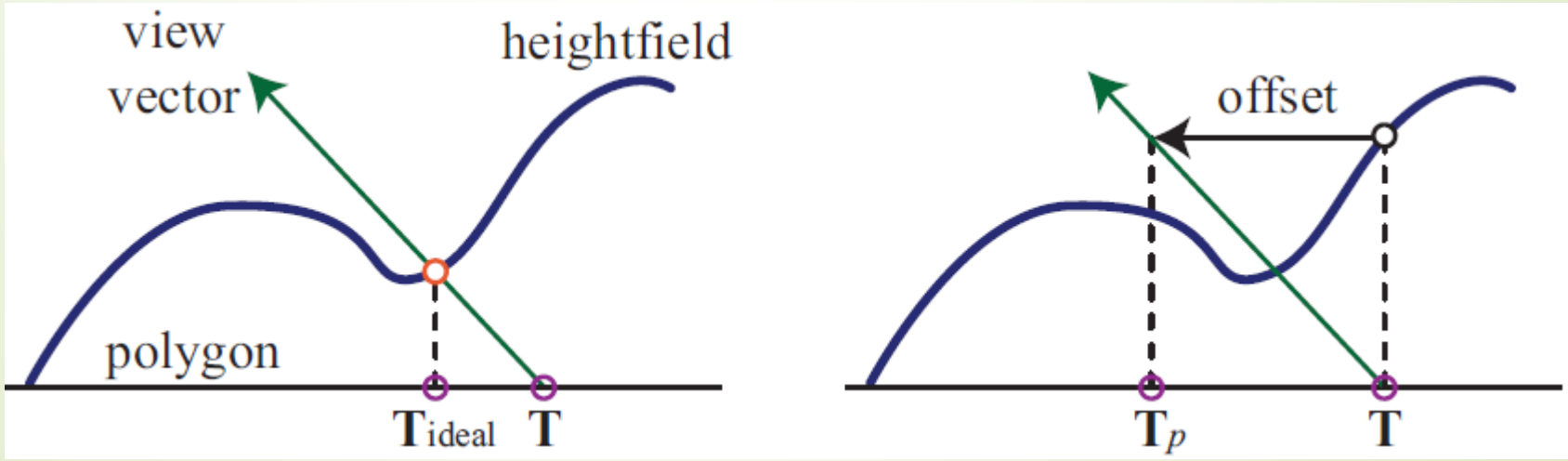
Some images are from Martin Mittring

Other

- 3D textures:
  - Feasible on modern hardware as well
  - Texture filtering is no longer trilinear
  - Rather quadlinear (linear interpolation 4 times)
  - Enables new possibilities
    - Can store light in a room, for example
- Multitexturing
  - More than one set of texture coords per vertex
  - The output from the first texture stage is input to the next
  - Opens up for many possibilities

Parallax Mapping

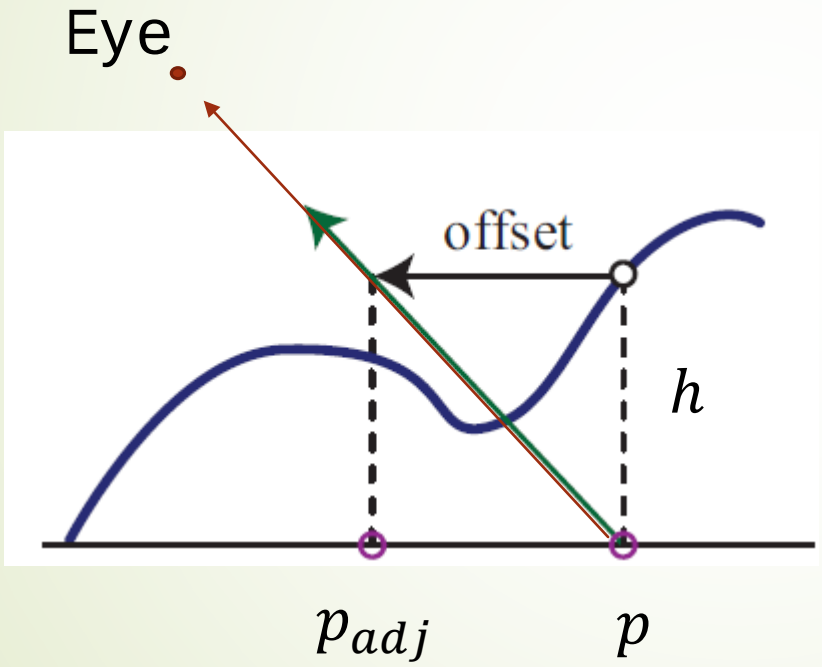
- A.k.a. Offset mapping, visual displacement mapping
- Using height field instead of normal map
- Example: What is the elevation and color for the green ray below



Parallax Mapping

Vector from eye to p

$v = (v_x, v_y, v_z)$



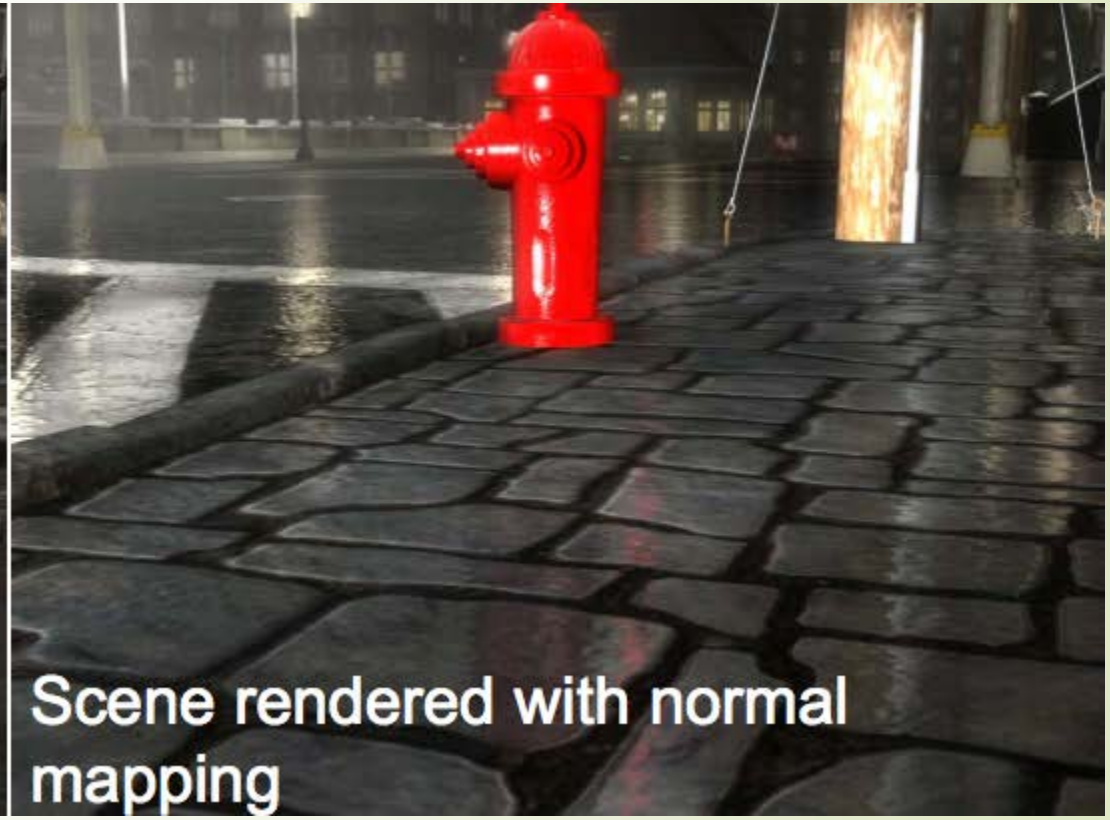
Project $v = (v_x, v_y, v_z)$ to the tangent plane with length = offset

Solve p_{adj}

Then the color of this ray is computed using color, normal defined at p_{adj} instead of those at p

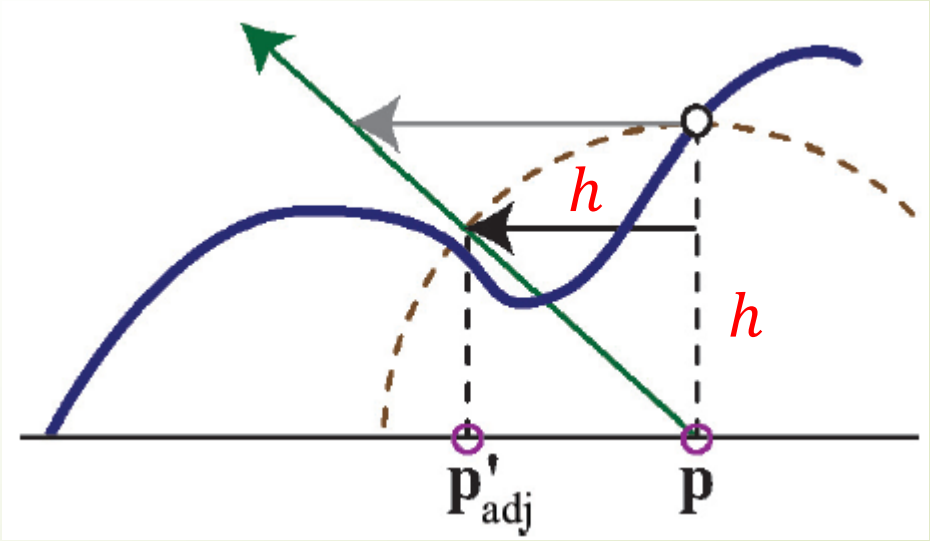
Parallax Mapping

- Parallax provides much better visualization of “occlusion”



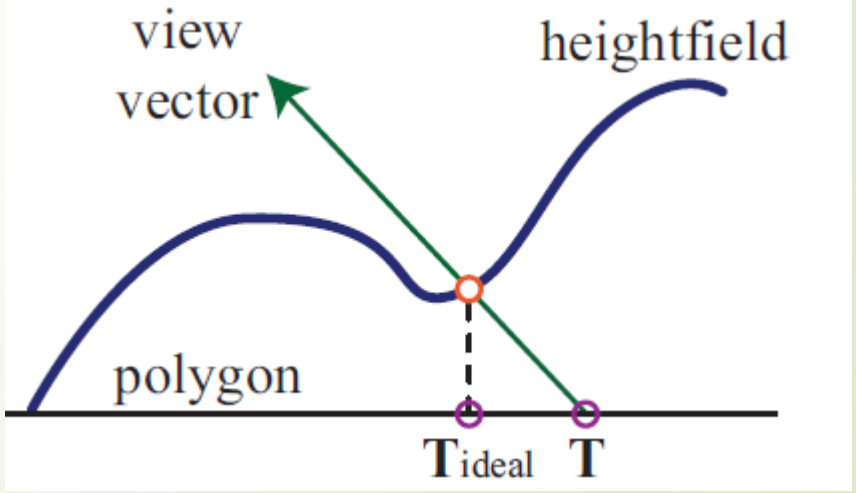
Parallax Offset Limiting

- Parallax fails if the neighboring heights are very different
- Solution: limit the amount of offset
- $p'_{adj} = p + h \cdot \boldsymbol{v}_{xy}$



Relief Mapping

- Relief mapping (a.k.a. Steep parallax mapping or parallax occlusion mapping)
- Compute the first intersection between the ray and the height field via Sampling
- Still an approximation

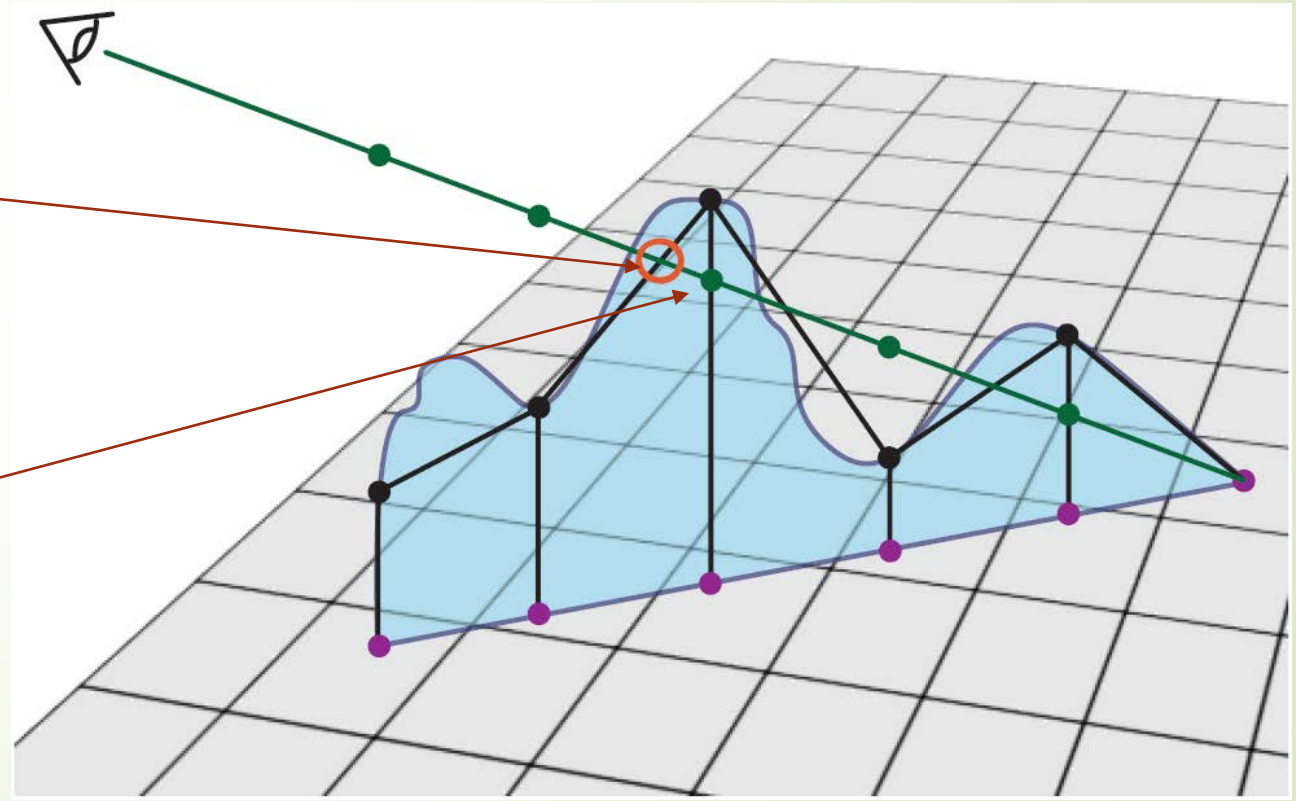


Relief Mapping

- Sample along the viewing ray

Goal: compute this point

First sample lower than the height map



Comparison

Texture Mapped

Normal Mapped

Parallax Mapped

Steep Parallax Mapped

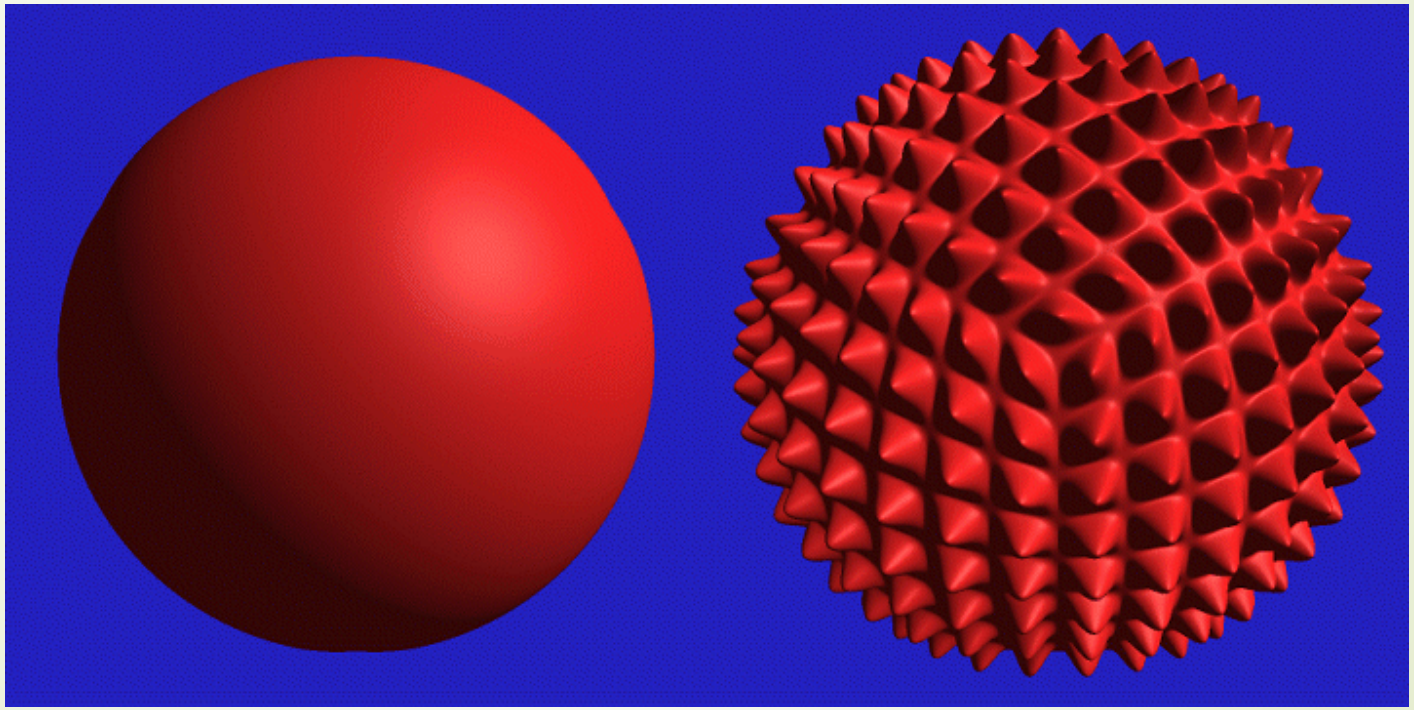
Image by Morgan McGuire and Max McGuire

Great visual effect

Not so much if the silhouette is revealed

Displacement Mapping

- Use the texture map to actually move the surface point
- The geometry must be displaced before visibility is determined



Displacement Mapping

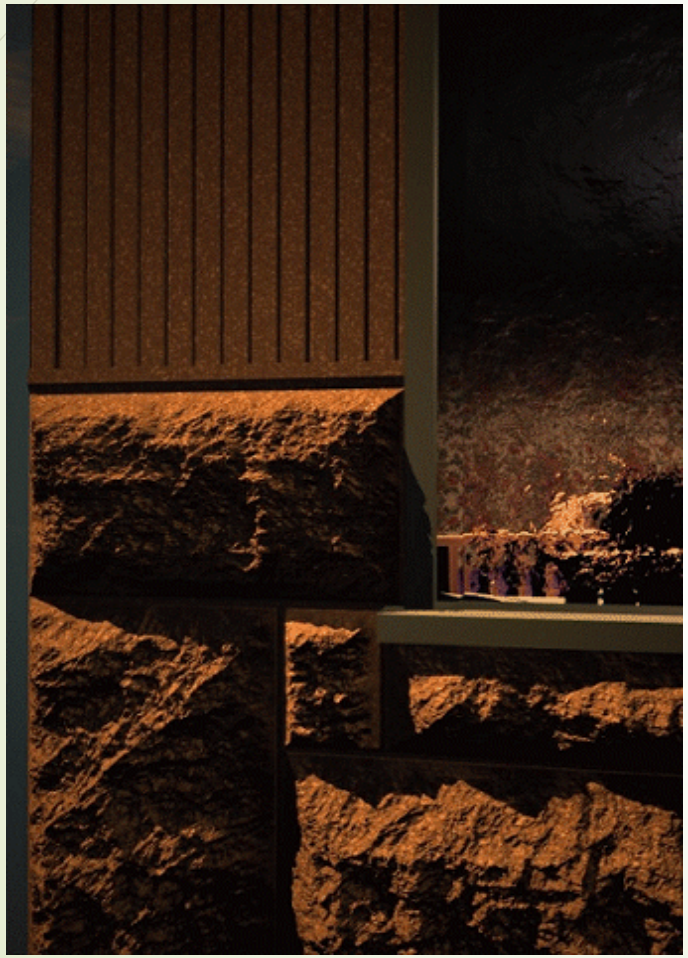


Image from:

Geometry Caching for Ray-Tracing Displacement Maps

by Matt Pharr and Pat Hanrahan.

note the detailed shadows cast by the stones

Displacement Mapping

Summary

- **Bump** mapping (using normal map, or height field)
  - Pro: Provide the illusion of local wrinkles
  - Con: No self-occlusion
- **Parallax** mapping
  - Pro: Provide self-occlusion
  - Con: The elevation cannot vary too much
- **Relief** mapping
  - Pro: Works with varying heights, can even provides shadow
  - Con: Bad visual effect on the silhouette
- **Displacement** mapping
  - Pro: bumps on silhouette
  - Con: Consume much more resources (CPU, GPU, memory)