

# **A Loose and Sketchy Approach in a Mediated Reality Environment**

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# Motivation

# Conventional Augmented Reality

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- ARToolKit
- Traditional CG lighting model
- Light sources are placed manually
- No shadows
- Objects look artificial

# Photorealism in AR



# Photorealism in AR

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- **Image-Based Lighting [Debevec et al. 2001]**
- **Analysis of illumination conditions [Kanbara and Yokoya 2002, Agusanto et al. 2003]**
- **Image-Based Photometric Reconstruction for Mixed Reality [Gibson et al. 2001]**
- **Addition of shadows [Haller et al. 2003, Sugano et al. 2003]**

Is there another way than  
photorealism?



# Non-photorealism in „AR“

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- **Non-photorealism in „AR“?**
- **Mediated Reality [Mann 94]**
  
- **The rendered scene has to be a believable world**
- **Convincing rather than realistic**

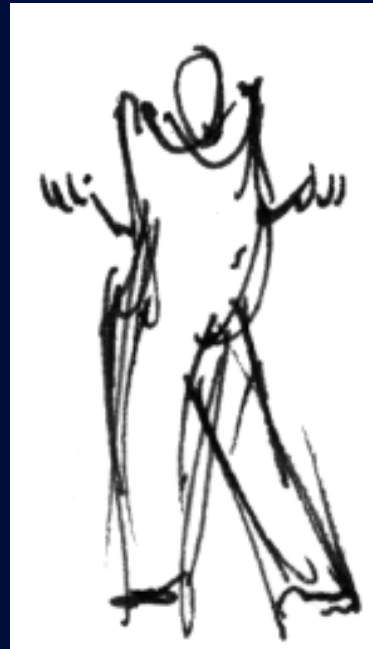
# Related Work

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- **Stylized Augmented Reality for Improved Immersion [Fischer et al. 2005]**
- **Non-photorealistic animation [Curtis 1999]**

# Loose & Sketchy

- **Simplification**
  - Objects
  - Color & shading
- **Silhouette**



[Curtis 99]

# Loose & Sketchy [Curtis 99]



> 1 minute to render this scenario

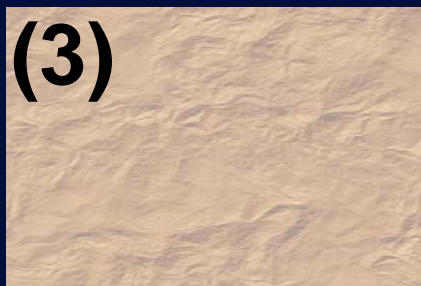
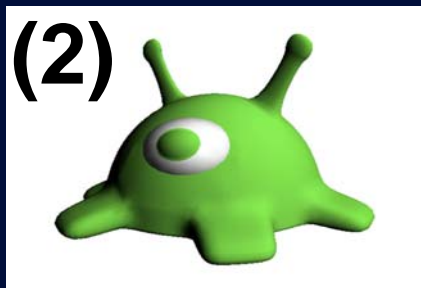
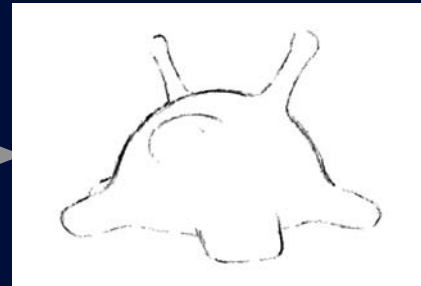
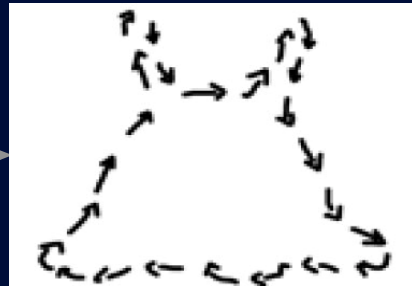
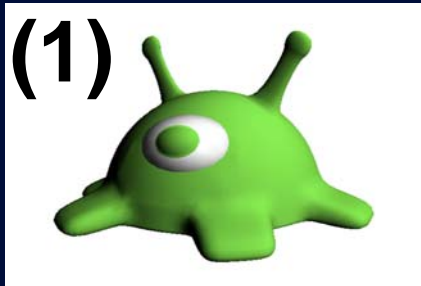
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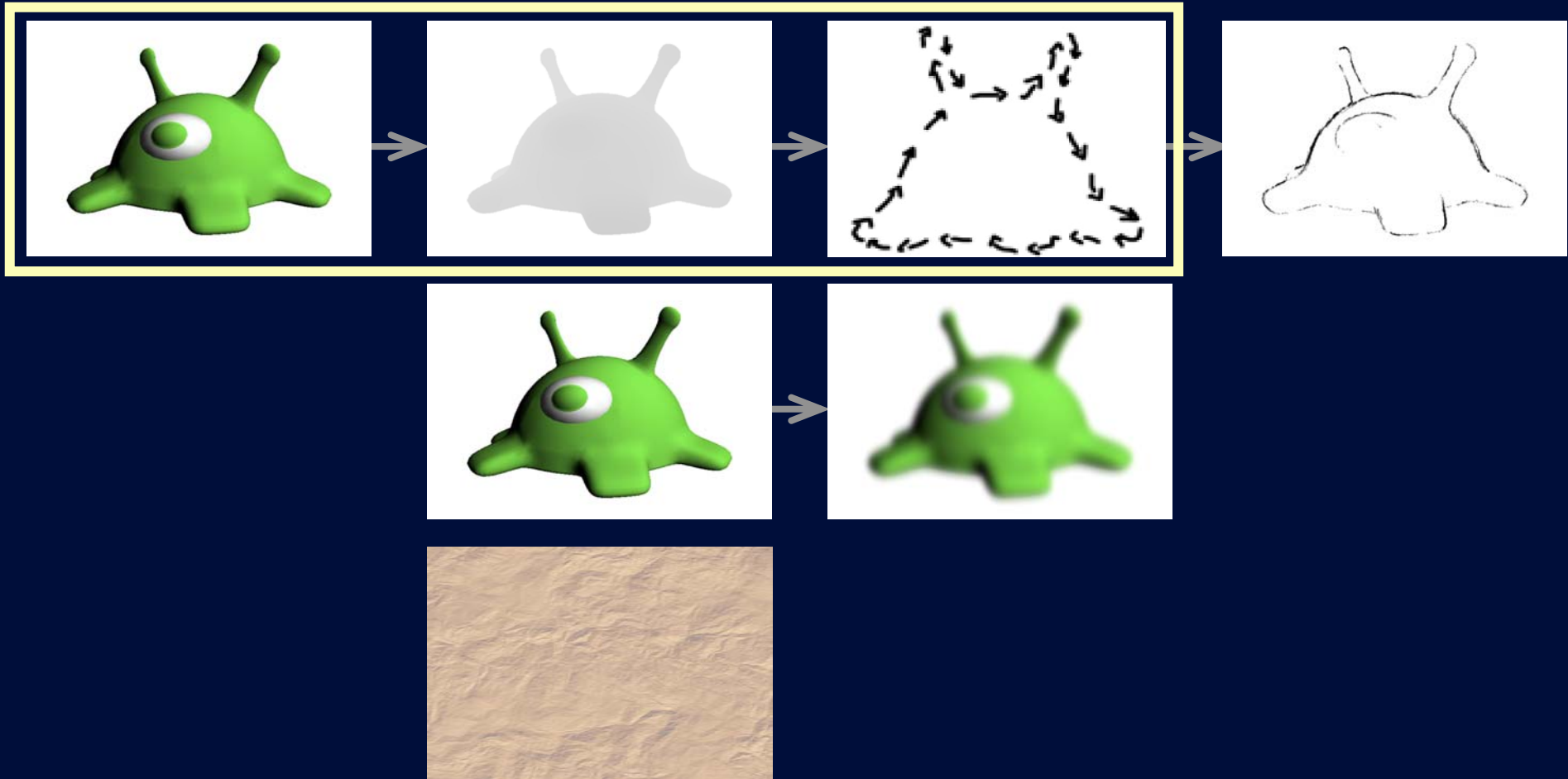
# Setup



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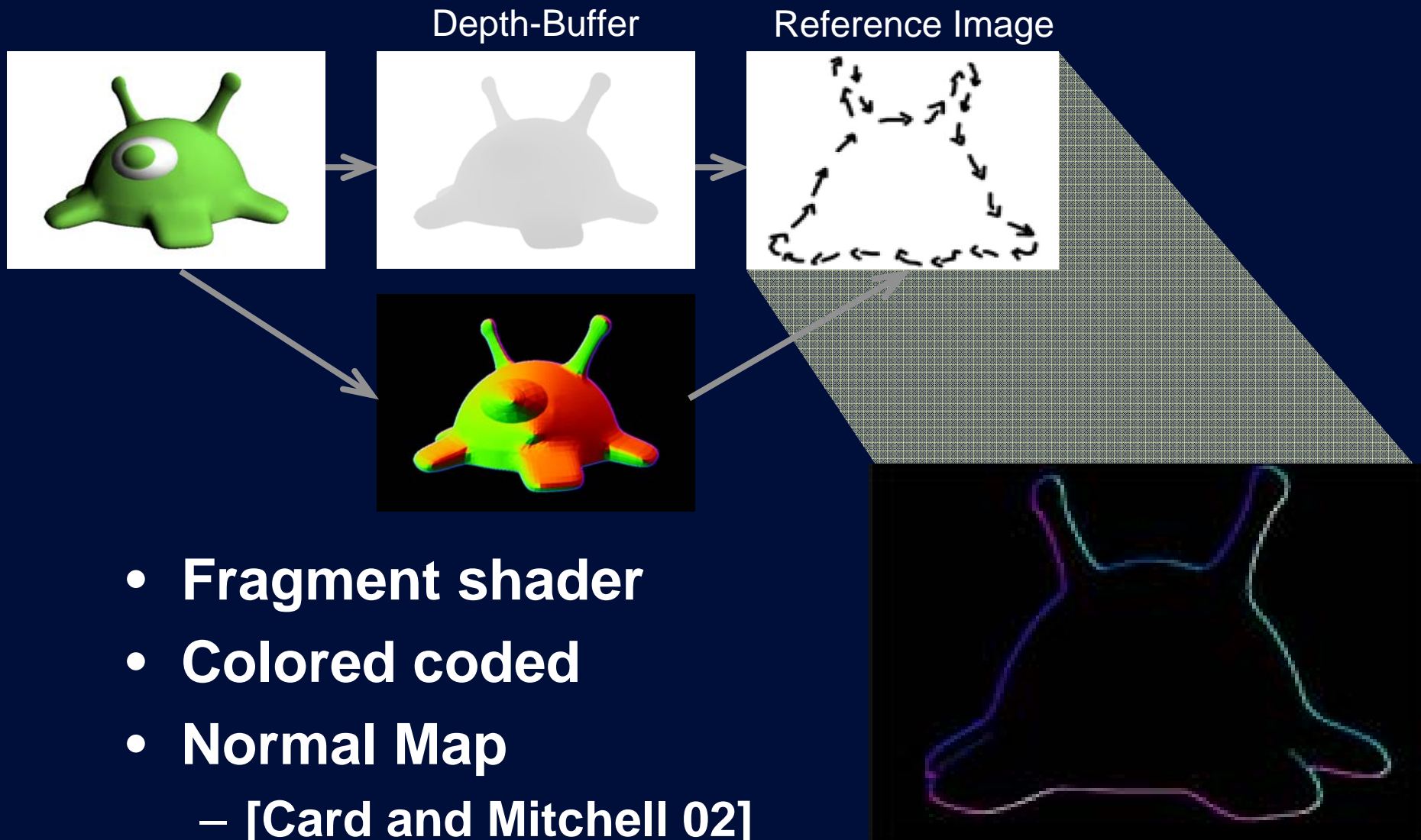
# Rendering Pipeline

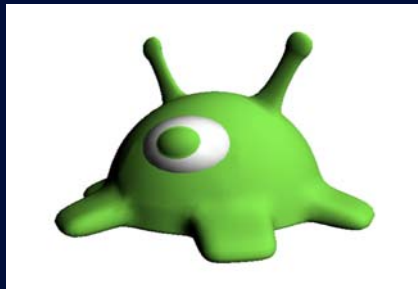
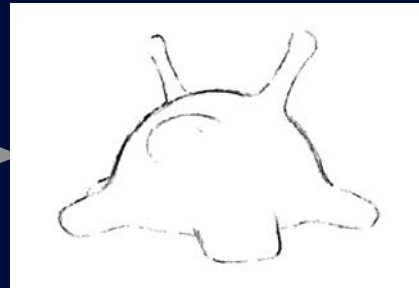
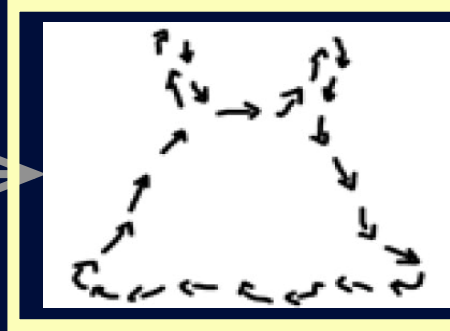
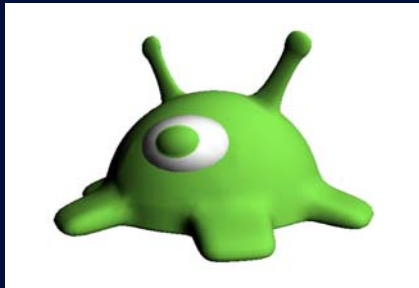






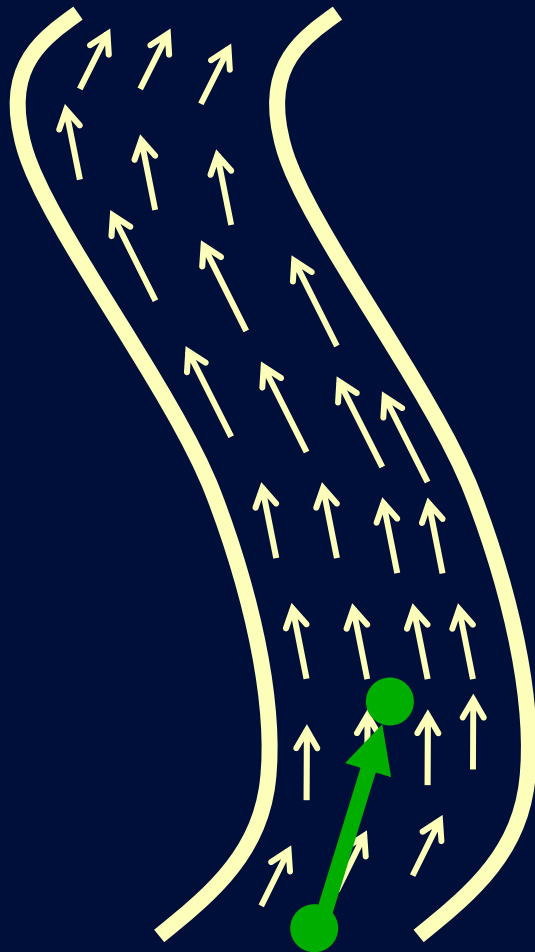
- **Reference Image**
  - Depth Buffer [Saito and Takahashi 90]
  - Sobel filter for the depth image (using GPU)
- **Force-field (using GPU)**
  - Direction of particles





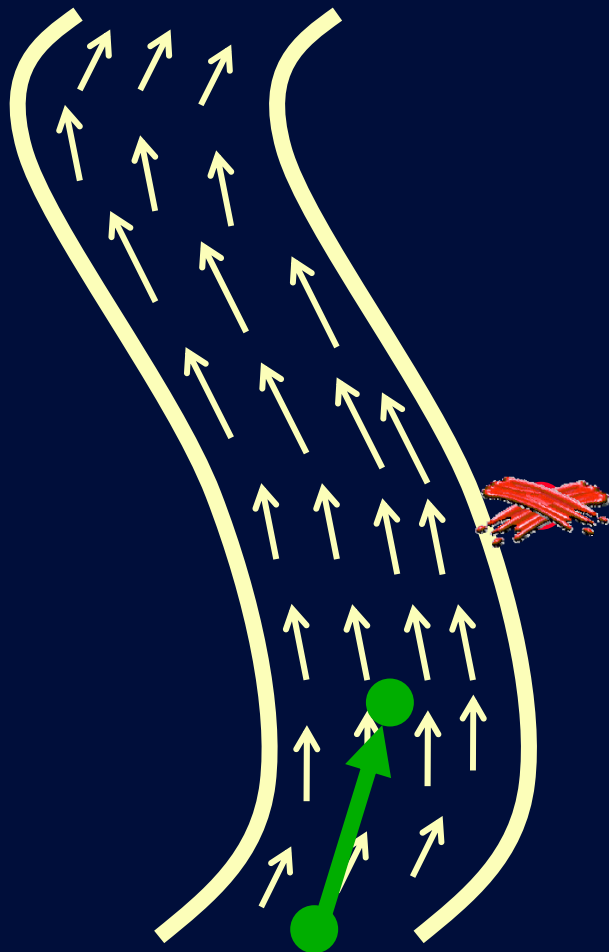
# Using the force field

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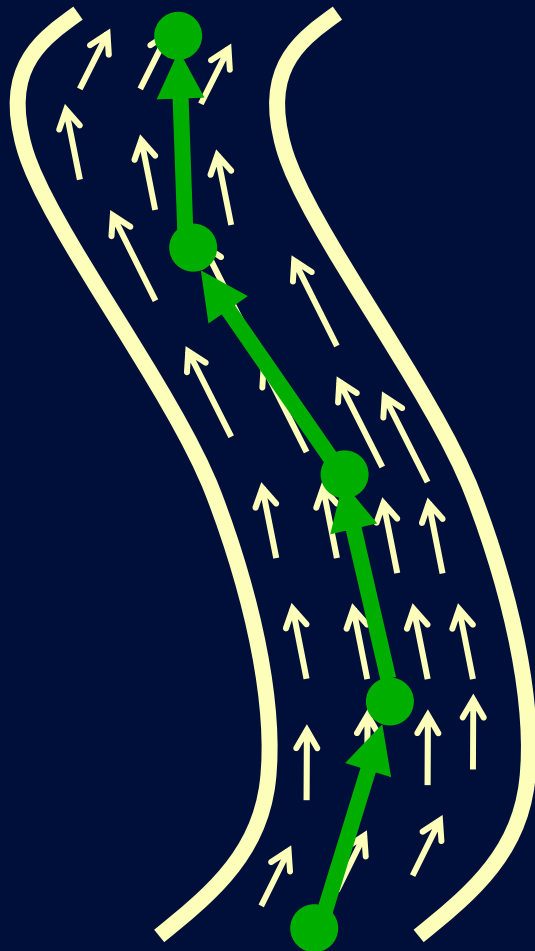


# Using the force field

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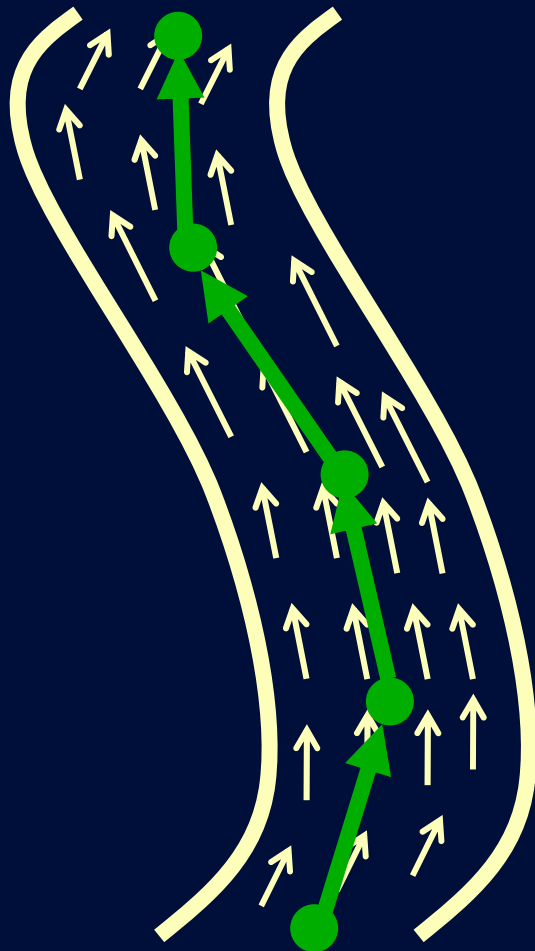
# Using the force field



- Particle System
- Particles are created along the silhouette

# Randomization

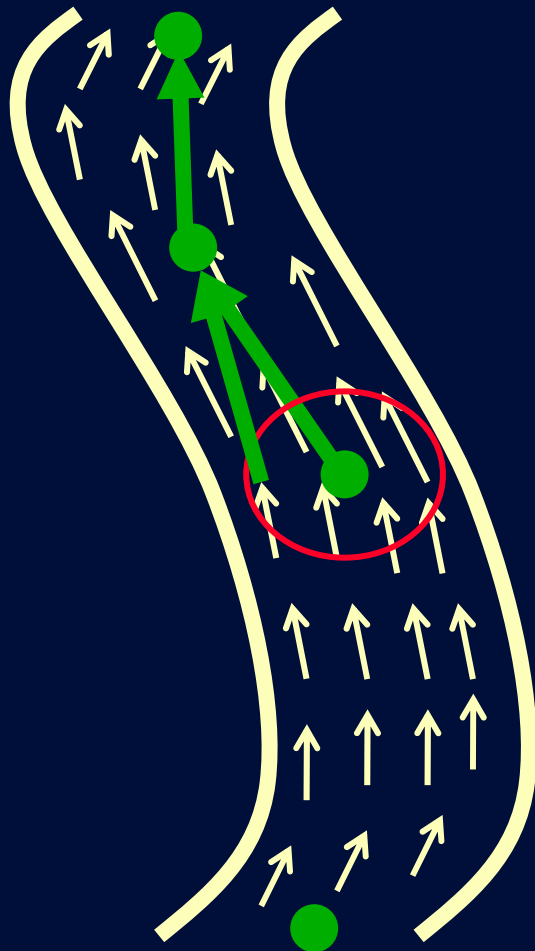
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- Remove some particles

# Randomization

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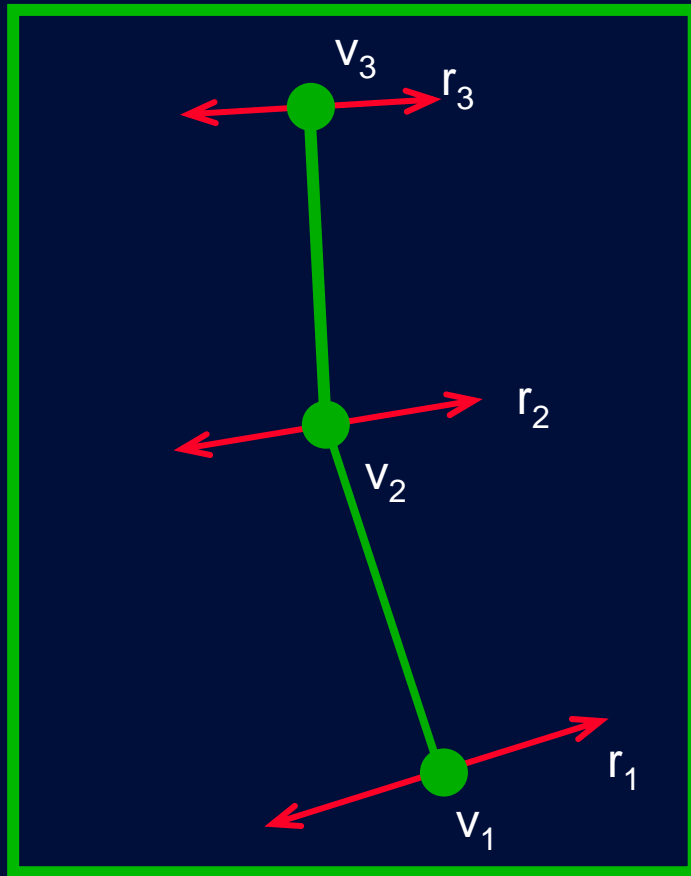


- Move the position



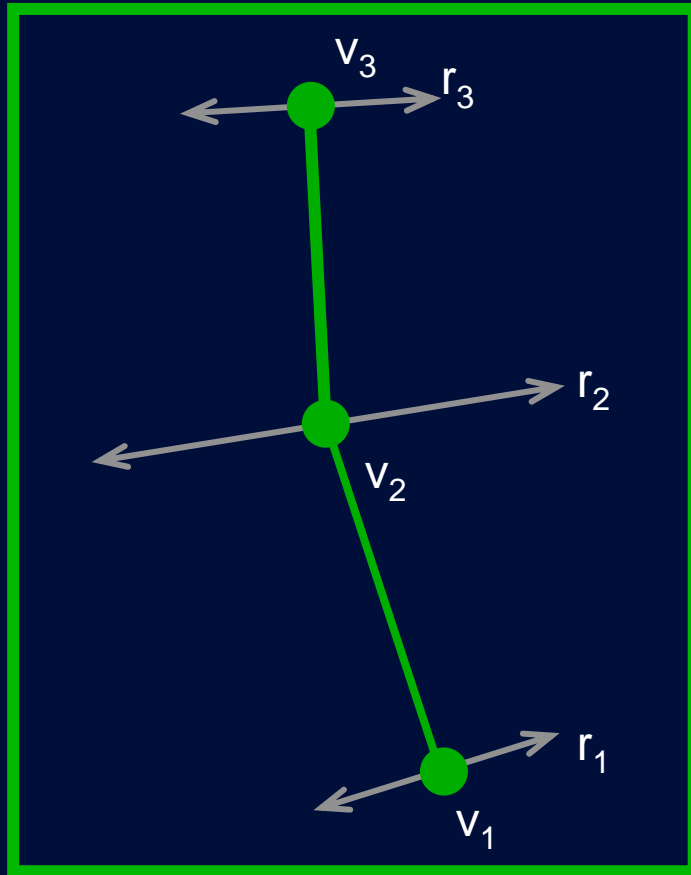
- How can we create the ink-wash look?

# Rendering the particles



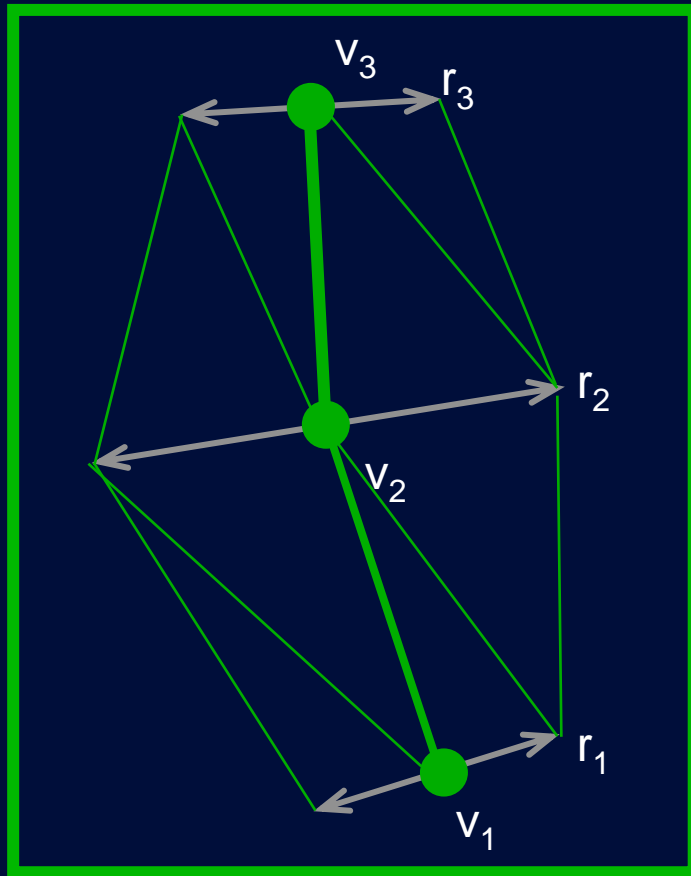
- Each vertex has its width
- „Rib“ vector  $r_i$

# Rendering the particles



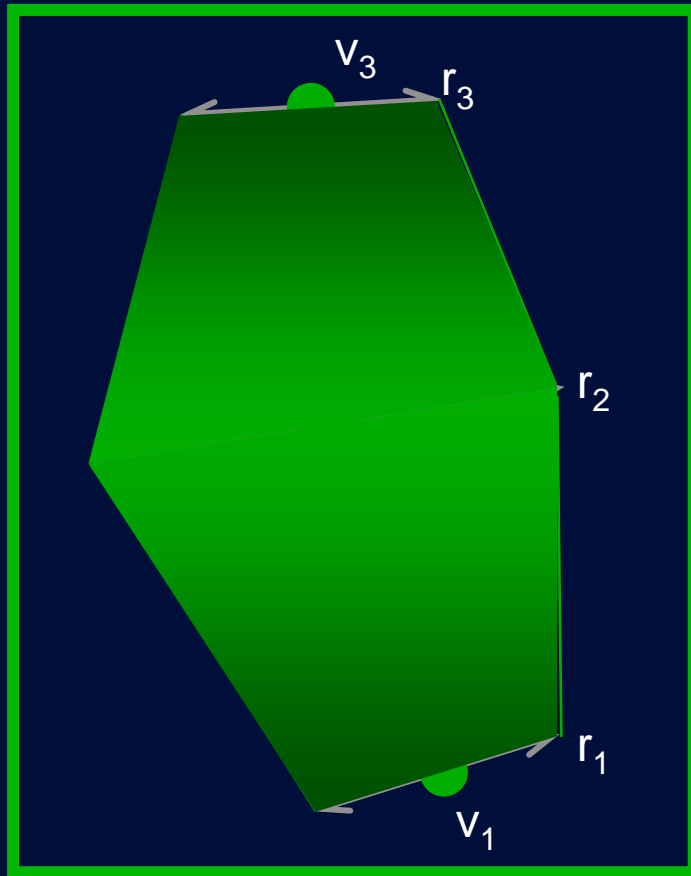
- Each vertex has its width
- „Rib“ vector  $r_i$  + scale factor [Northrup 00]

# Rendering the particles

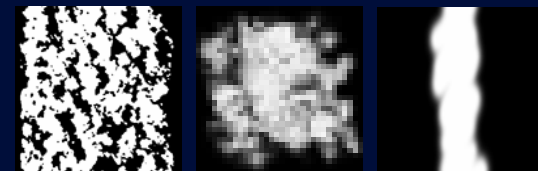


- Each vertex has its width
- „Rib“ vector  $r_i$  + scale factor [Northrup 00]
- Triangle Strips

# Rendering the particles

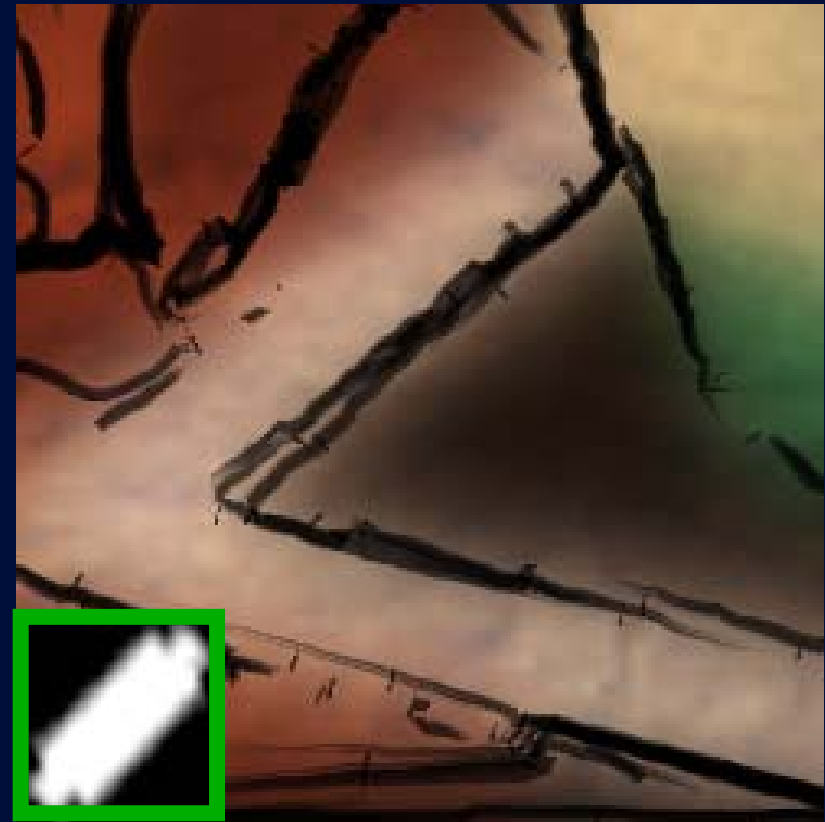


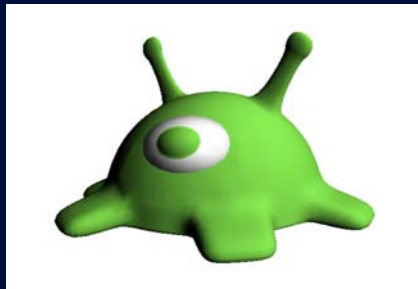
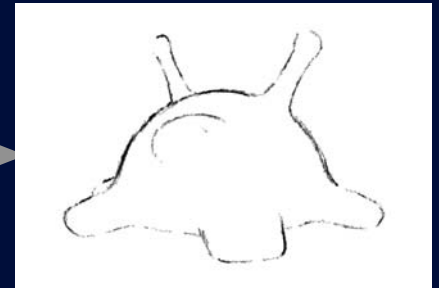
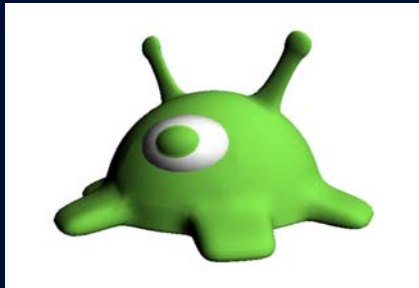
- Each vertex has its width
- „Rib“ vector  $r_i$  + scale factor [Northrup 00]
- Triangle Strips
- Alpha blending using
  - Flare function [Northrup 00]
  - Texture maps



# Close-up

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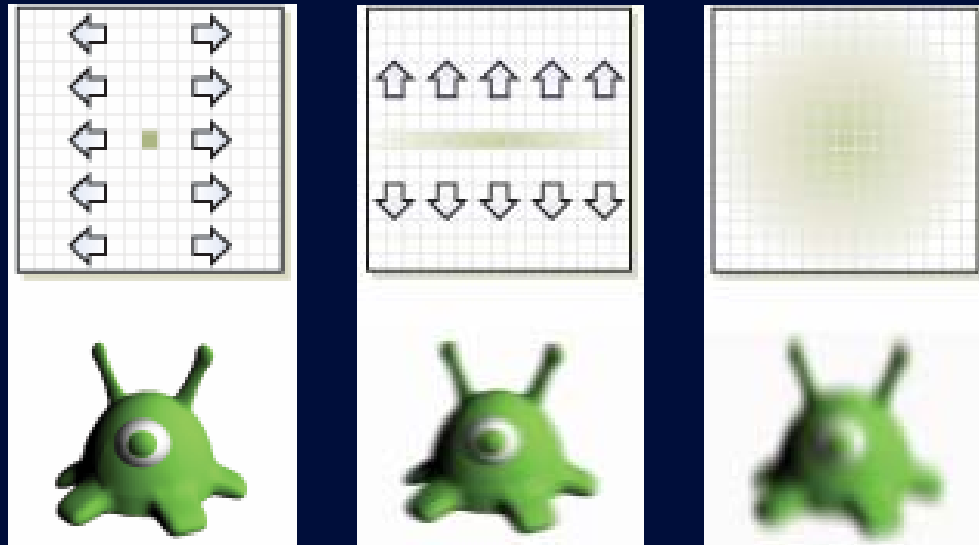




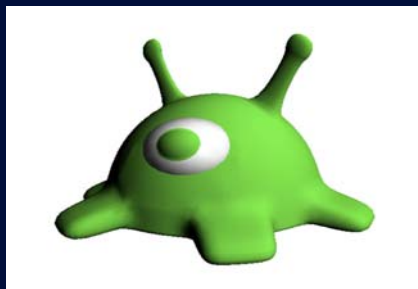
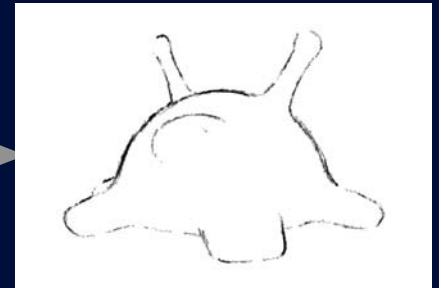
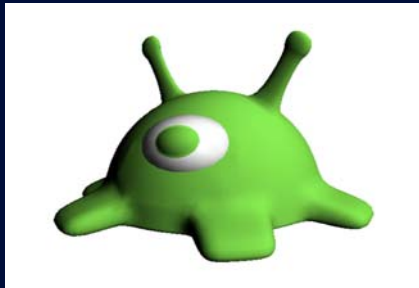
# Gaussian Blur

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- Using GPU (fragment shader)



- Easier approach: low resolution texture



# Combination with reality

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- **Virtual objects vs. Real objects**
  - Different threshold values
  - Only virtual content can be sketched
- **Real environment (video image) doesn't have a depth information**
  - Intensity color

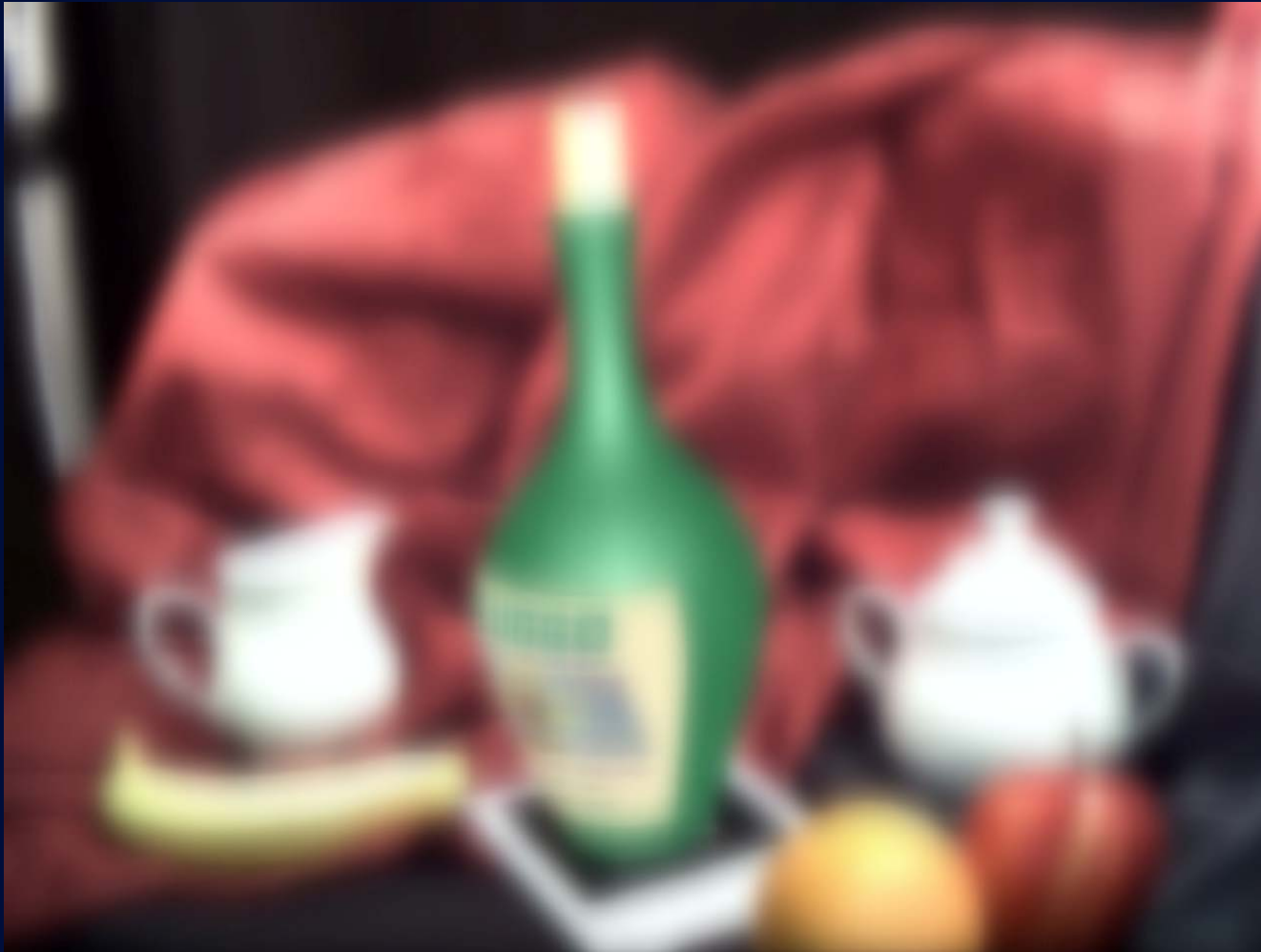
# Results

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# Gaussian blurred scenario

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# Adding paper texture

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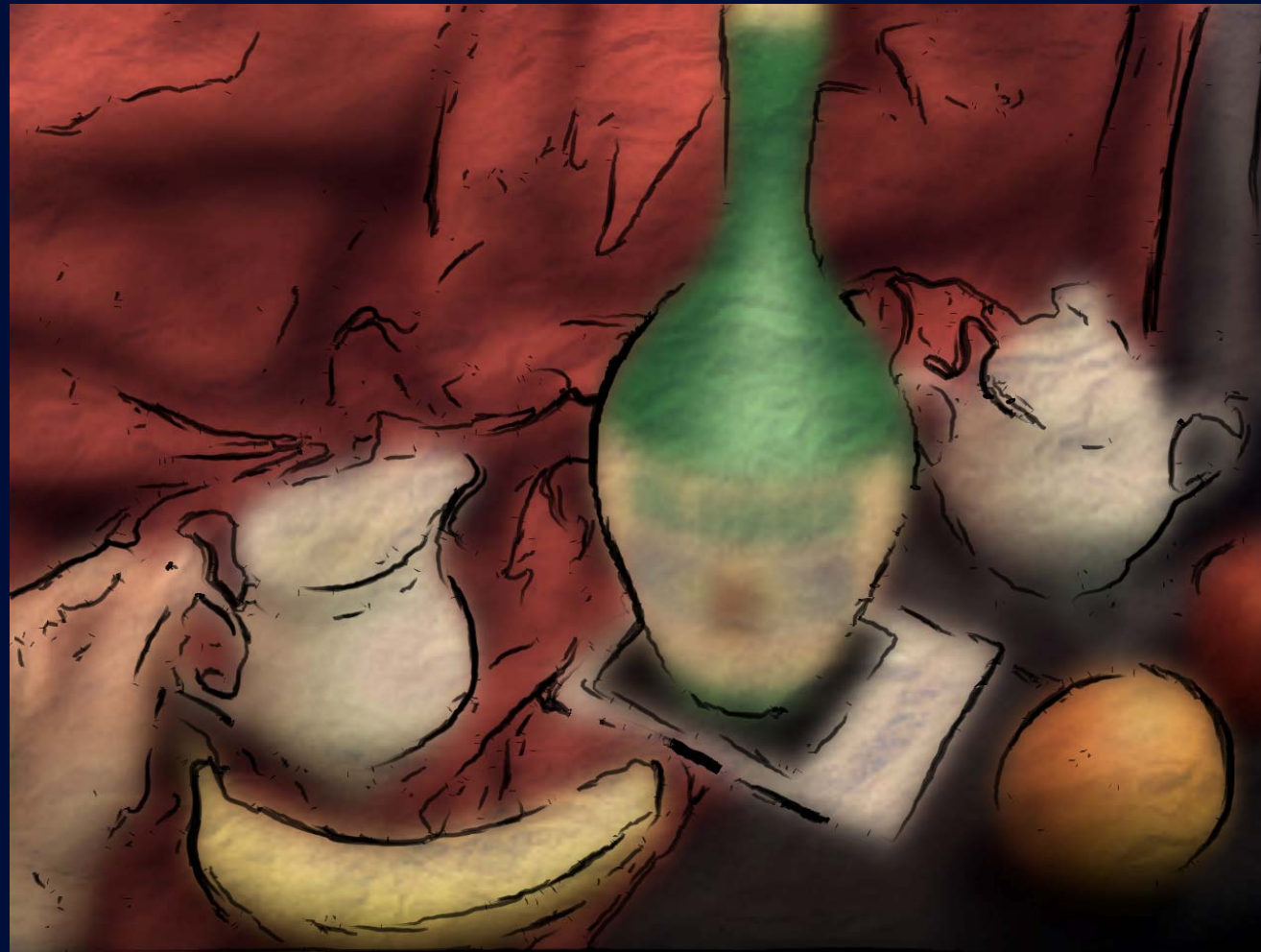


# Adding the silhouette

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# Interaction



**> 16 fps on a  
Geforce FX  
6800**

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# Conclusions

# Conclusions

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- **Real-time version of the loose & sketchy algorithm in a Mediated Reality setup**
- **Randomization vs. frame-to-frame coherence [Kalnins et al. 2003]**
- **Better results by using:**
  - **Depth image, Normal image, & Intensity Image**
- **Formal Evaluation**
- **Does it make sense to use NPR techniques in a Mediated Reality setup?**



# Questions?

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