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## Expressive Compositing for Augmented Reality

Xavier Granier, Jiazhou Chen

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# Expressive Compositing for Augmented Reality

Xavier Granier & Jiazhou Chen



# Expressive Compositing for Augmented Reality

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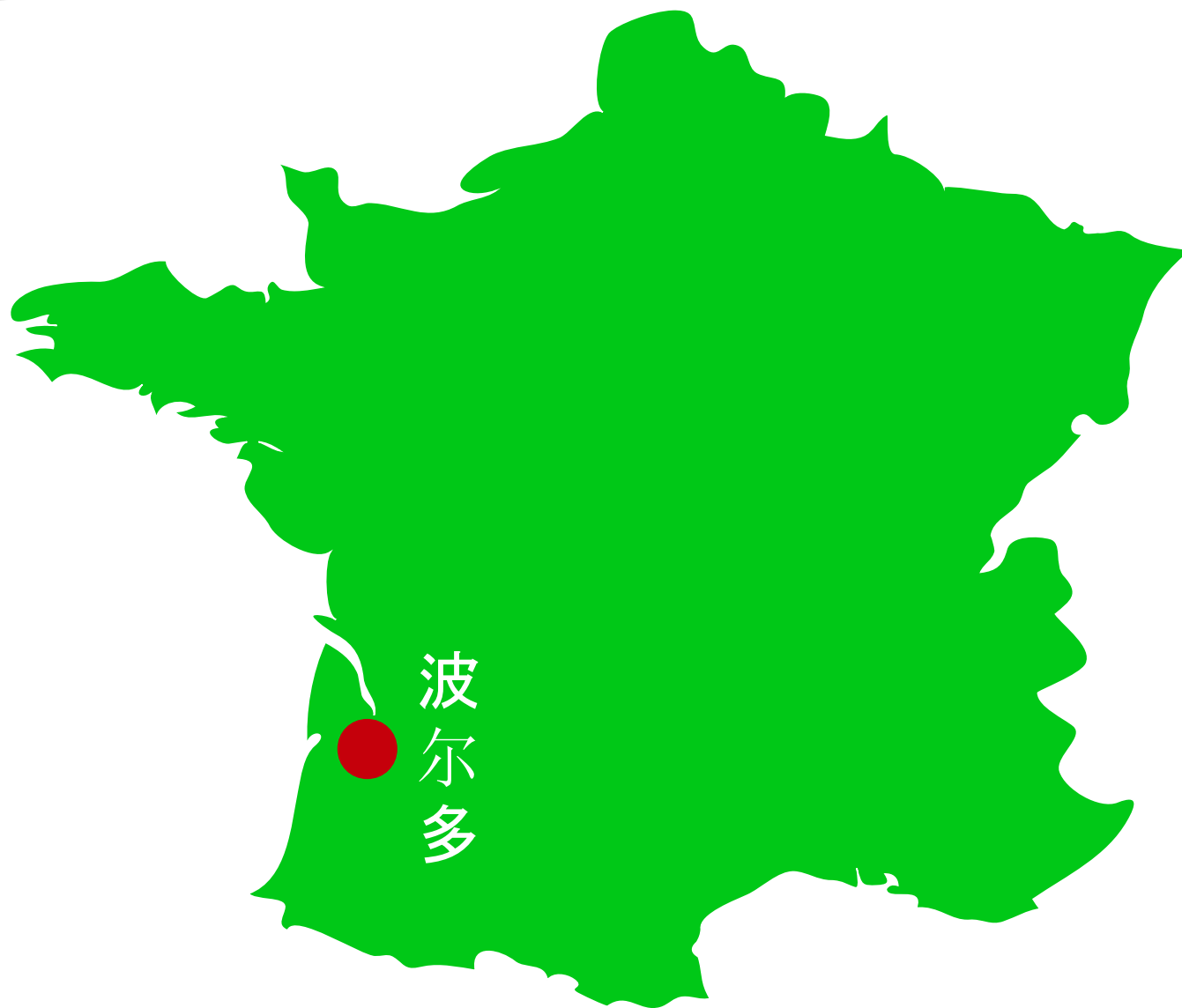
*Inria*



INSTITUT  
d'OPTIQUE  
GRADUATE SCHOOL



# 玛瑙科研组在哪里？



法国

# 玛瑙科研组是什么？

◦ Joint team



◦ Goals

LP2N

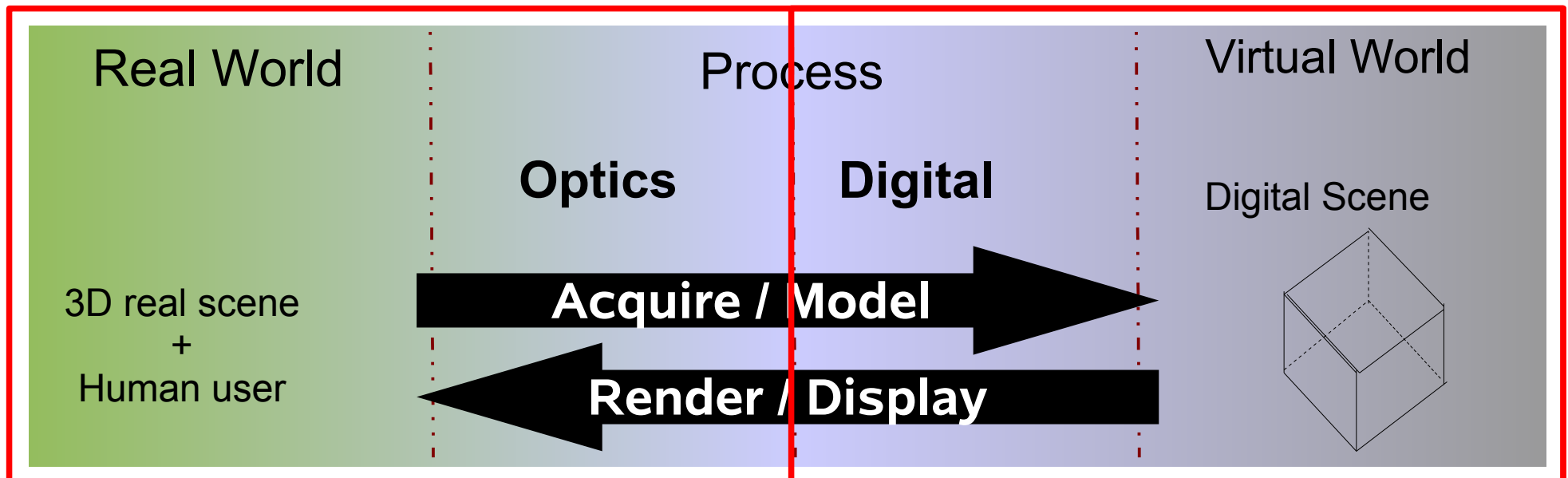


- **Study, model, acquire** interactions between light, shape and matter
- **Take into account observers** (humans or sensors)
- 4 axes
  - Analysis and Simulation
  - Acquisition and Display
  - Rendering, Visualization and Illustration
  - Creation and Edition

# Our approach: beyond Computer Graphics

A **global view but specialized** of processes

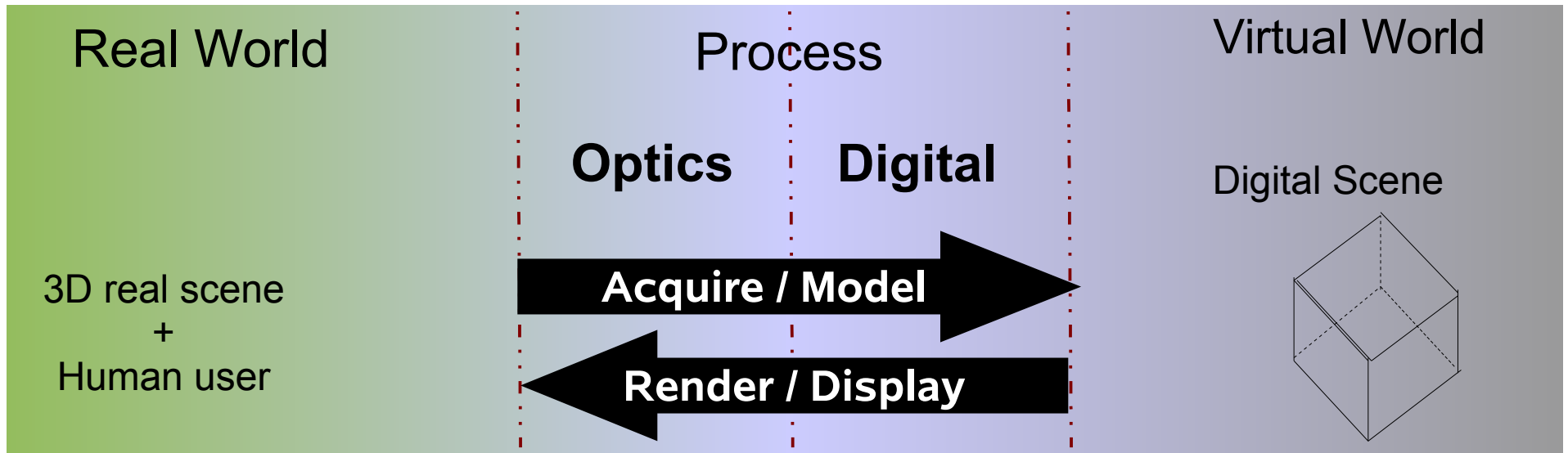
- **Real World:**
  - Physics and Optics laws
  - Human abilities
- **Virtual World:** models & algorithms



# Our approach: beyond Computer Graphics

A **global view but specialized** of processes

- **Real World:**
  - Physics and Optics laws
  - Human abilities
- **Virtual World:** models & algorithms



# Members



**Xavier Granier**  
Inria Research Scientist



**Jannick Rolland**  
Professor @ Rochester & Optics Institute



**Christophe Schlick**  
Professor @ Univ. Bordeaux

+2 Postdocs  
+5 PhD Students  
+3 Master Students



**Pascal Barla**  
Inria Research Scientist



**Gael Guennebaud**  
Inria Research Scientist



**Ivo Irhke**  
Inria Research Scientist



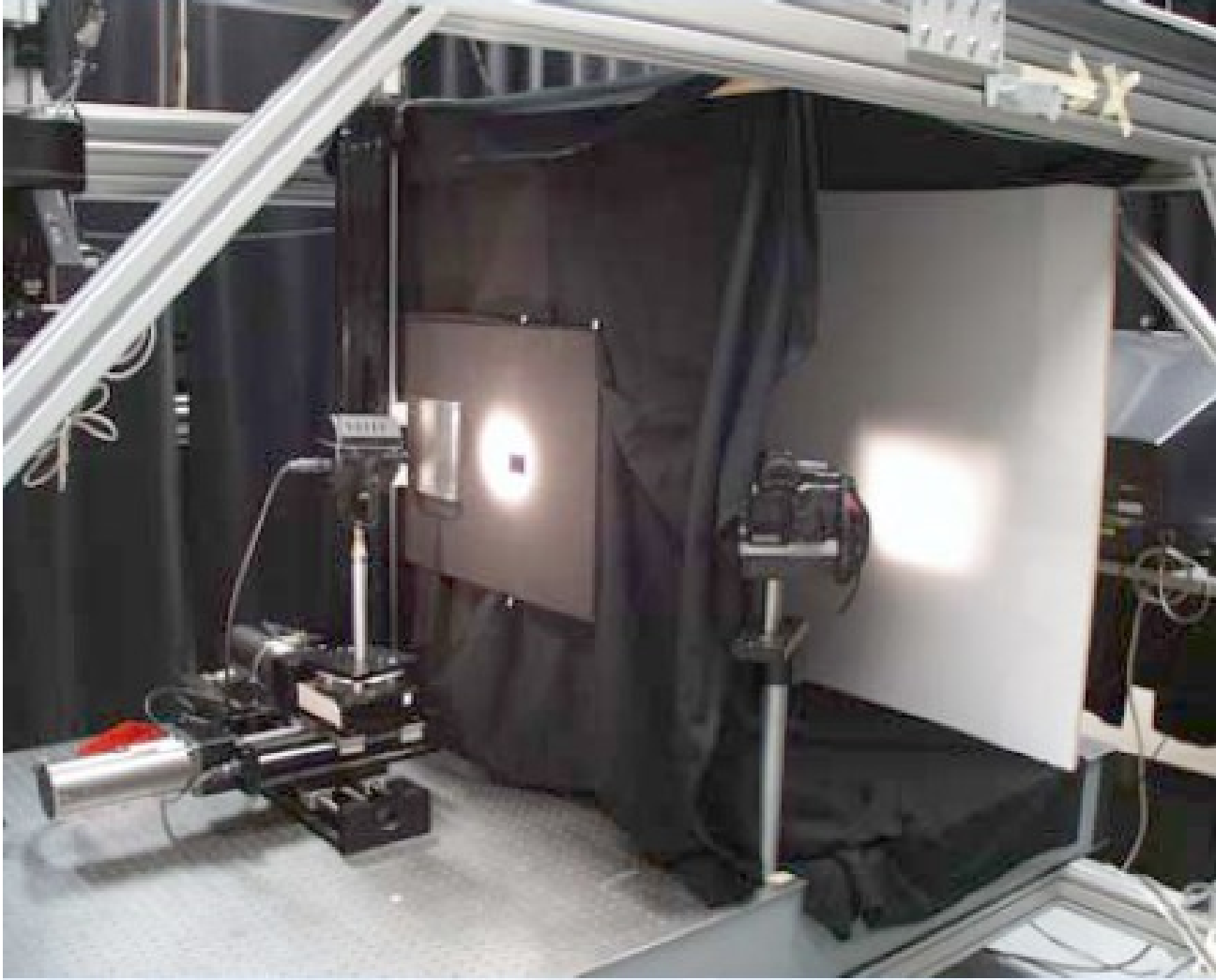
**Romain Pacanowski**  
CNRS Research Engineer



**Patrick Reuter**  
Assistant Professor @ Univ. Bordeaux



# New Setup and Rendering



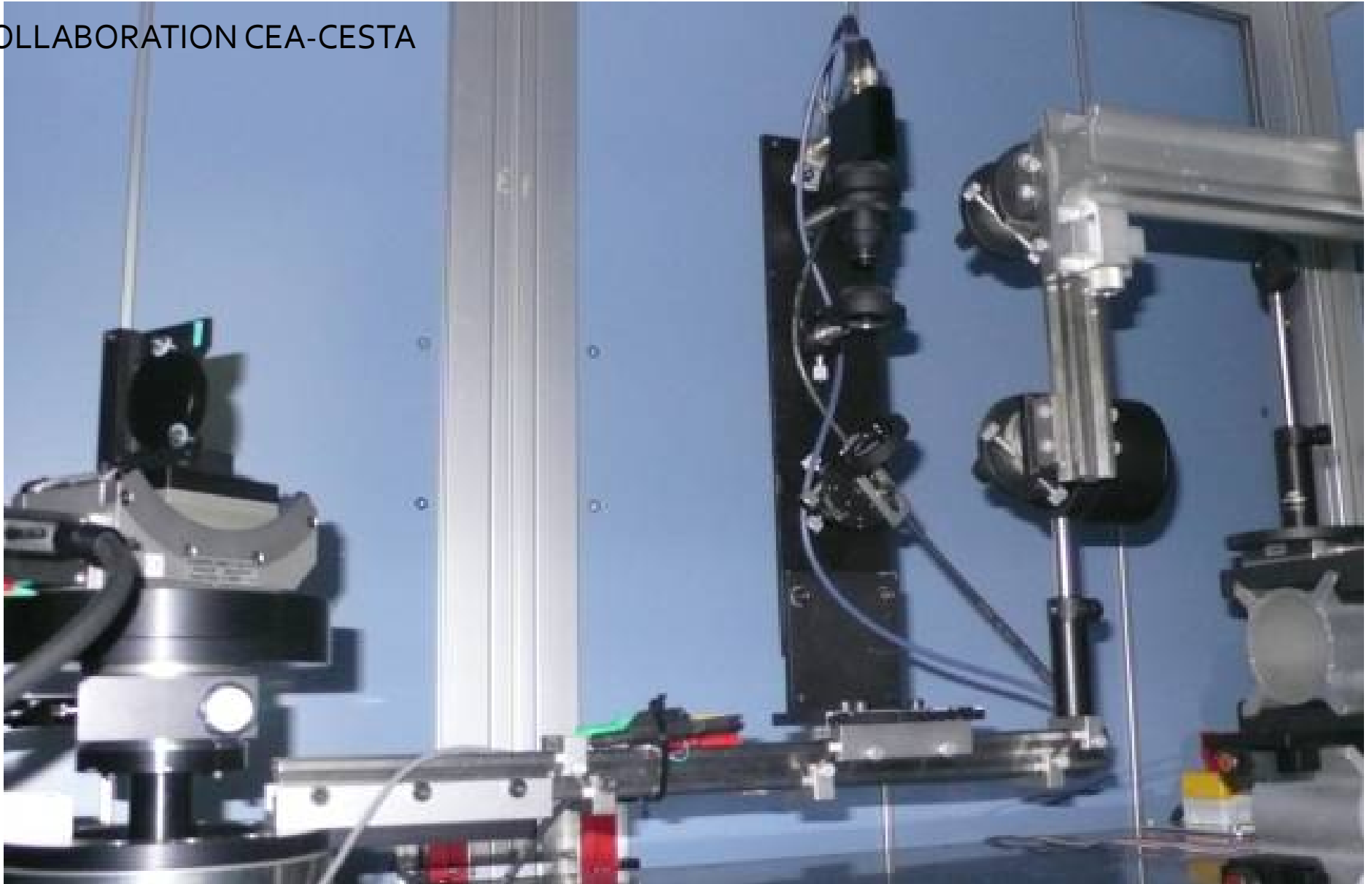
TEAM

Ex. AR

Conclusion

# BRDF Acquisition

COLLABORATION CEA-CESTA

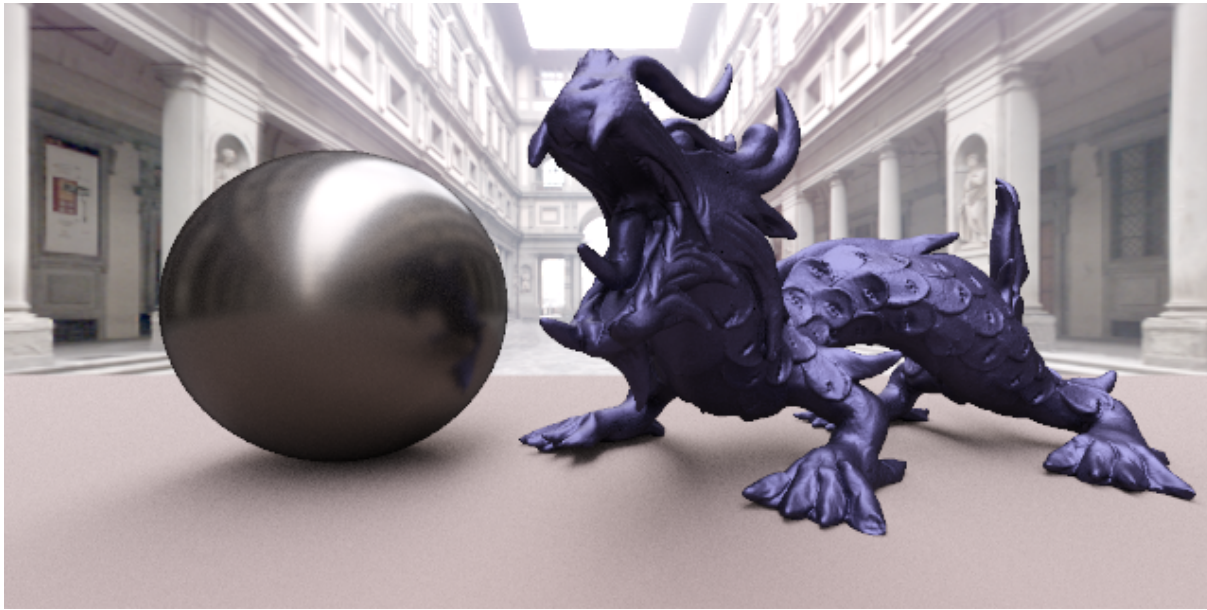


TEAM

Ex. AR

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# Accurate Approximation of BRDF



Original Data  
99 MB

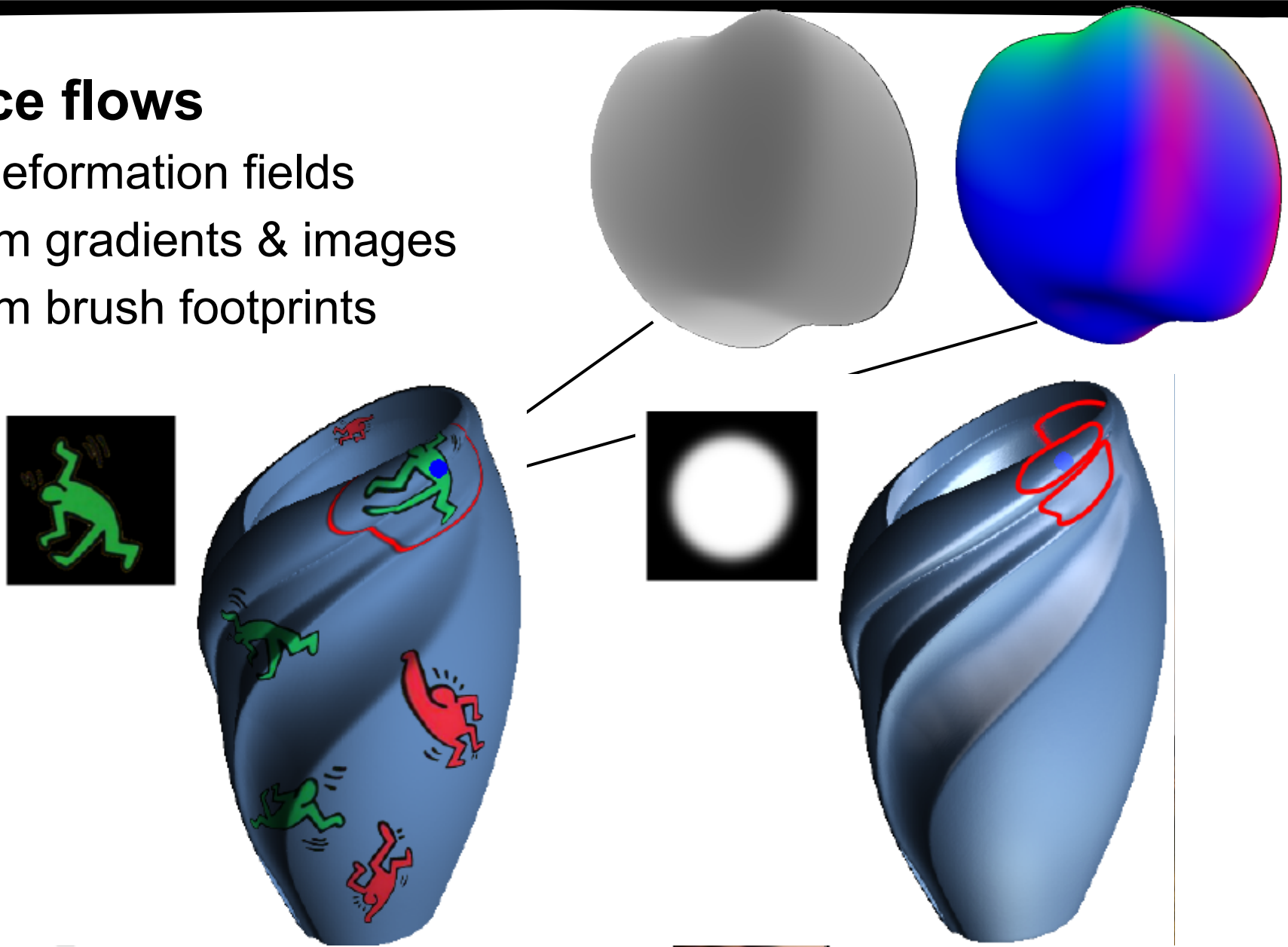
Approximation  
1,7 kB



# Shading by Image Deformation

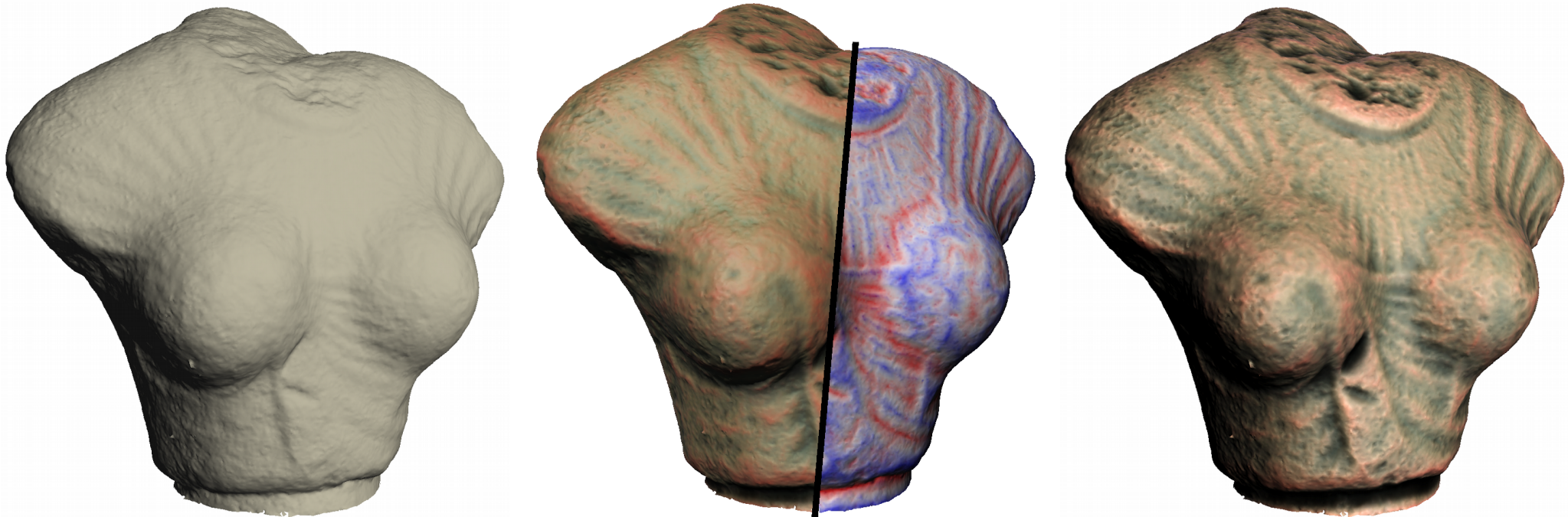
- **Surface flows**

- Two deformation fields
- Deform gradients & images
- Deform brush footprints



# Illustrative Shading

- Based on new relief analysis
  - **Non-local**: features in neighborhood
  - **Multi-direction**: better anisotropy / filtering
  - **Multi-scale**: feature size



# AR: Tracking of Outdoor Lighting



TEAM

Ex. AR

Conclusion

[Liu & Granier – IEEE VR 2012]

# Expressive Compositing for Augmented Reality



Inria



State Key Lab of CAD&CG, Zhejiang University

# Motivation

- Visualization of **underground pipelines** in video streams
- With visually **correct occluding order**
- **Without 3D geometry** of the real environment



Artistic painting on a street



# Motivation

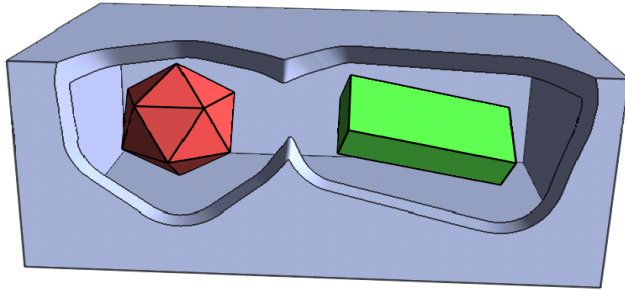
- Visualization of **underground pipelines** in video streams
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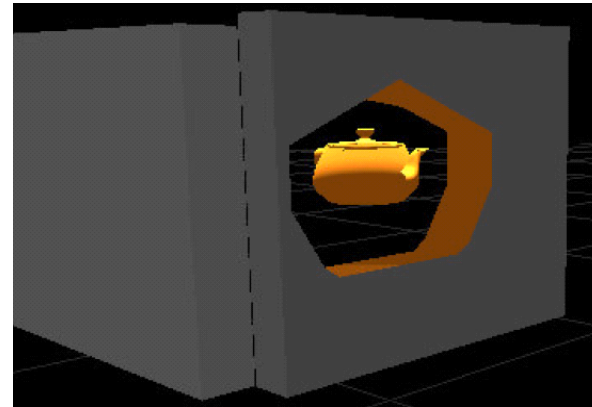
Artistic painting on a street

# Related work

## ◉ Cutaways

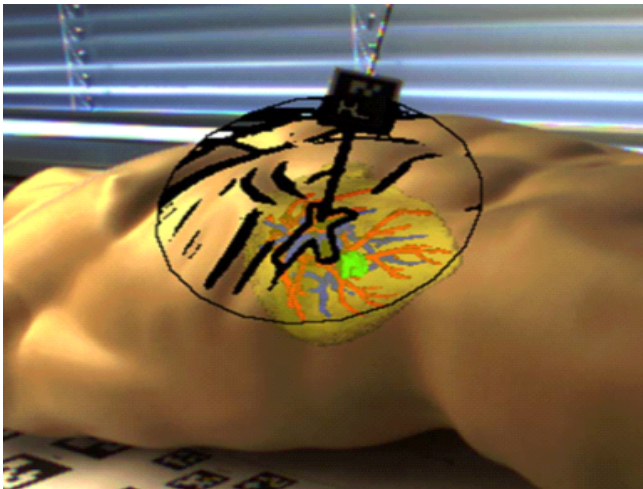


[Burns & Finkelstein 2008]

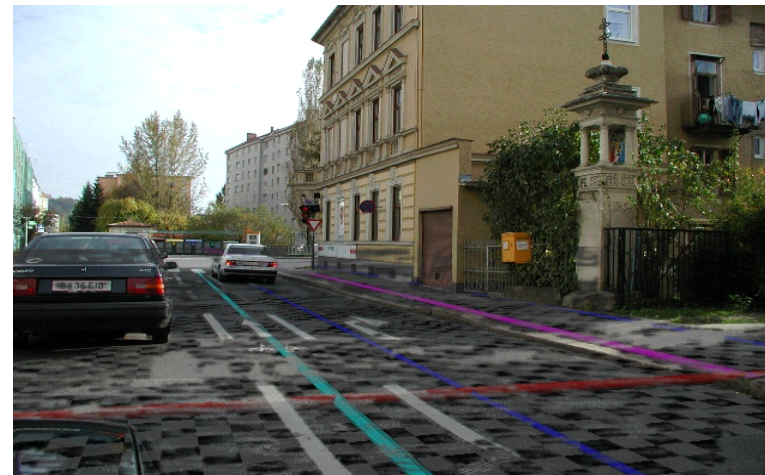


[Coffin et al. 2006]

## ◉ Transparency (**Focus+Context** rendering)



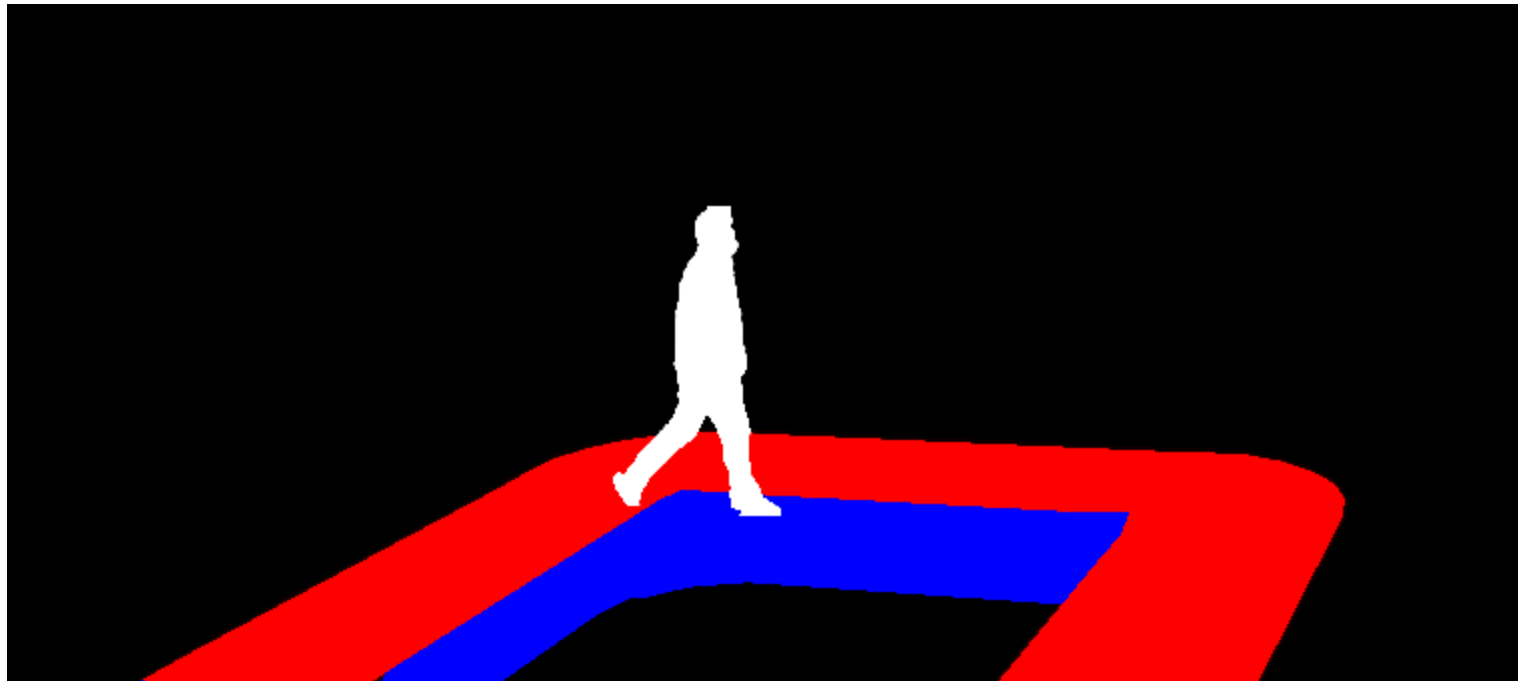
[Kalkofen et al. 2007]



[Zollmann et al. 2010]

# Segmentation into Depth-ordered Regions

- Video segmentation [Zhong et al. 2009]
- Separation of front and back faced surfaces



□ Moving Context

■ Main Focus

■ Static Context

■ Second Focus

# Region-based Compositing

- Moving contexts on the top
- Transparency for second focus



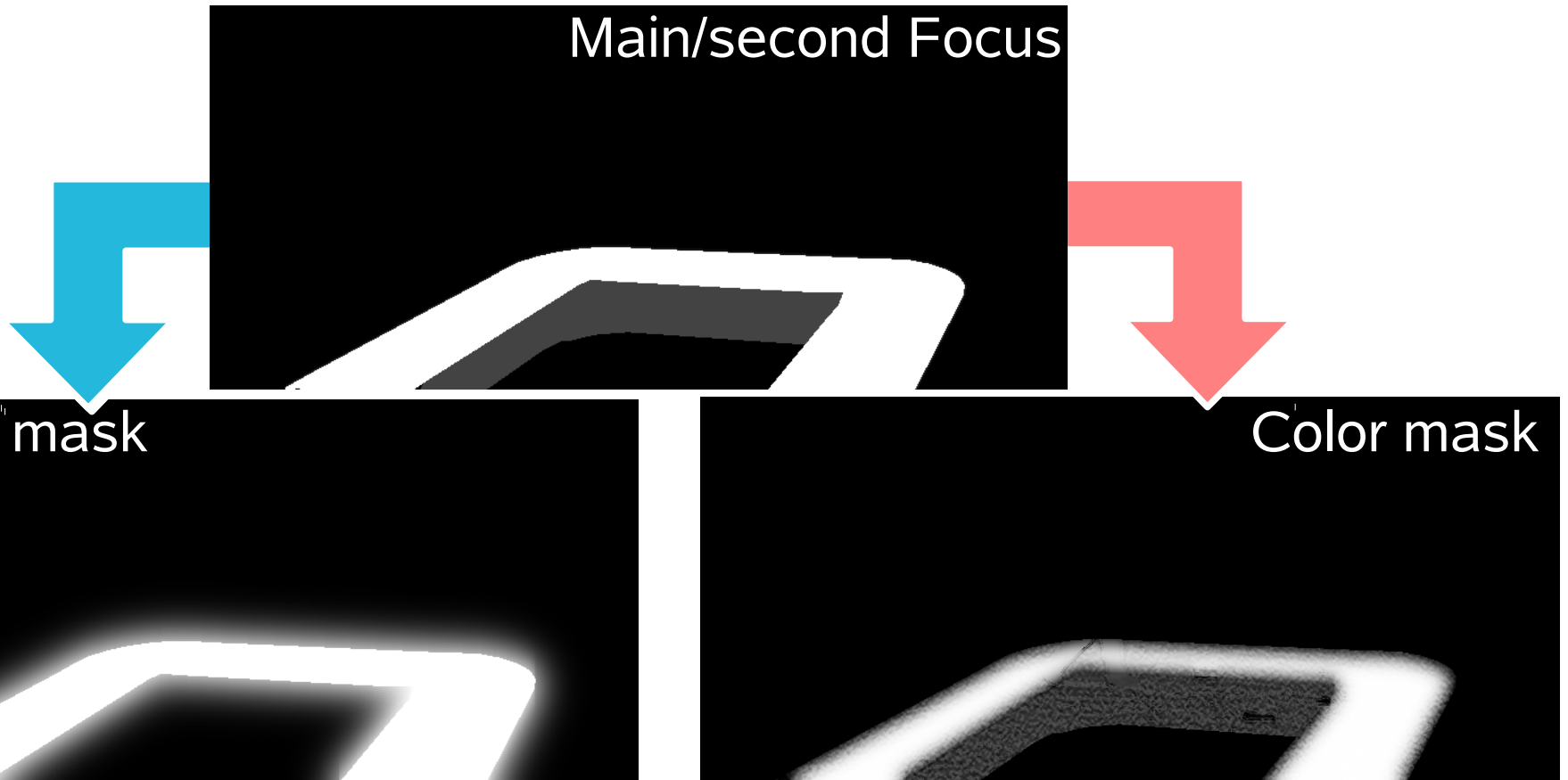
# Depth Cues Using Contours

- **Contours** from pipelines and video streams
- But, boundary-breaking problem



# Compositing Masks

- To preserve the **context continuity**
- Smooth outside using Gaussian filter
- Smooth inside using cross bilateral filter [Eisemann et al. 2004]



# Final compositing

- ◉ **Contrast enhancement**
  - ◉ around contours



Unsharp masking [Badamchizadeh et al. 2004]

# Final compositing

- ◉ **Contrast enhancement**
  - ◉ around contours



Unsharp masking [Badamchizadeh et al. 2004]



# Result using a Tunnel Cutaway



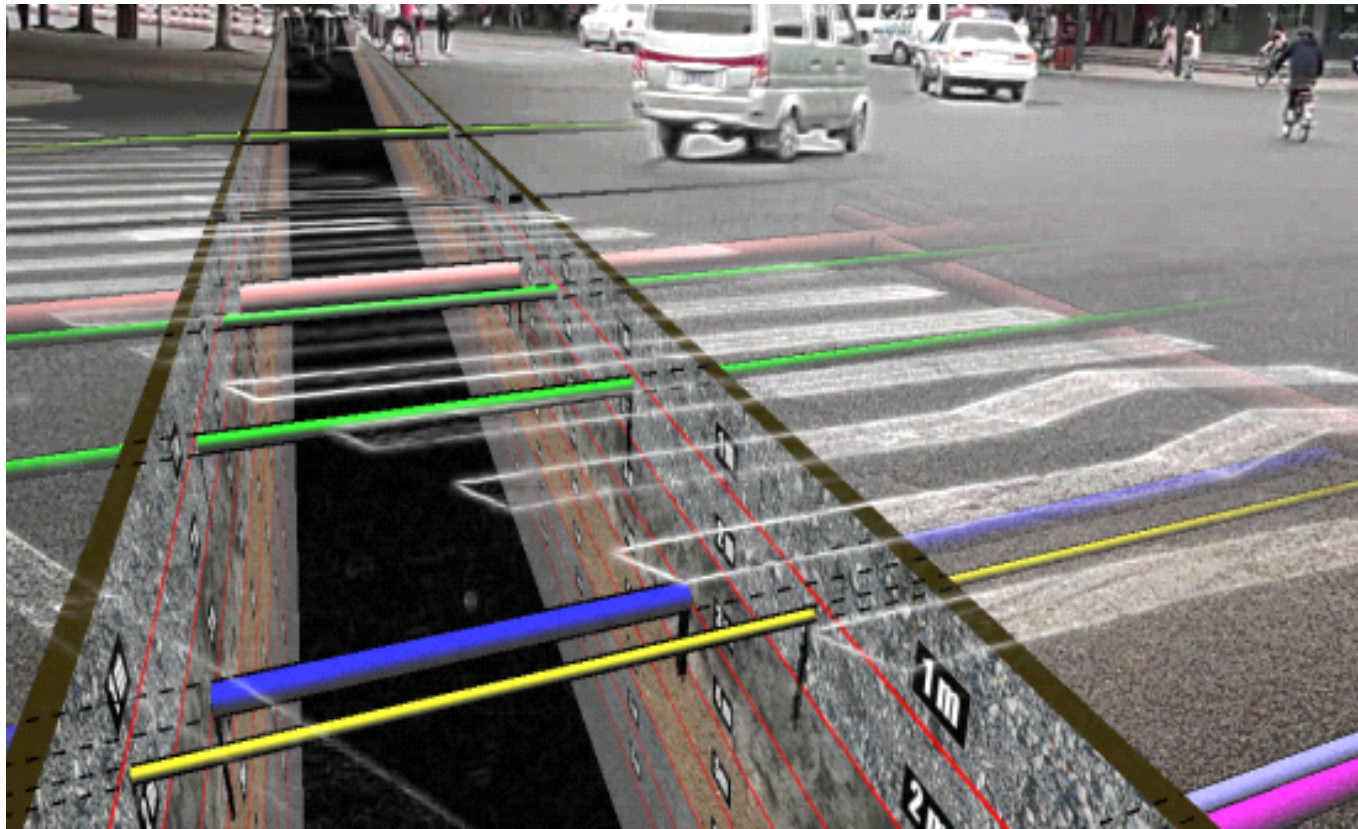
TEAM

Ex. AR

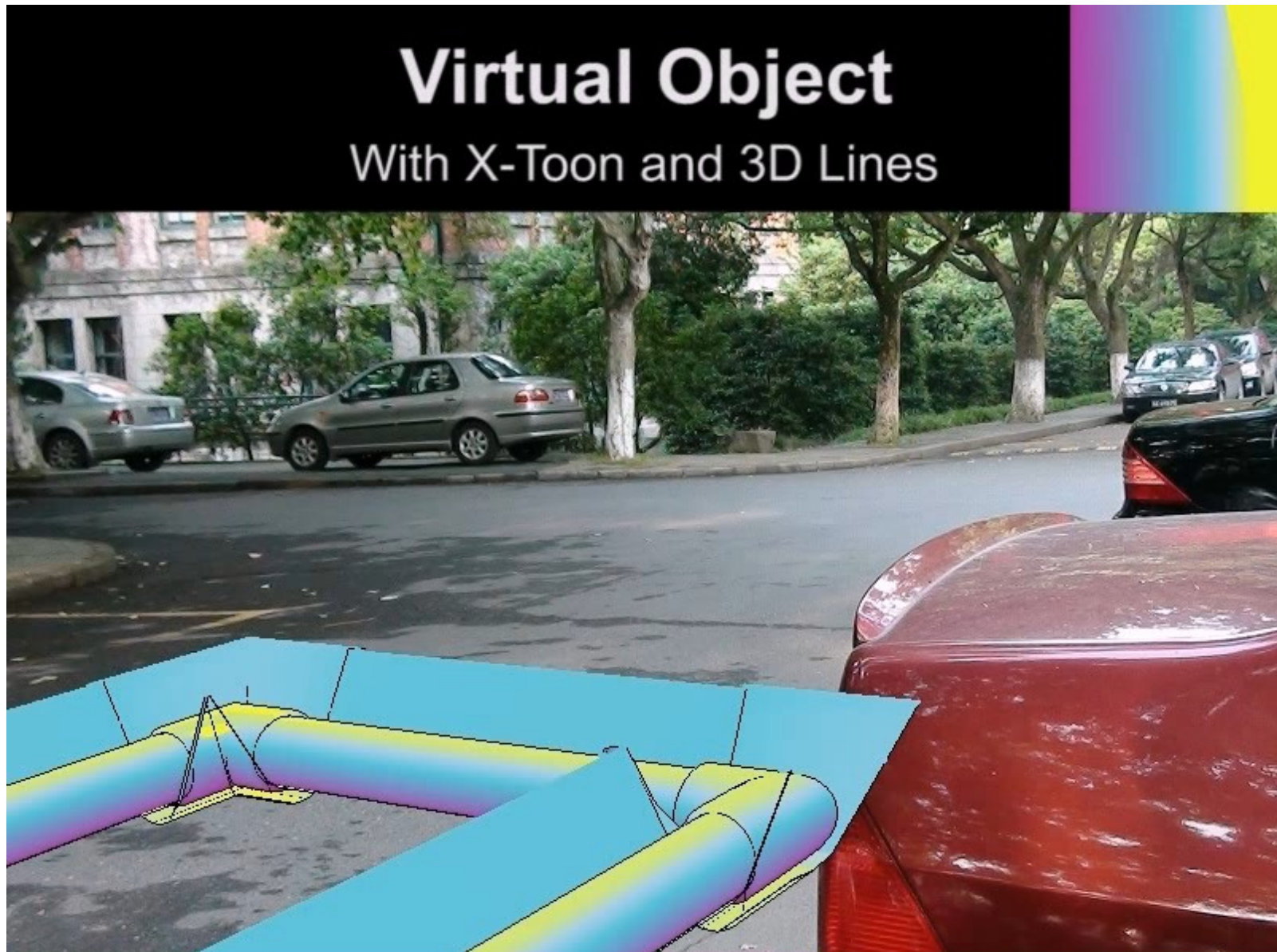
Conclusion

# Result using other Cutaway Geometry

- ◉ Shadow casting
- ◉ Depth marks



# Video 1



# Video 2

## Video: Walking (with Magic Lens)



# Conclusion

# Summary & Limitations

- **Expressive Rendering**
  - Better visualization of occluding order
  - Do not require 3D geometry of the real environment
- **Limitations**
  - Moving camera
    - Camera registration
  - Quality of contours
    - Need improved contour detection
  - Only planar geometry

谢谢！  
Merci！



<http://manao.inria.fr>



State Key Lab of CAD&CG, Zhejiang University

<http://www.cad.zju.edu.cn/>