

1 OCT 2010, RUC

*Virtuality, Augmentation, Design
and the Arts*



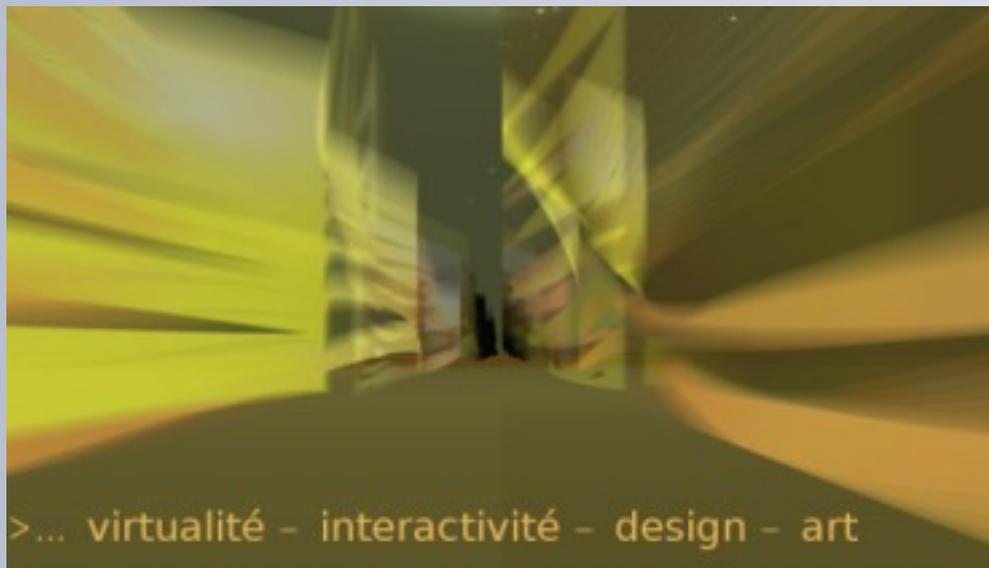
*Christian Jacquemin, LIMSI-CNRS
and University Paris 11, Orsay, France*

AR
in Public
Space
@ RUC

purpose of the presentation

→ *present some research
projects in arts & science
in which I have been
involved*

→ *synthesis on protocol
and solutions*



LIMSI by numbers

→ 120 permanent researchers and
administrative staff

→ 80 PhDs & postdocs

→ 2/3 computer science
1/3 physics



LIMSI by topics

→ *Spoken, written and gestural language processing*

→ *Multimodal perception and interaction*

→ *Augmented and Virtual Reality*



AR
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@ RUC

Virtuality, Interaction, Design, & Art (VIDA)

→ **seminars:**

2008-09: 4 seminars on simulation & materialization

→ **research projects:**

you will see some of them



→ **collaborations:**

with artists, culture centers, associations, companies...

*AR
in Public
Space
@ RUC*

augmented virtuality

AR
in Public
Space
@ RUC

augmented virtuality

trompe-l'oeil artwork

→ *multiple cameras*
for multiple projections
→ *viewer's location*
is constrained



Espaces Indicibles
Incidents Mémorables

May 2007

AR
in Public
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augmented virtuality

stereoscopic artwork

→ *double camera for stereo rendering*



Bertrand Planes

Gate:3.5

Artcore 2007

augmented virtuality

realistic shadow

(1) ***natural shadows*** through shadow mapping

(2) ***video-based shadowing***



→ *increase the feeling of presence*

→ *allow for non tactile contact*

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augmented virtuality

augmenting VR with shadow

→ *video-based shadowing*

Bertrand Planes

Mar3D

La Paz 2006

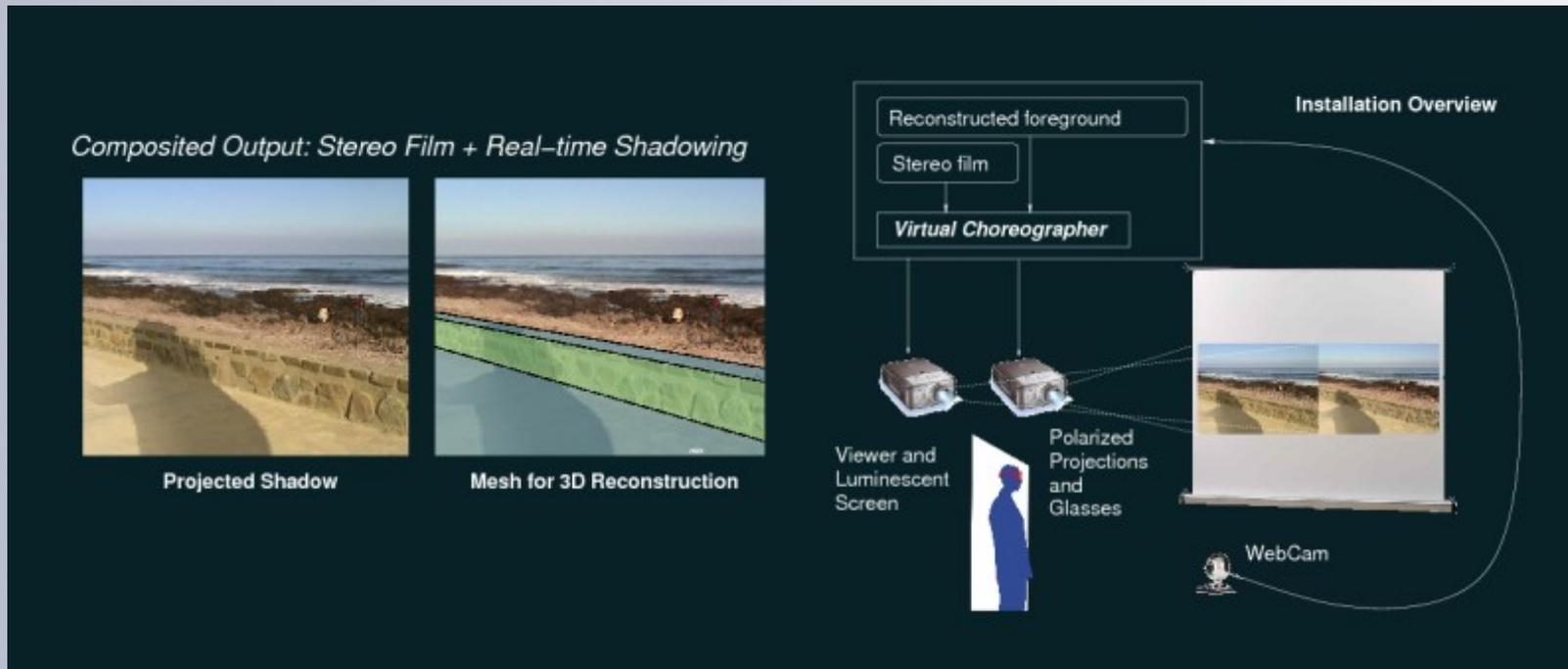
Rami Ajaj & Fabien Pigeaud



AR
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augmented virtuality

3D reconstruction for shadowing



AR
in Public
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@ RUC

augmented virtuality

*augmenting VR with
shadow*



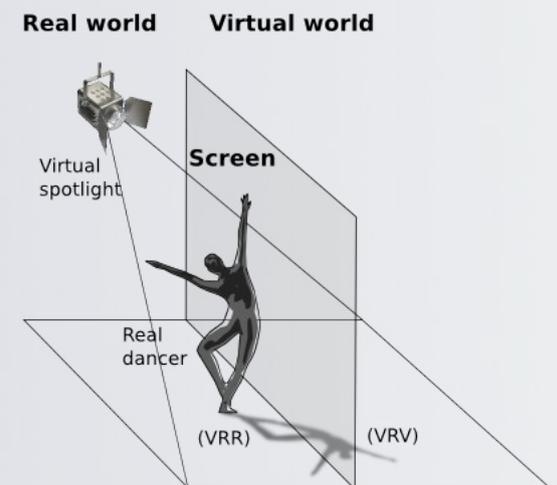
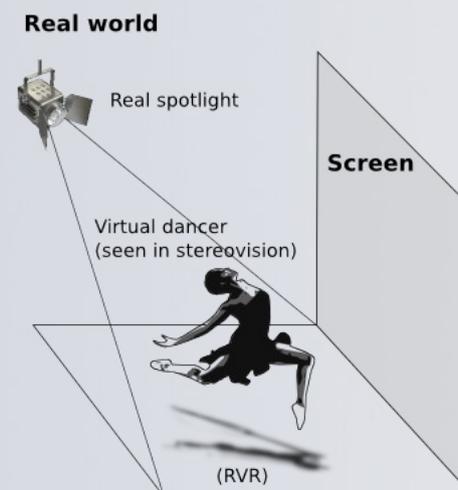
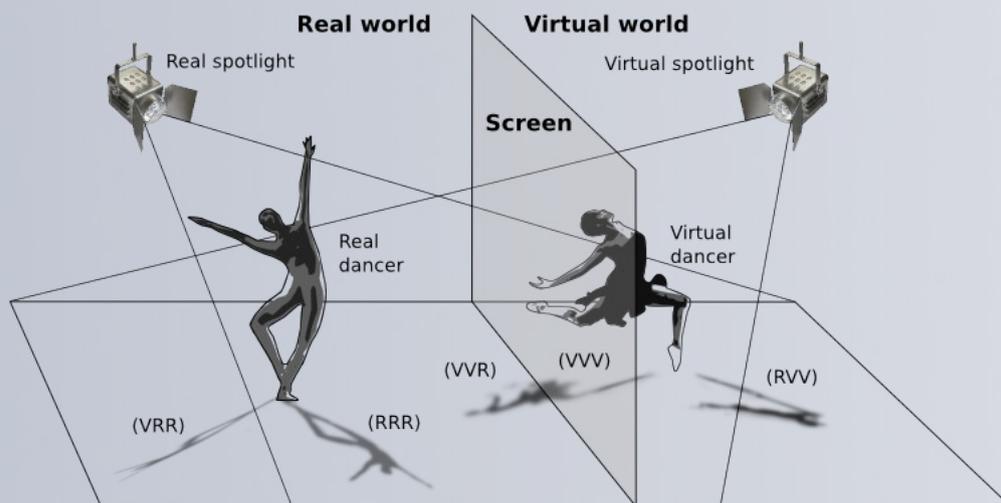
→ **related works:**

- *virtual shadows in VR (Naemura et al. 2002)*
- *shadows in augmented reality (Haller et al 2003)*

AR
in Public
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@ RUC

augmented virtuality

*some issues
in shadow continuity*

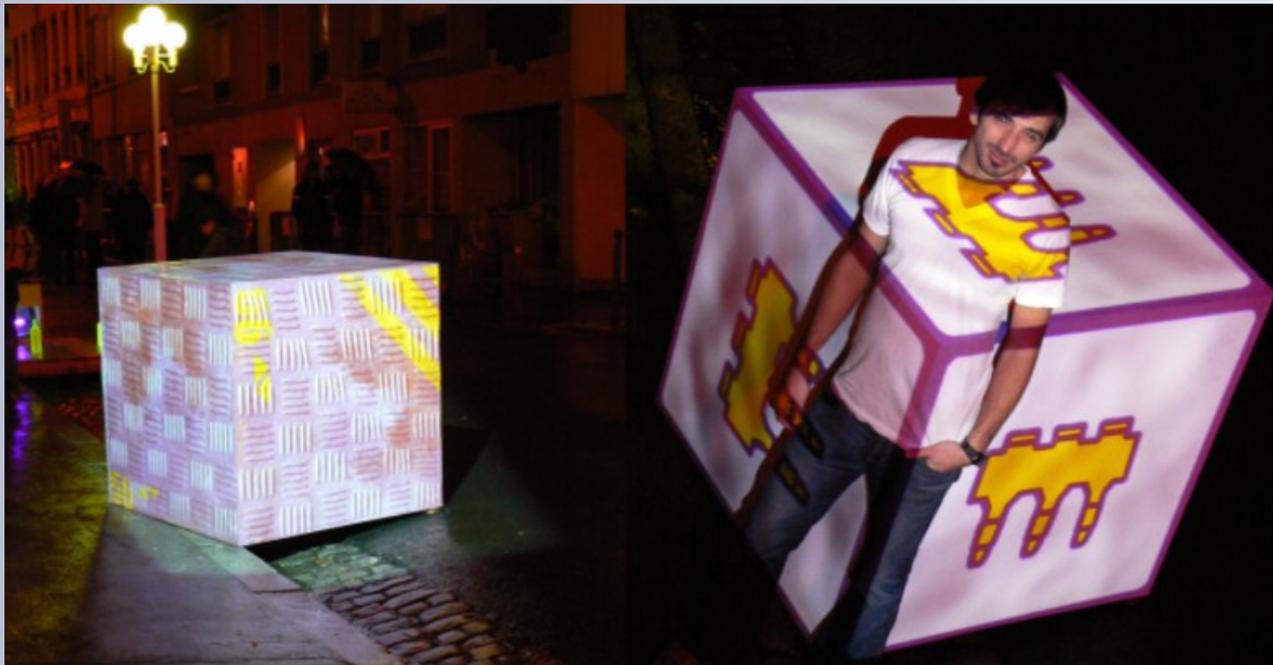


AR
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*(static) augmented
reality*

AR
in Public
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AR for open air installations



→ *virtual texture
mapping*

Bertrand Planes

Bump it! Superflux

Lyon Lumieres 2006

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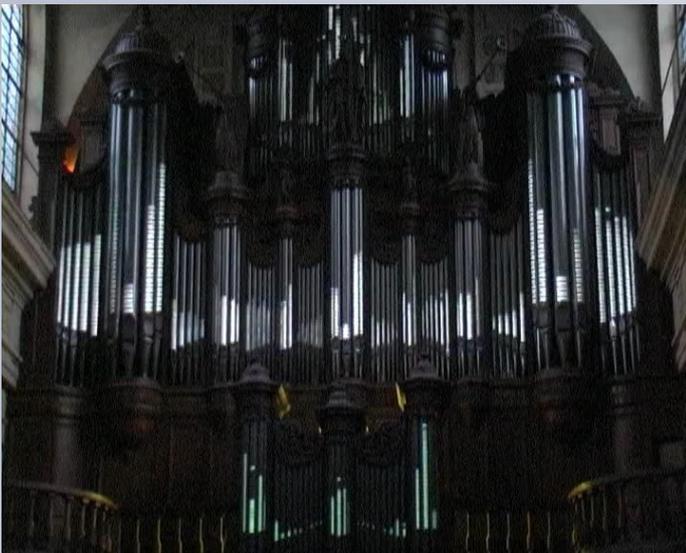
multimedia architectural AR

*multimodal
synchronization*

→ *real-time **sound analysis**
and network communication*

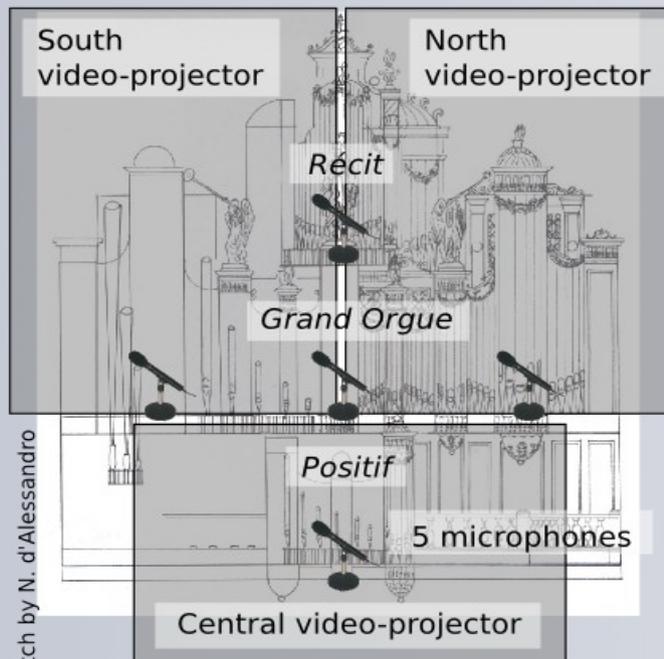
→ *audio & graphic
multi-channeling*

→ *audio & graphic **special effects**
(display of peak values)*

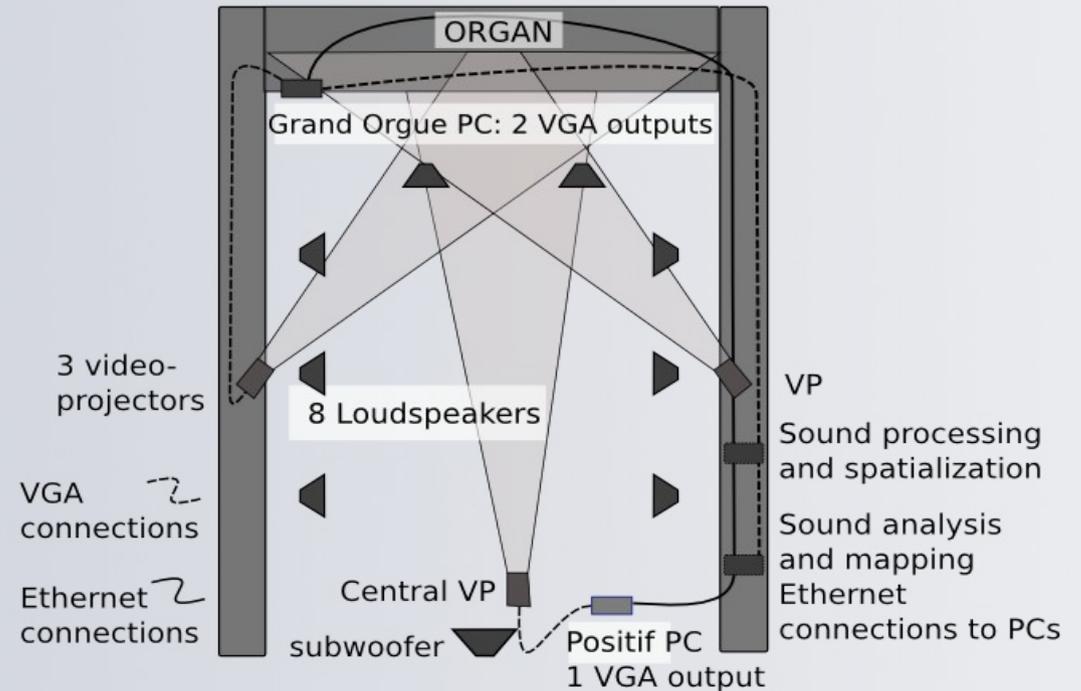


multimedia architectural AR

FRONT VIEW



TOP VIEW



multimedia architectural AR

FOUR-LAYER COMPOSITING



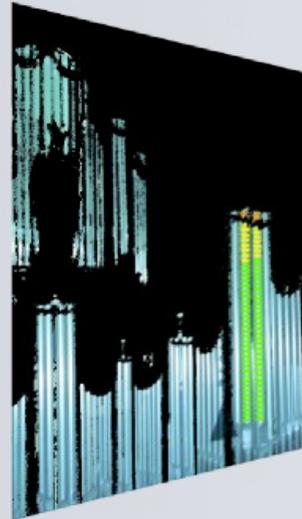
Background layer



VU-meter layer



Mask layer



Keystone layer

VU-METER ANIMATION

Input values received by the vertex shader from the mapping component

Maximum value

Instantaneous value

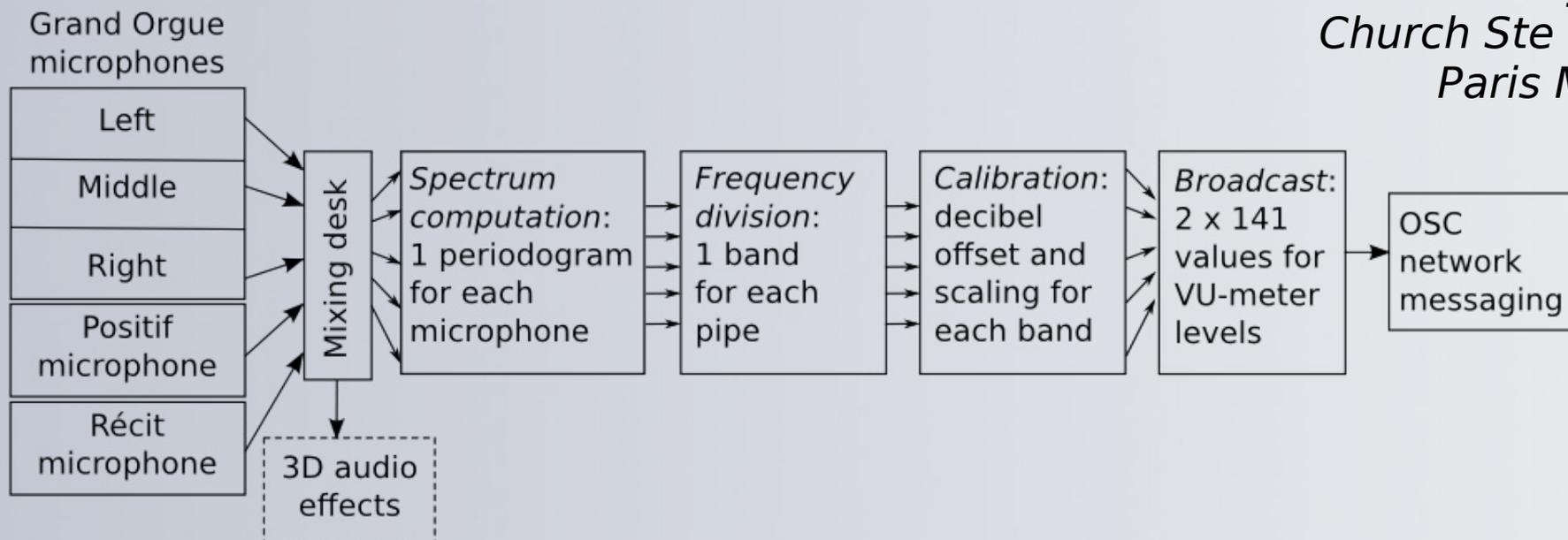
3 sampling values computed by the vertex shader and received by the fragment shader



multimedia architectural AR

→ audio & graphic multi-channeling

Rami Ajaj
Christophe d'Alessandro
Markus Noisternig
Bertrand Planes
Organ & AR
Church Ste Elisabeth
Paris May 2008



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audio AR

*multi-listener
spatialized audio*

*→write and play a spatialized
audio composition
for up to 200 listeners
through wireless network*



audio AR

*multi-listener
spatialized audio*

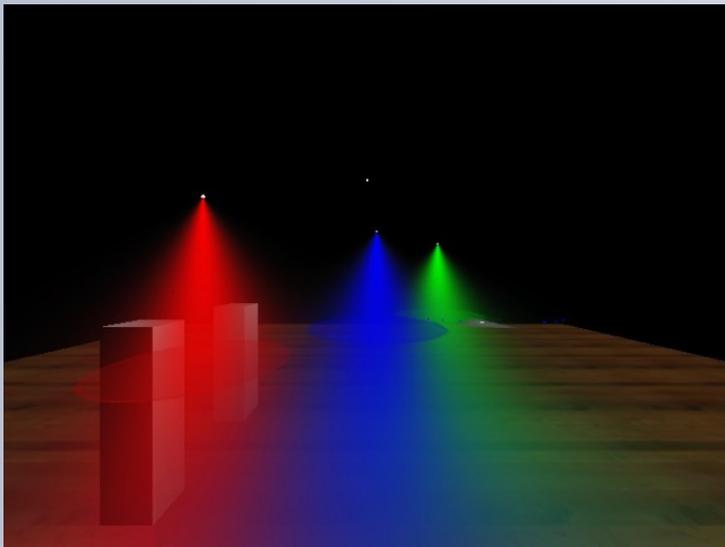
→ **single geometry** vs. multimodal outputs

→ **virtual listeners**

→ **multipurpose**

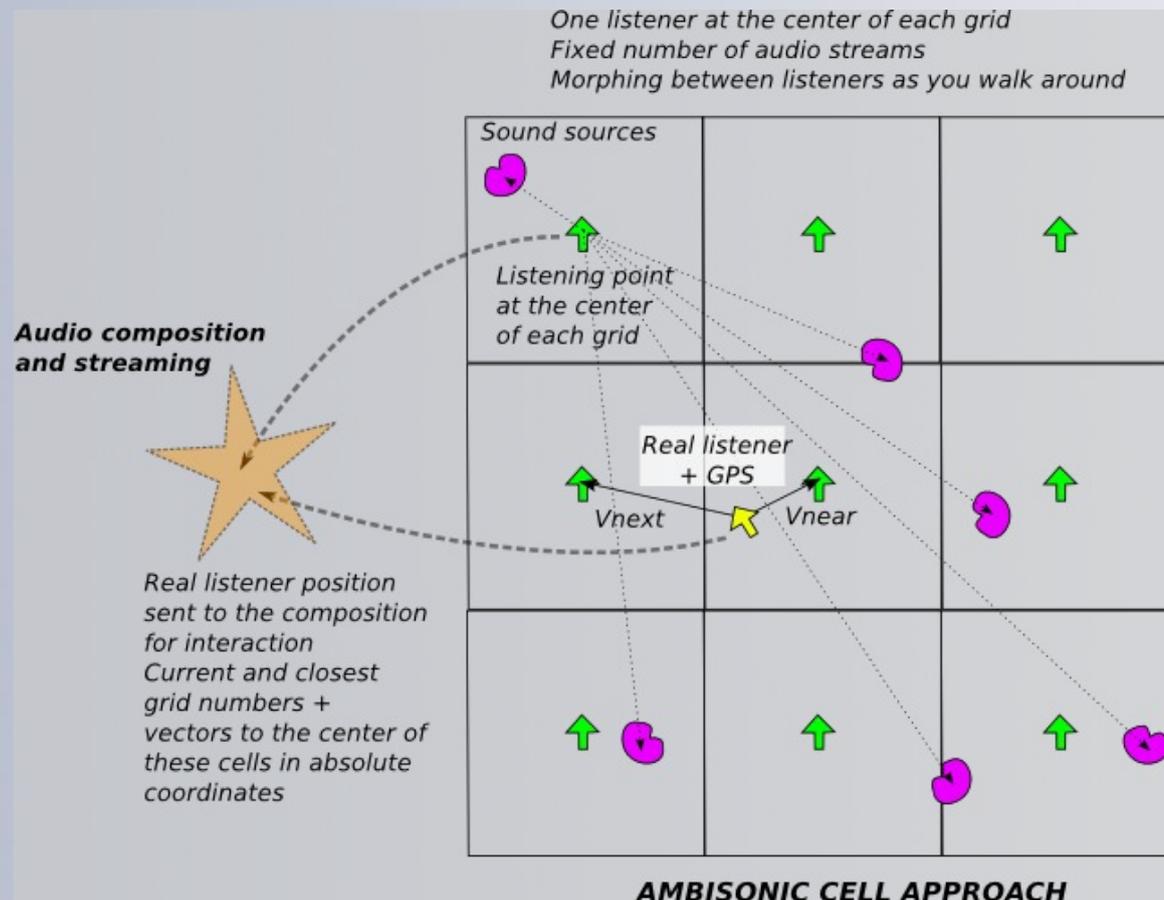
graphical interface:

- *spatialized sonic composition*
- *audio rendering computation*
- *graphical advanced rendering*



audio AR

→ *virtual listeners*



SoundDelta

2007-2009

Wai Kit Chan

Brian Katz

Perrine Monjoux

Nick Mariette

Marcus Noisternig

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*(in situ) augmented
reality*

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in situ AR

→ **Genius Loci** project
recycling 3D digital heritage into in situ Augmented Reality



Partners

MAP-GAMSAU

(Livio de Luca)

Laboratoire Victor Vrit

(Veronique Caye)

LIMSI-CNRS

(Emmanuelle Frenoux

Sonia Dahdouh)

Chartreuse-ls-Avignon

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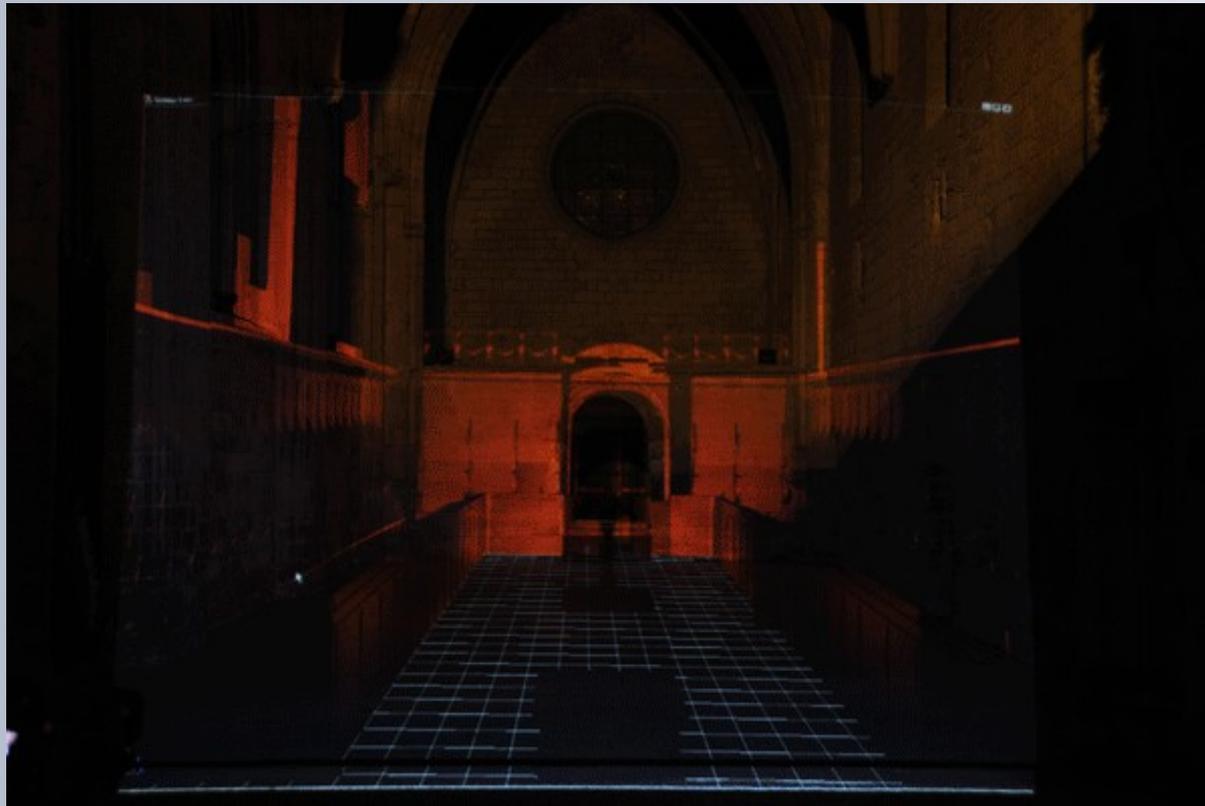
in situ AR

→ **historical hypotheses =**

*3D scans of buildings,
furniture, sculptures...*

*+ 3D models of
lost items*

*recycled into AR
interactive installations*





in situ AR

→ **contemporary rendering =**

*3D scans of buildings,
furniture, sculptures...*

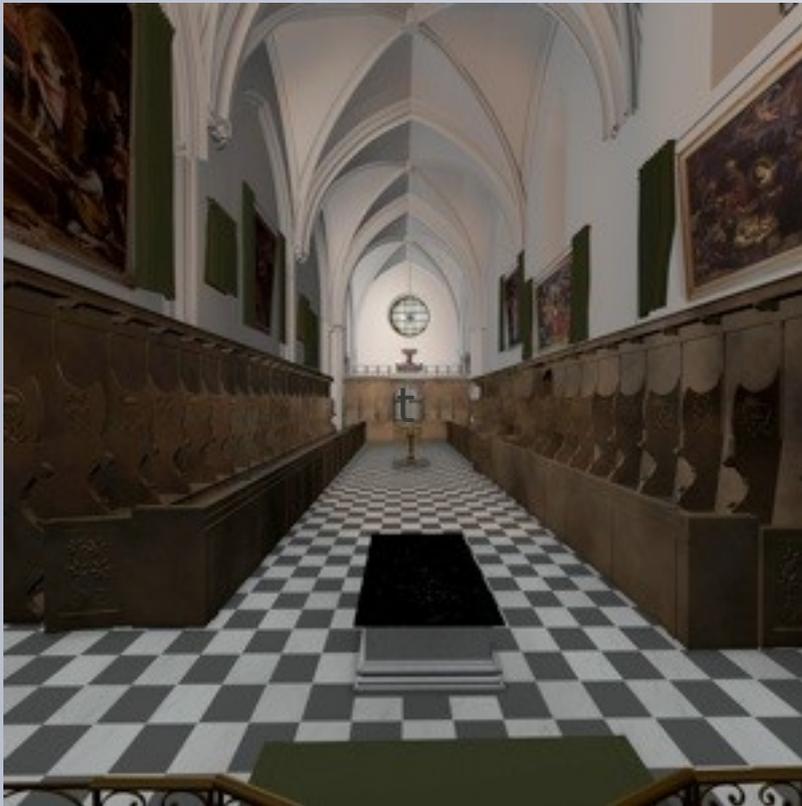
*+ non-photorealistic
rendering*

+ special FXs

for in situ AR

interactive installations

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© MAP GAMSAU

in situ AR

→ **issues**

- *calibration*

- *data recycling*

(*scans, models, textures...*)

- *media merging*

(*video, 3D synthesis, audio...*)

- *interactivity*

(*tracking, lighting, scenarios...*)

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*mobile augmented
reality*

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mobile AR

*June 5, 2009 - Futur en Seine
augmentation of an urban
environment in motion*

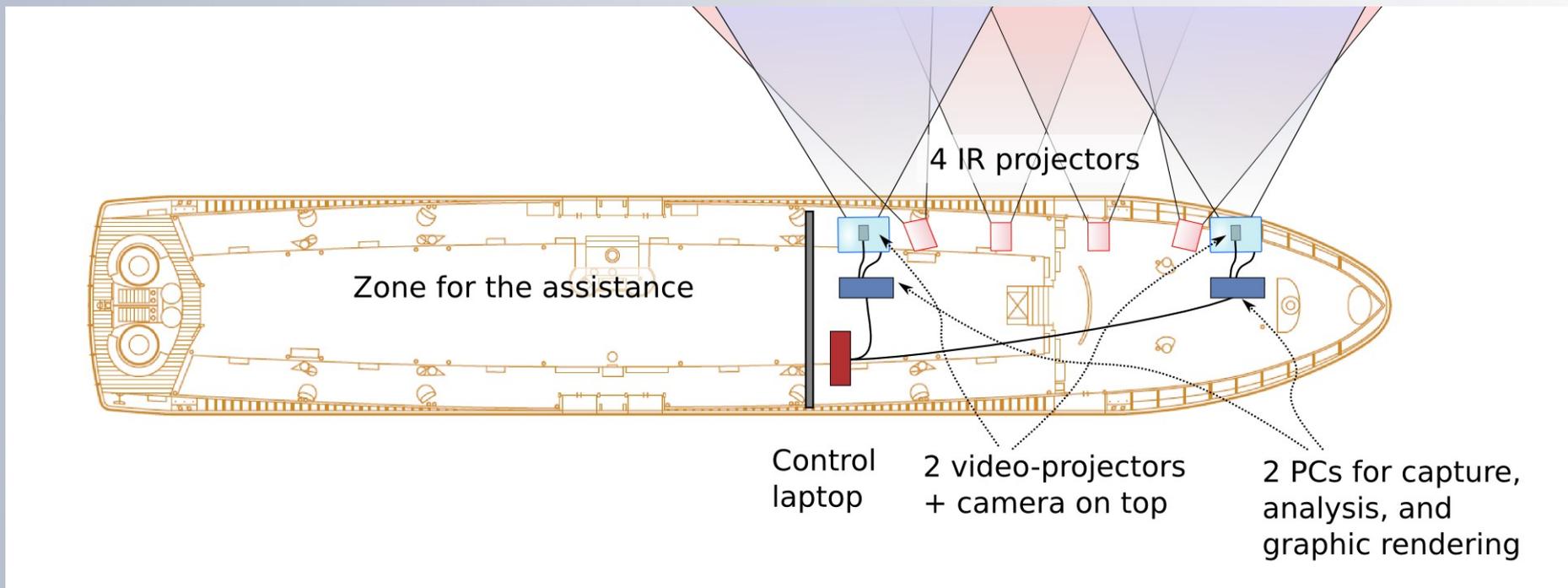


- **IR camera capture**
with IR lighting
to avoid video feedback
- **real-time image processing (GPU)**
- **approximate calibration (keystone)**

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mobile augmented reality

technical setup



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@ RUC

mobile AR

considered effects

→ *image filters*

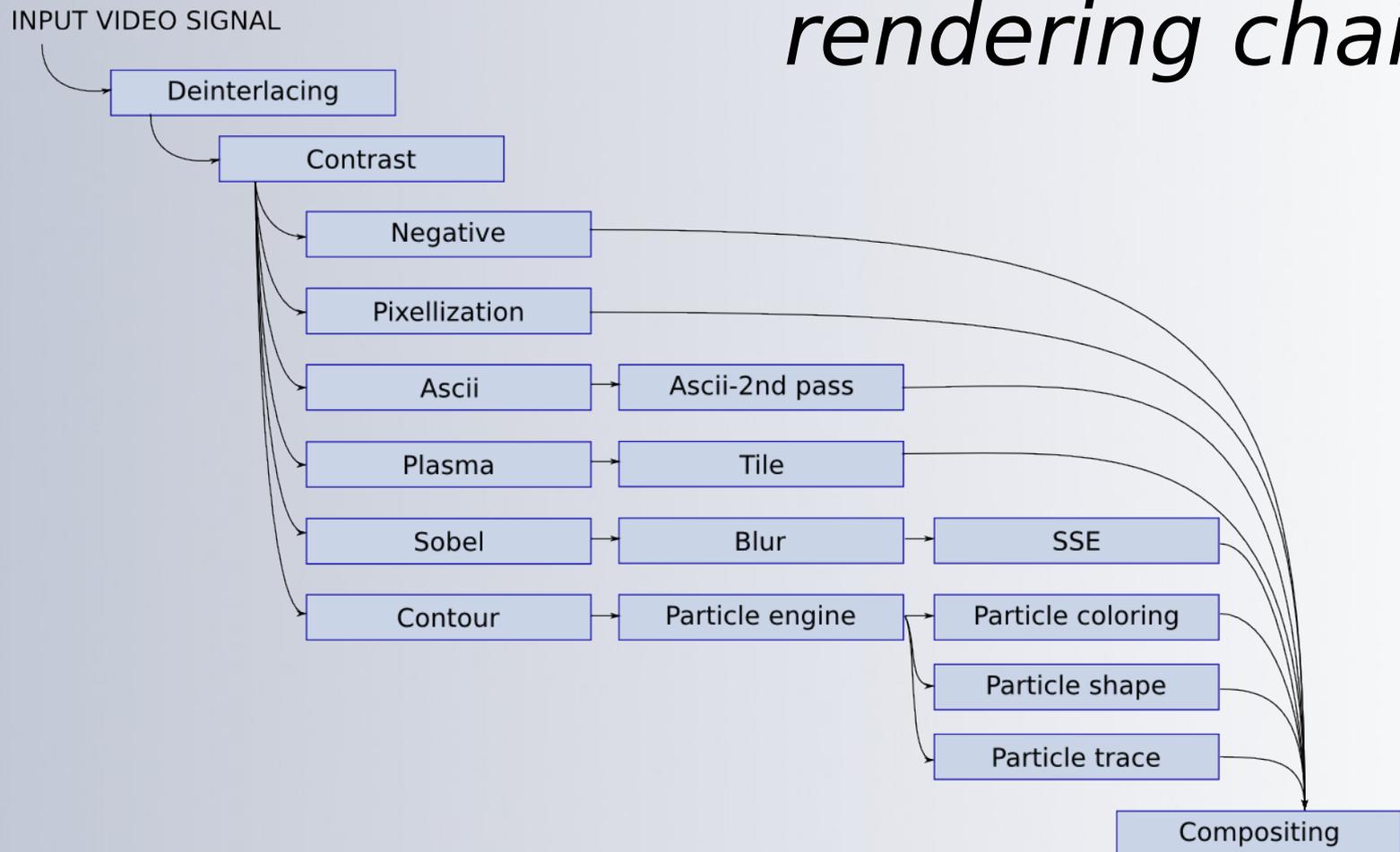
→ *physical models*

→ *particles*



mobile AR

multipass GPU rendering chain



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mobile augmented reality

*augmentation of urban
environment*



→ **aesthetics issues**

what looks nice?

→ **technical issues**

lag, accuracy, lighting

→ **scientific issues**

prepare symbolic

mobile AR

AR
in Public
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@ RUC

mobile augmented reality



Bertrand Planes

Wai Kit Chan

Matthieu Courgeon

Sonia Dadouh

Emmanuelle Frenoux

Emmanuel Blachon

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@ RUC

shadow mobile AR

AR
in Public
Space
@ RUC

Toute La Lumière Sur L'Ombre

*shadow/silhouette detection
and ornamentation*

→ **IR camera capture**
with/without IR lighting

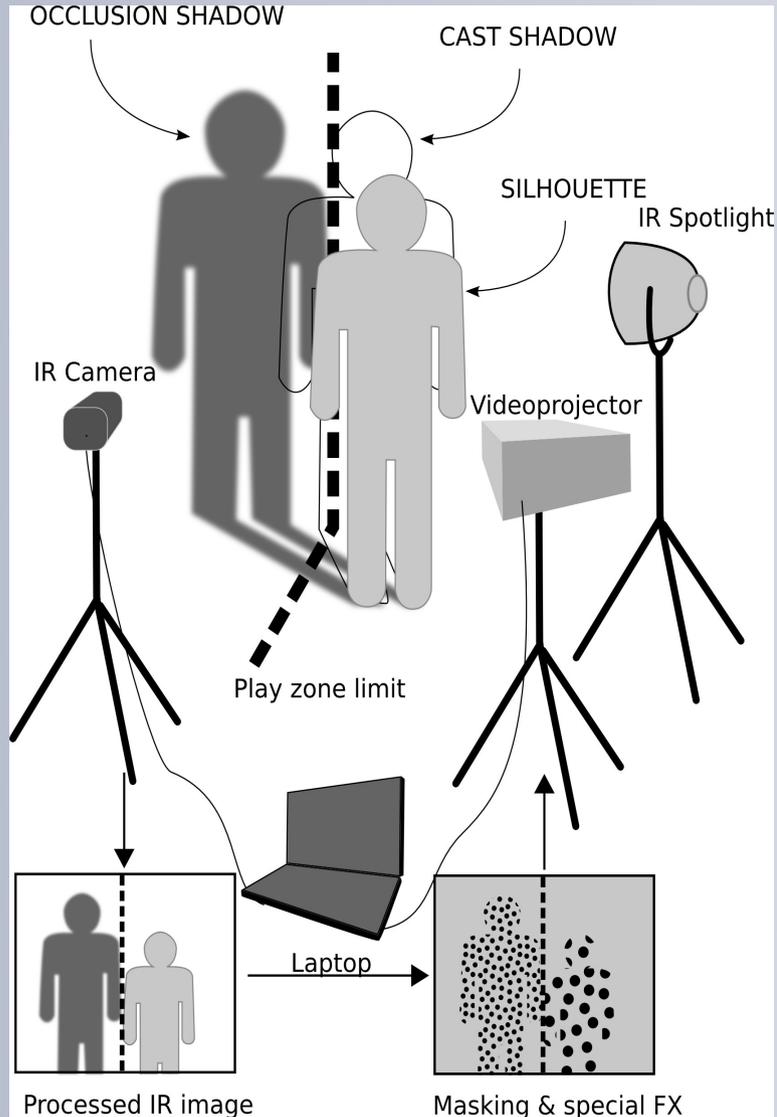
shadow + silhouette detection

→ **real-time image synthesis**
*masked by shadow
and/or silhouette*



AR
in Public
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@ RUC

Toute La Lumière Sur L'Ombre



set-up

→ *image analysis:
shadow & silhouette*

→ *image synthesis:
masking & special FX*

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Toute La Lumière Sur L'Ombre

sample FXs



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Toute La Lumière Sur L'Ombre

→ **scientific issues**

smart projection & environment-aware AR

→ **social issues**

how shadow can inform us

on our relationship

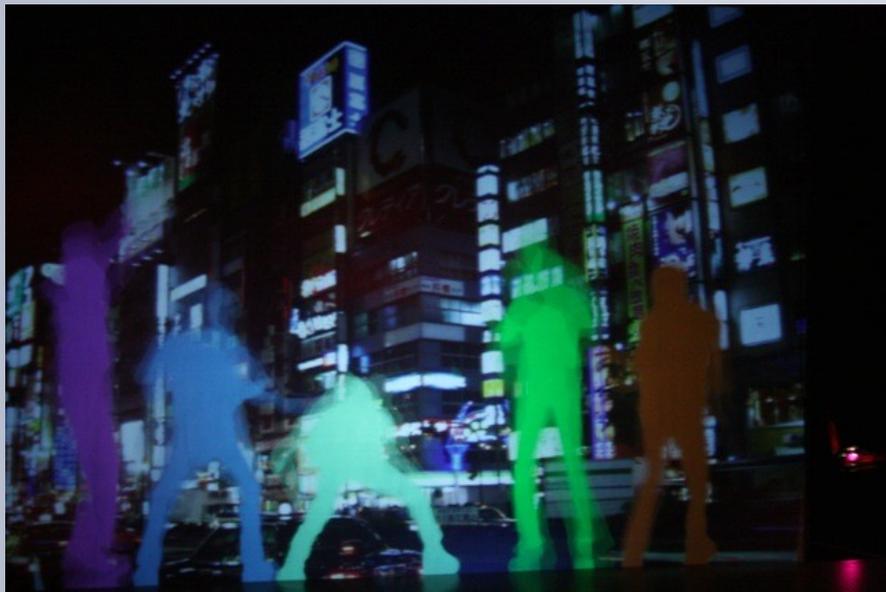
with our environment

→ **artistic issues**

can we have a portable

installation for the street

the library, & the stage



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hybrid interfaces

physical world augmentation

physical layers

→ *physical layers for **animation***

from performer's capture

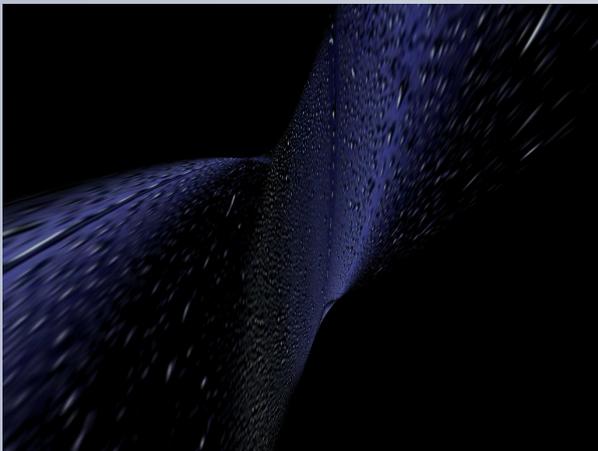
(postural or physiological sensors)

→ *multiple transparent layers*

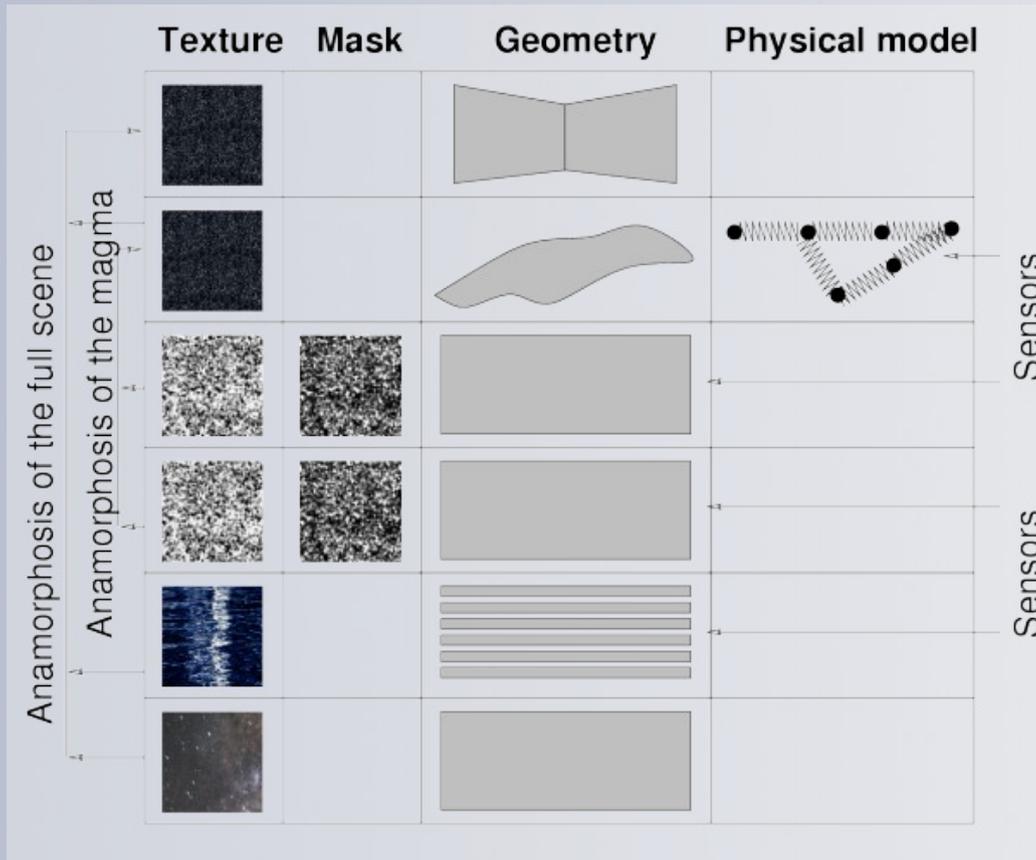
*for **scene depth***

→ ***visual changes***

through layer removal



physical world augmentation



→ multiple
physical layers

La Pluralité des mondes

Jacques Roubaud

Incidents Mémorables

December 2006

physical world augmentation

→ **related works:**

- *augmented performance (Sparacino et al 1999)*
- *computer theater (Pinhanez 1997)*
- *mass-spring models (Provot 1995)*



physical world augmentation

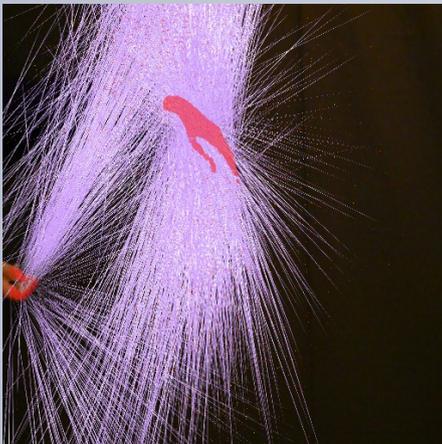
physical models

***image-based animation
of physical models***

→ *live or prerecorded video*

→ *real-time 2D/3D graphics*

*allows for real-time interaction
with a mass-spring system*



physical world augmentation

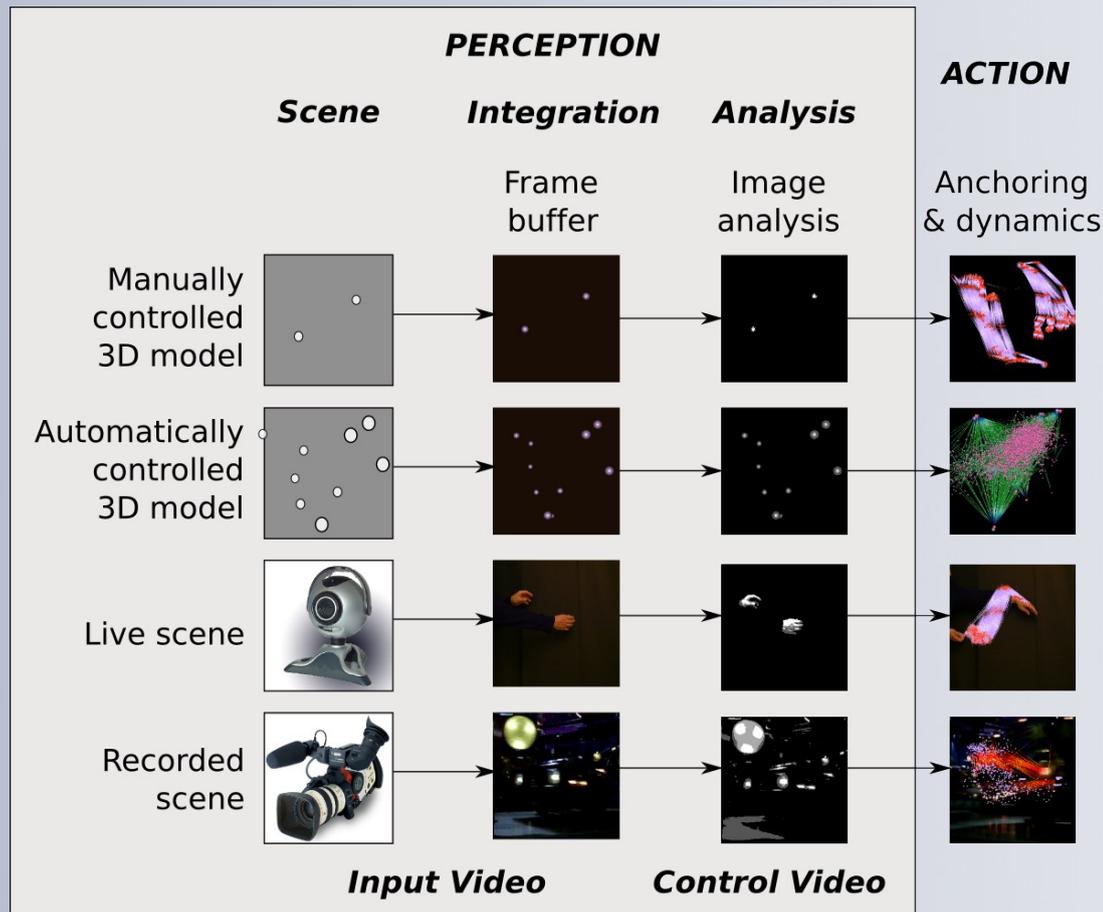


image-based

MSS animation

four set-ups

with live or

synthesis video

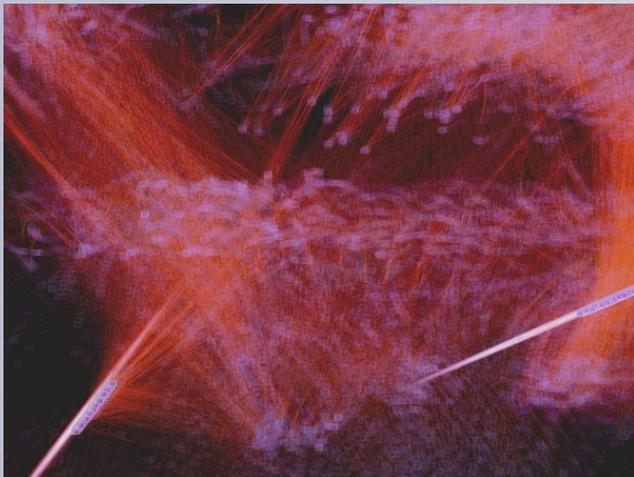
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physical world augmentation

→ *related work*

- *mass-spring systems through GPGPU (Georgii & Westermann 2005)*

- *particles for cloning motion (Wolford & Guedes 2007)*



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dance gesture analysis for physical models control

→ **collaboration IRCAM/LIMSI**

- *gesture analysis*

- *physical model rendering*

- *control and expressiveness*



<http://sarah.alaoui.free.fr/>

Co-supervisor: Frederic Bevilacqua (IRCAM)

PhD student: Sarah Fdili Alaoui (LIMSI & IRCAM)

Funding: University Paris Sud 11

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dance gesture analysis for physical models control

→ **some scientific issues**

- *movement quality recognition*

- *physical model rendering and control*

- *contribution to dance performance and pedagogy*



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multimodal interfaces

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audiovisual magnifier lens

*multimodal distortion
for multimedia
information access*

→ apply **geometrically**

coherent distortions to

visual and audio output

→ evaluate the **gain** in speed

and comfort

→ study **dissimila**

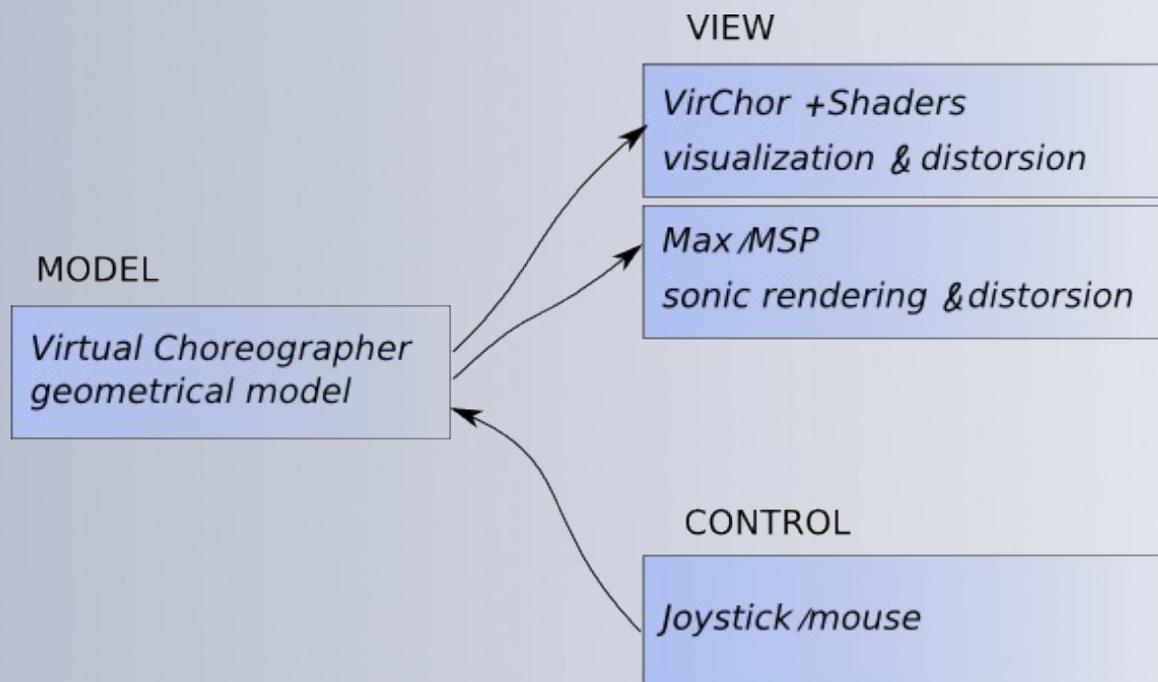
occlusions or distortions



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audiovisual magnifier lens

*multimodal distortion
for multimedia
information access*



→ *geometrically coherent
distortions to visual
and audio output*

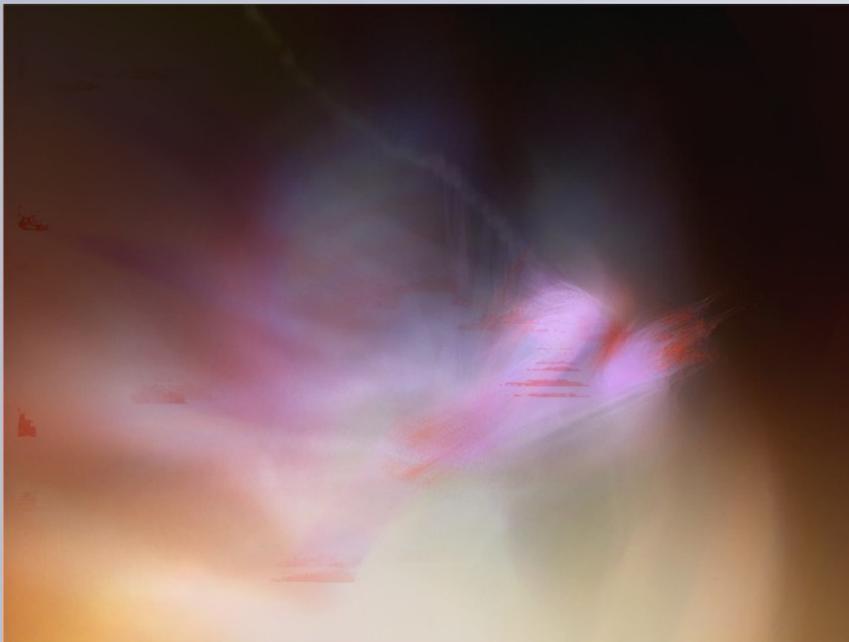
Tifanie Bouchara

Brian Katz

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audiovisual magnifier lens

*multimodal distortion
for multimedia
information access*



→ **related work:**

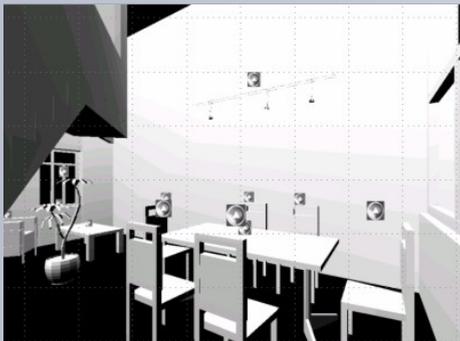
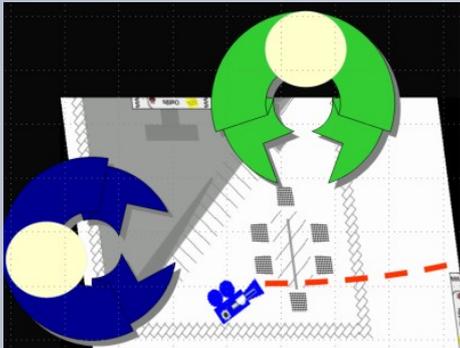
- *on demand video browsing (de Rooj 2007)*
- *comparison AV, audio, & visual navigation in 3D (Gröhn et al. 2003)*
- *fish eye views (Gutwin 2002)*

μ -surface, μ -view, μ -modal interface

→ **2D/3D combination**
for architectural design

→ **shared degrees of freedom**
between the modalities

→ tool for **interface design & modeling**
modalities × devices × I/O



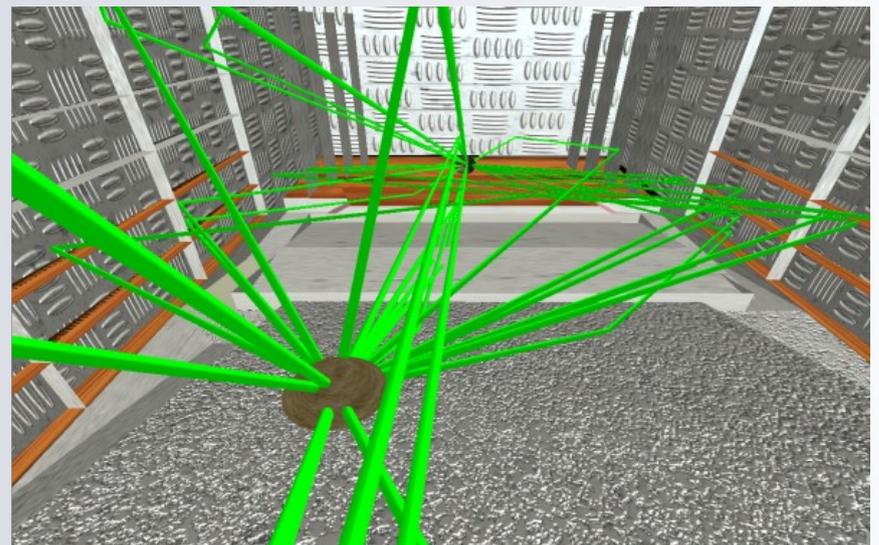
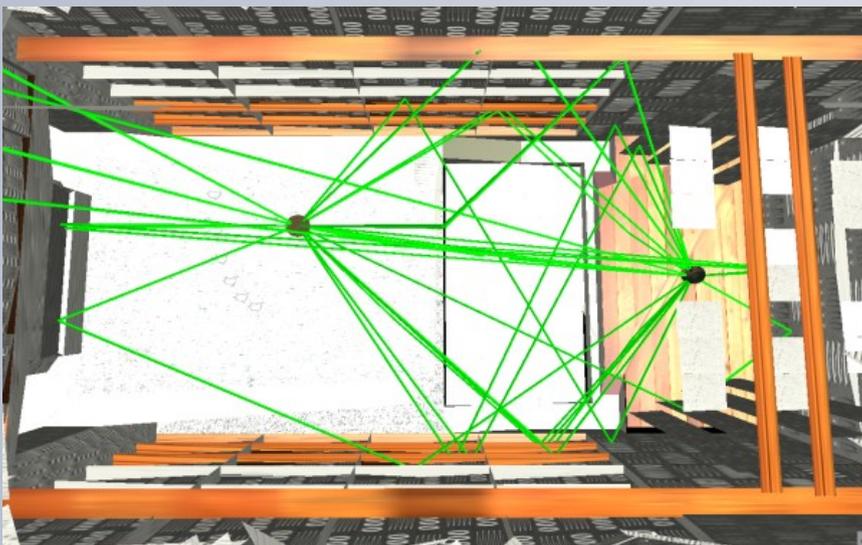
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μ -surface, μ -view, μ -modal interface

→ 2D/3D interface for acoustic rendering control & visualization

Rami Ajaj, Markus Noisternig, Lauri Savioja

3D visualization



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sonographic space

plumage

→ **sound analysis**

spatialization according to sound parameters

→ **interaction**

navigation into a soundscape

→ **synthesis**

granular synthesis from sound grains

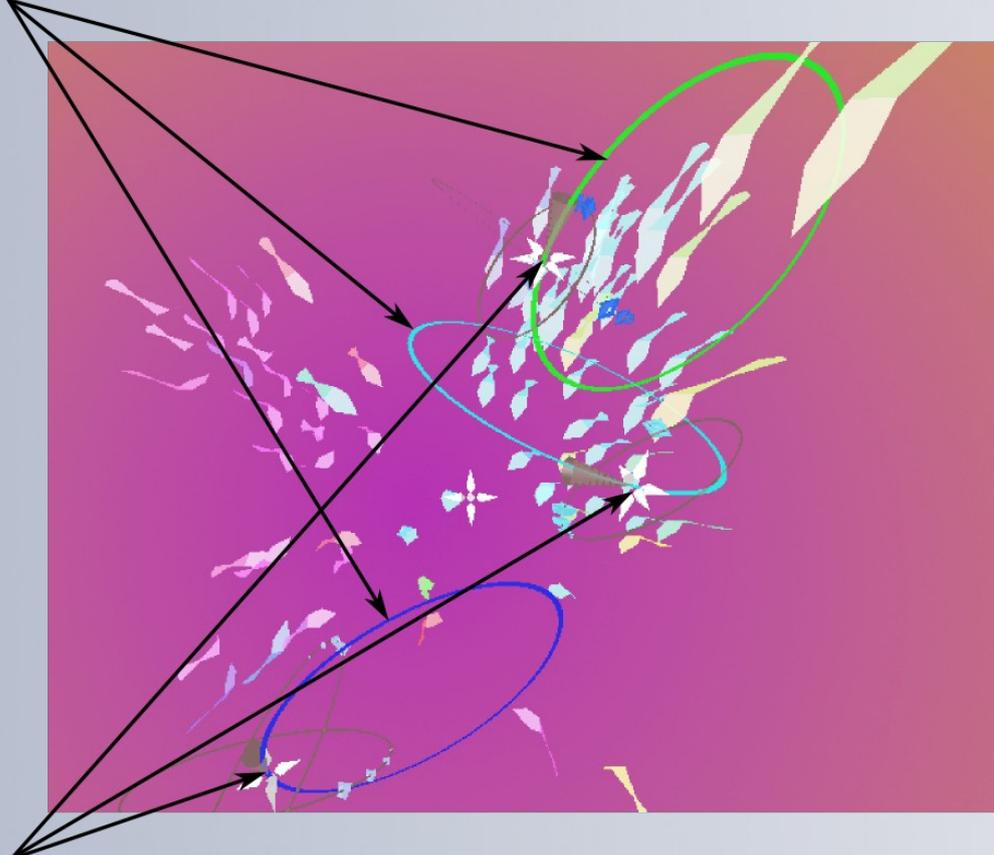


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sonographic space

plumage

elliptical trajectories



read head

→ *read heads*
+ *free trajectories*
or *elliptic paths*

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sonographic space

the concatenator



→ **live sound analysis**
and replay
for musical performance
or teaching

AR
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sonographic space

related works

→ **Phase**

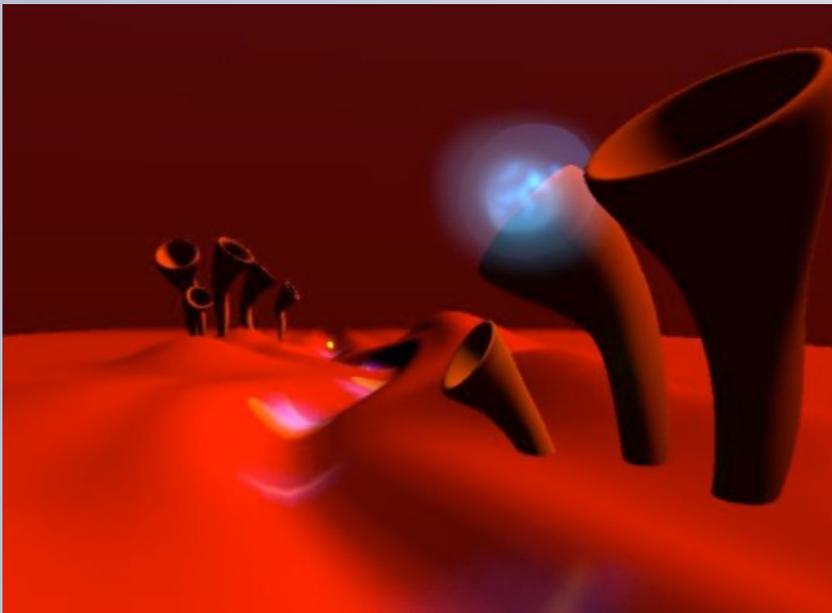
(Rodet et al. 2005)

→ **CatART**

(Schwarz 2007)

→ **audio orientation**

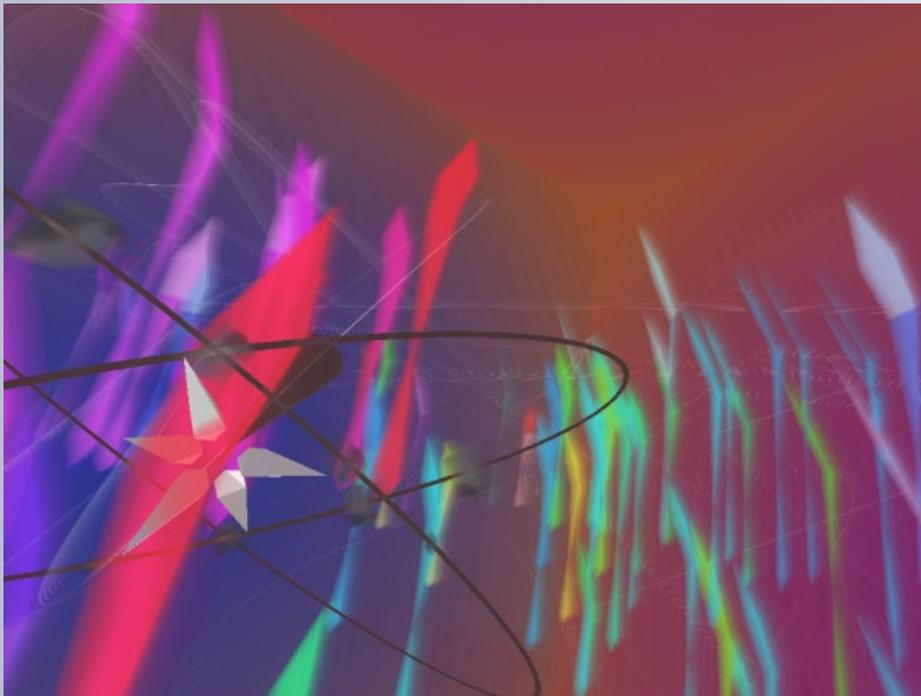
(Afonso et al. 2005)



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sonographic space

participants



Roland Cahen - ENSCI
Diemo Schwarz - IRCAM
Etienne Brunet - Musician

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Topophonie: granular audio- graphical rendering

→ **consortium ENSCI/IRCAM/LIMSI/Navidis/SmallLab**

- *granular concatenative sound rendering*

- *graphic particle rendering*

- *audio-graphical representation*

and synchronization

→ **funding**

topophonie

<http://www.topophonie.fr/>

Agence Nationale de la Recherche

Coordination: Roland Cahen (ENSCI)

Topophonie: granular rendering

→ **LIMSI scientific issues**

- *3D audio-graphic scene representation (XML):*
extension of X3D

- *LOD computation of*
audio-graphic granular scenes:
cf LOD for point-based graphics

- *audio-graphic synchronization*



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*affective computing
& performing arts*

capture of emotions

physiological signals

→ ***intrusiveness*** of the capture

→ ***complex signal processing:***

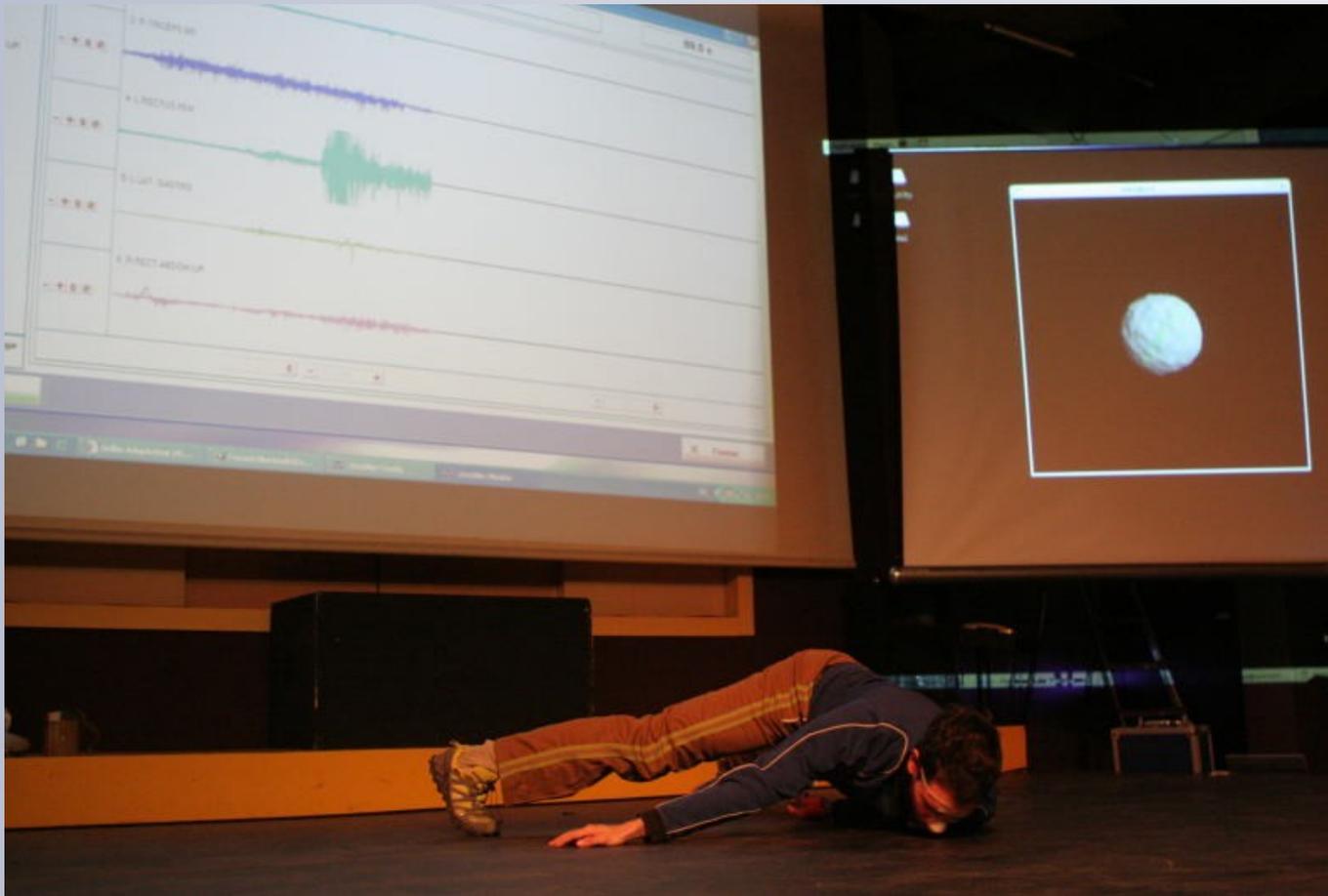
- *multiple time-scales,*
- *noise & signal overlay,*
- *multivariate analysis required*



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capture of emotions

→ live audio & graphics from physiological signals



photography: Perrine Monjaux

Rami Ajaj

Ivan Chabanaud

Loïc Kessous

Renaud Rubian

Performer:

Laurent Chanel

Artistic design:

Benedicte Adessi

capture of emotions

→ **related work:**

- *signal processing for emotion*

recognition (Kim et al. 2004,

Haag et al. 2004)

- *affective computing (Picard, 2002,*

Rani et al 2005)

- *emotion in voice (Banse & Scherer*

1996)



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tangibility

anthropomorphic interface

tangible & affective

→ *attractiveness of **anthropomorphic interfaces** for affective computing*

→ ***body schema** helps*

to cope with

complex percepts

→ ***intuitive associations***

between action and effects



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anthropomorphic interface

tangible & affective

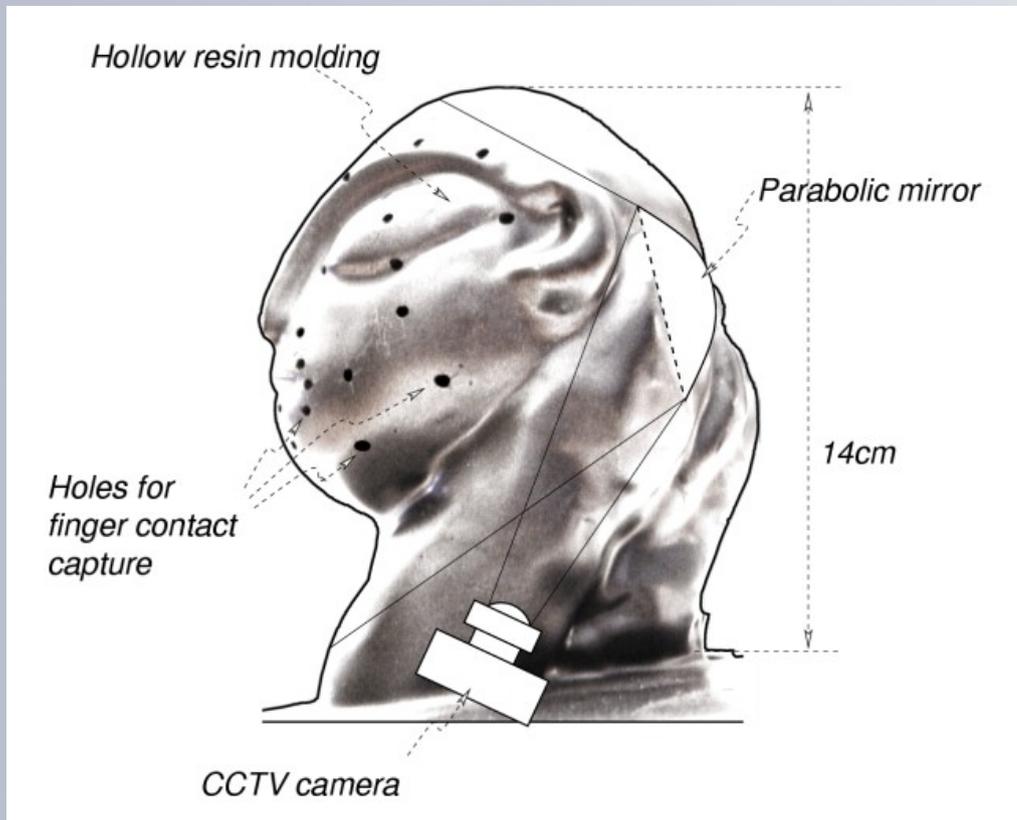
→ *related works*

- *Doll's head interface (Hinckley et al. 1994)*
- *SenToy (Paiva et al. 2002) a full body doll*



anthropomorphic interface

Pogany head-shaped interface

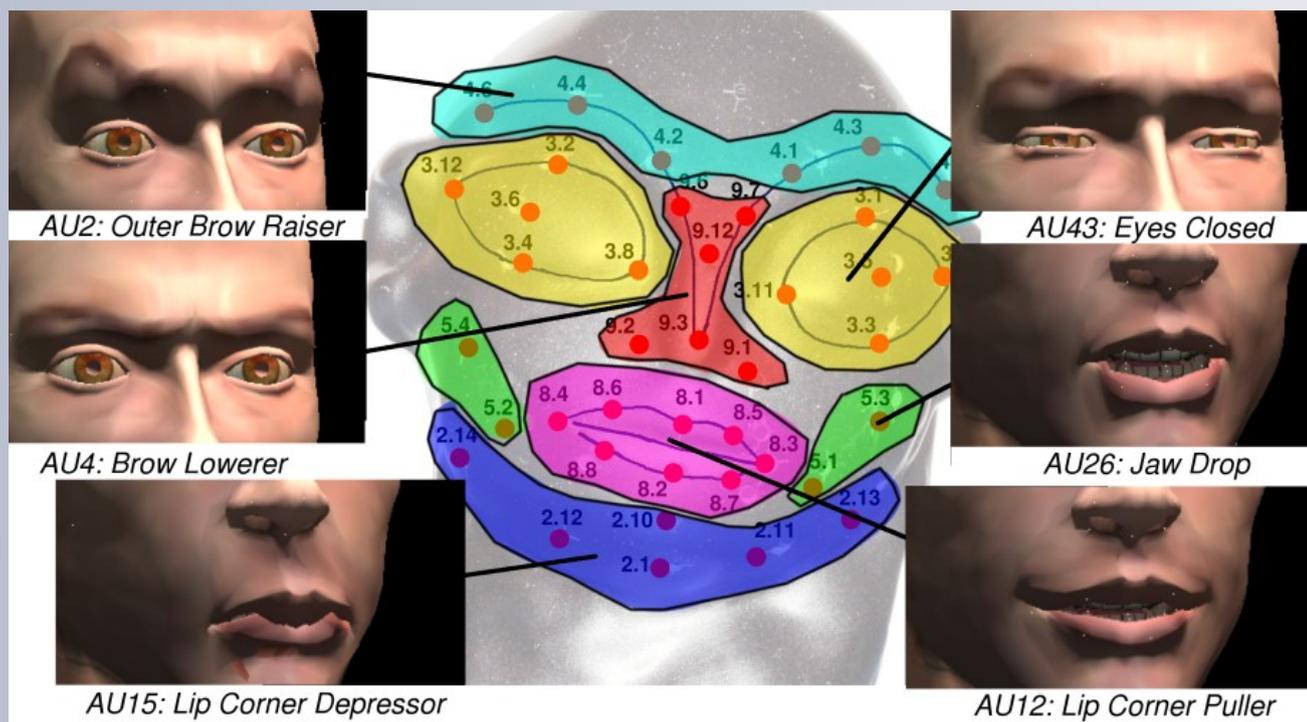


→ *image-based
tangible interface*

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anthropomorphic interface

*Pogany head-shaped
interface*



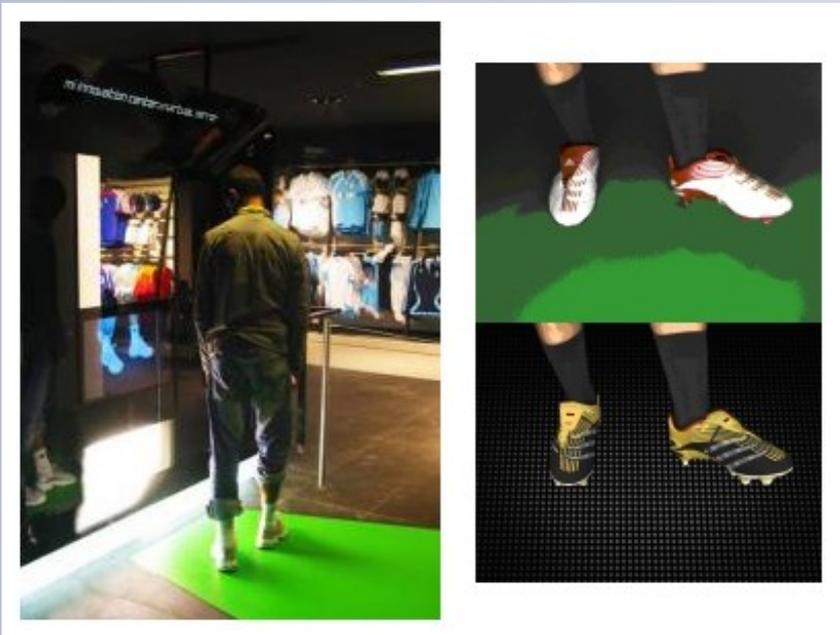
→ used for
the control
of expressive
facial
animation

*AR
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@ RUC*

*augmented jewel @
Fraunhofer*

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previous work Virtual Mirror



→ **Virtual Mirror:**
*try-on installation
for virtual garments
(shoes, or cloth texture
and color)*

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previous work Virtual Mirror

→ **Virtual Mirror:**

work by Anna Hillsman

& Peter Eisert

on garment tracking

and texture overlay (clothes)

or substitution (shoes)

→ *based on*

deformable surface

tracking or object tracking

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extension: virtual jewels



→ *based on deformable surface
tracking and virtual objects*

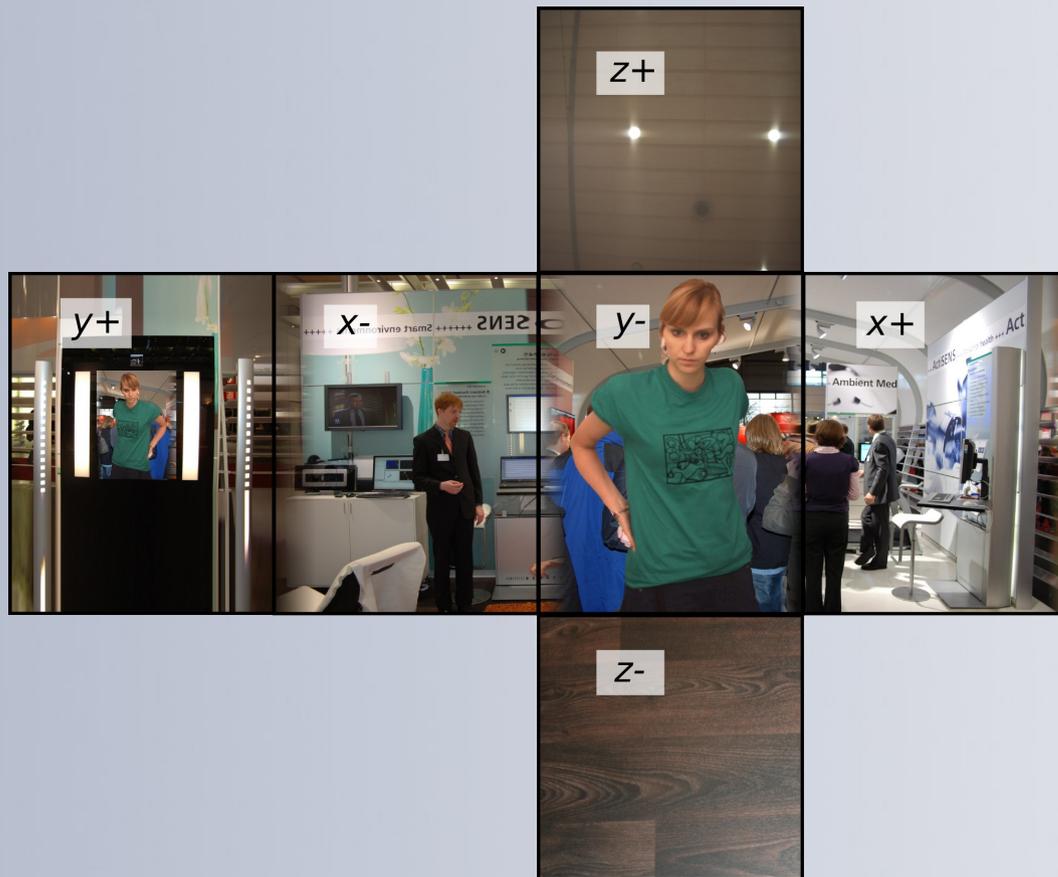
rendering:

*two techniques for **virtual***

jewel augmentation

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environment-based rendering



→ **3D multipass
rendering:**

- reflection

- transparency

- blending

through environment
mapping

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image-based rendering

→ *from real jewel capture
& reconstruction*

(Peter Eisert)



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shadowing + compositing



→ **shadowing:**

*ambient rendering + scaling
+ blur + semi-transparency*

→ **compositing:**

video + shadows + jewel rendering

synthesis and perspectives

→ **current: cloth tracking + EBR/IBR**
*flexible technique for cloth registered
jewels (pendant or brooch)*

→ **ongoing: body tracking**
for necklace, ear-rings, bracelets...

*how far can go
through markerless capture?
can we make jewel substitution?*



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synthesis and perspectives



Christophe Luxereau, Gecom. Rhizomes. 2006

→ *virtual jewels open research avenues
to social and affective computing*

→ *ongoing collaboration with ENSCI
has proposed the following tracks:*

- *jewel as interactive **diary***
- *jewel as personal **avatar***
- ***extravagant** & dream jewel*

Solène Borrat (ENSCI)

Flavie Papin (ENSCI)

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offers & protocol

opensource softwares & hardwares

→ **graphic engines:**

3D engines Ogre3D, Panda3D, Irrlicht, VirChor...

other tools are more favored in the artistic community

such as OpenFrameworks, Max/Jitter or PD/GEM

(ease of use, interactivity...)

→ **sound engines:**

PureData, SuperCollider...

also used for interaction

→ **electronics platforms:**

Arduino, SuidBee...



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opensource softwares & hardwares

→ **metaverse servers:**

RealXtend & The Metaverse Project

used by artists as a location

for performance or by architects

for building preview and user test

→ **and all you know....:**

gimp, audacity, inkscape...



AR
in Public
Space
@ RUC

art/science conferences & journals

→ **journals:**

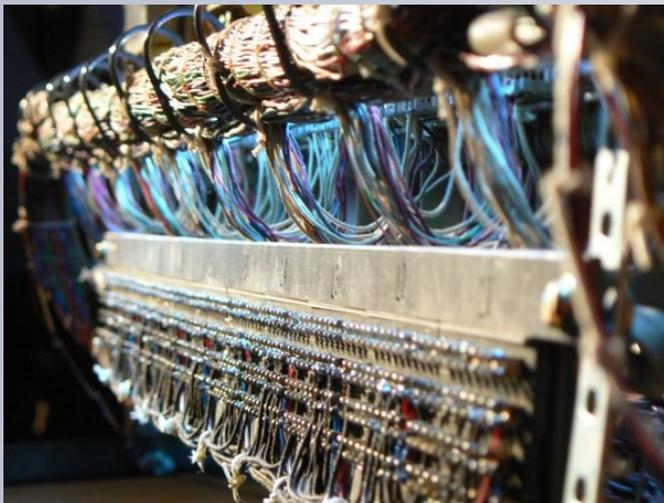
Leonardo, IJPADM, IJCICG, IJART...

→ **conferences:**

*ISEA, ACM Multimedia,
SmartGraphics, NIME, ICMC,
SIGGraph, H2PTM...*

→ **lists:**

spectre, yasmin, artsciedu@limsi.fr...



protocol

→ **project control:**

scientific issues should remain clear

funding should be shared

→ **design and development:**

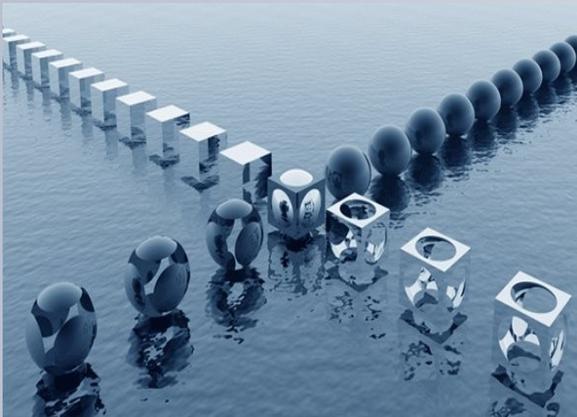
- *design is crucial because most projects*

are non-standard and complex

- *development must include engineering*

because artists want applications

not prototypes



contributions

→ **new scientific issues:**

artists tend to explore non-mainstream configurations

→ **specific usage context:**

*art installation generally involve
an audience and large scale
testing environments*

→ **diffusion:**

*art events can appeal medias
and promote project visibility*

