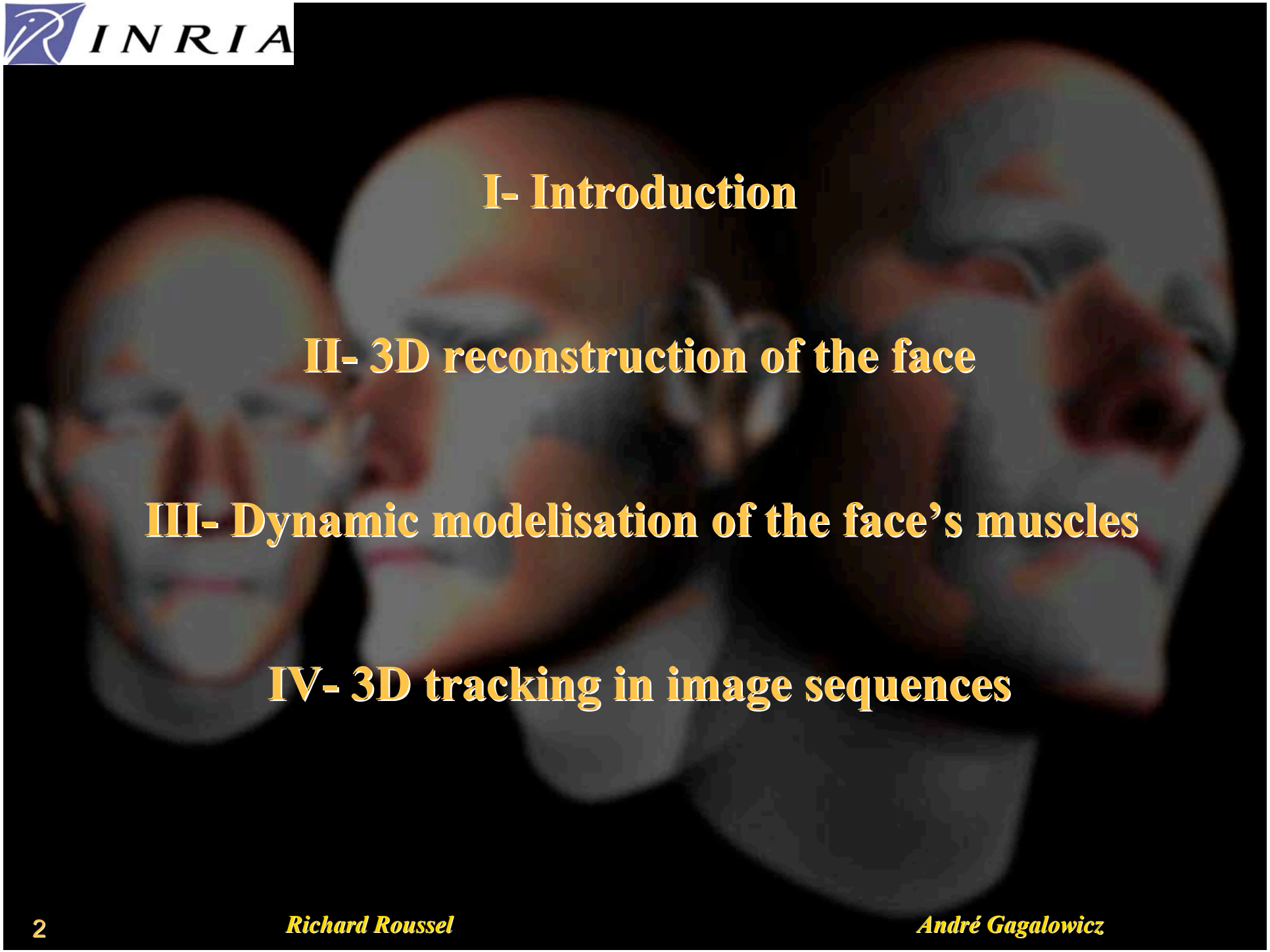

INRIA
A hierarchical FACE behavi or model for 3D face tracking without markers.
1
Richard Roussel
André Gagalowicz



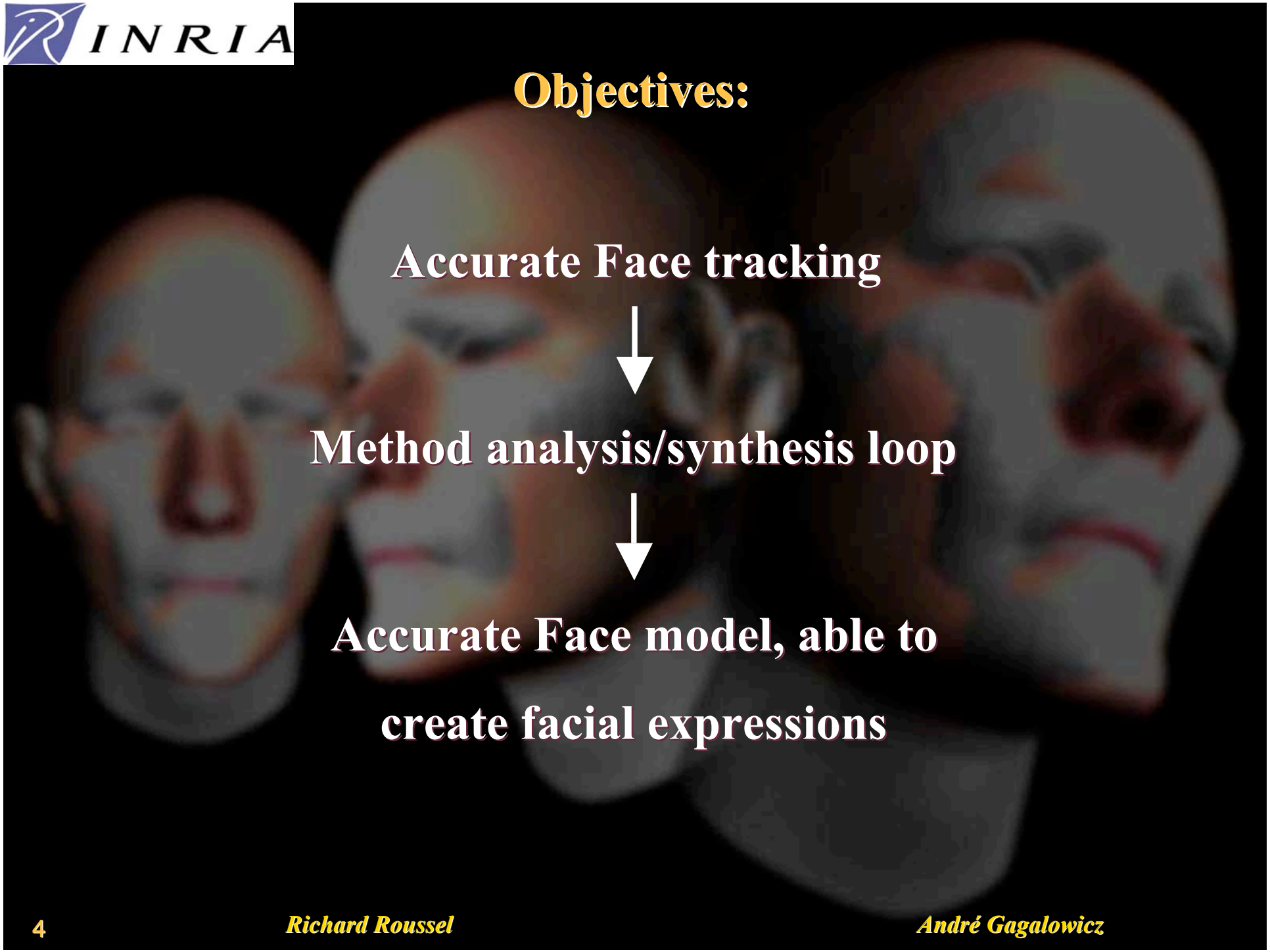
I- Introduction

II- 3D reconstruction of the face

III- Dynamic modelisation of the face's muscles

IV- 3D tracking in image sequences


I- Introduction


Objectives:
Accurate Face tracking
Method analysis/synthesis loop
Accurate Face model, able to create facial expressions

I- 3D reconstruction of the face

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GLOBAL SCHEME

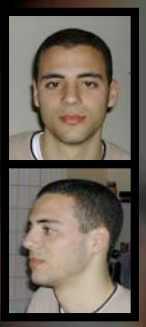
Data

Calibration / Reconstruction loop

Deformation Interpolation by RBF

Final Deformation

Result



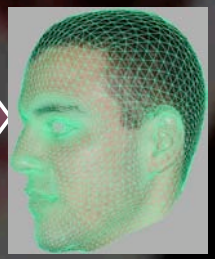
Generic Face

Camera Calibration with characteristic points

3D points Reconstruction

3D mesh deformation by RBF

Refinement of the 3D mesh by its silhouettes



Specific Face

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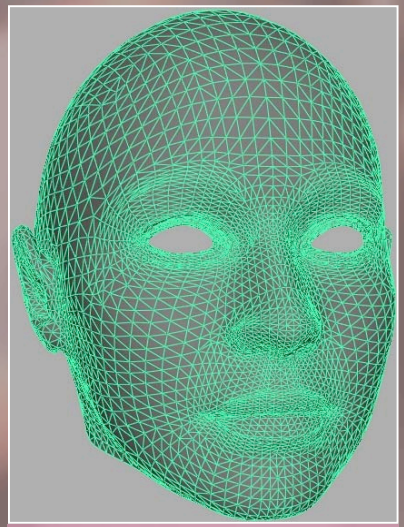
Data

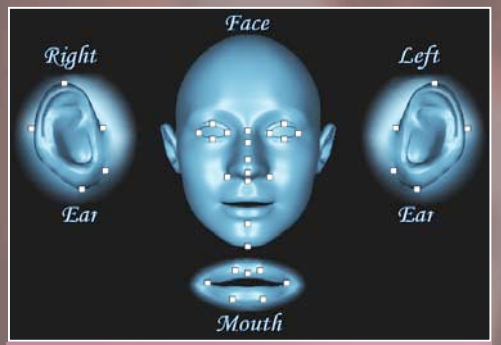
Input

A priori knowledge



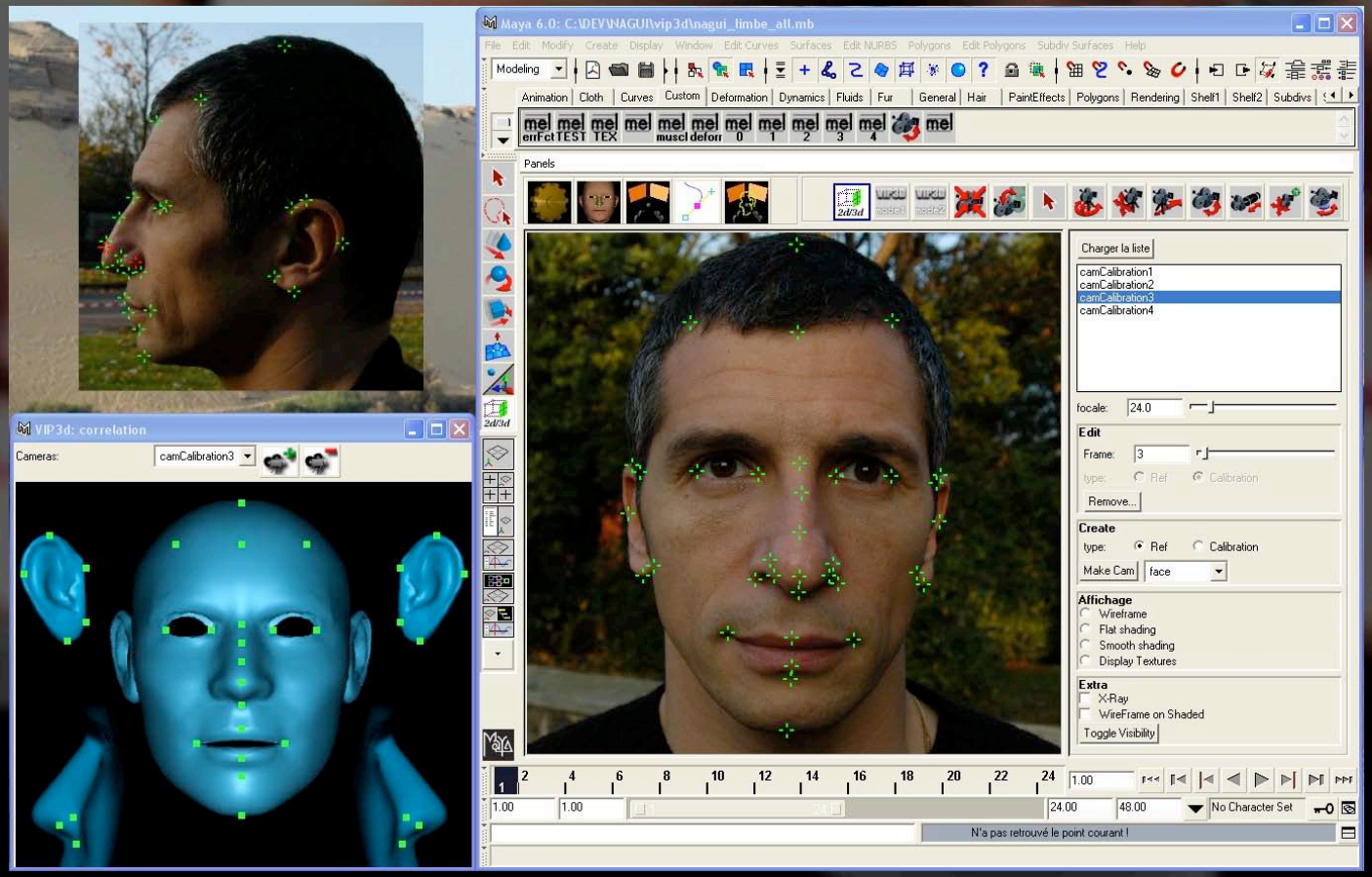
Generic model

+



38 characteristic points from MPEG-4 set

INTERACTIVE LABELING OF THE CHARACTERISTIC POINTS PROJECTIONS IN IMAGES



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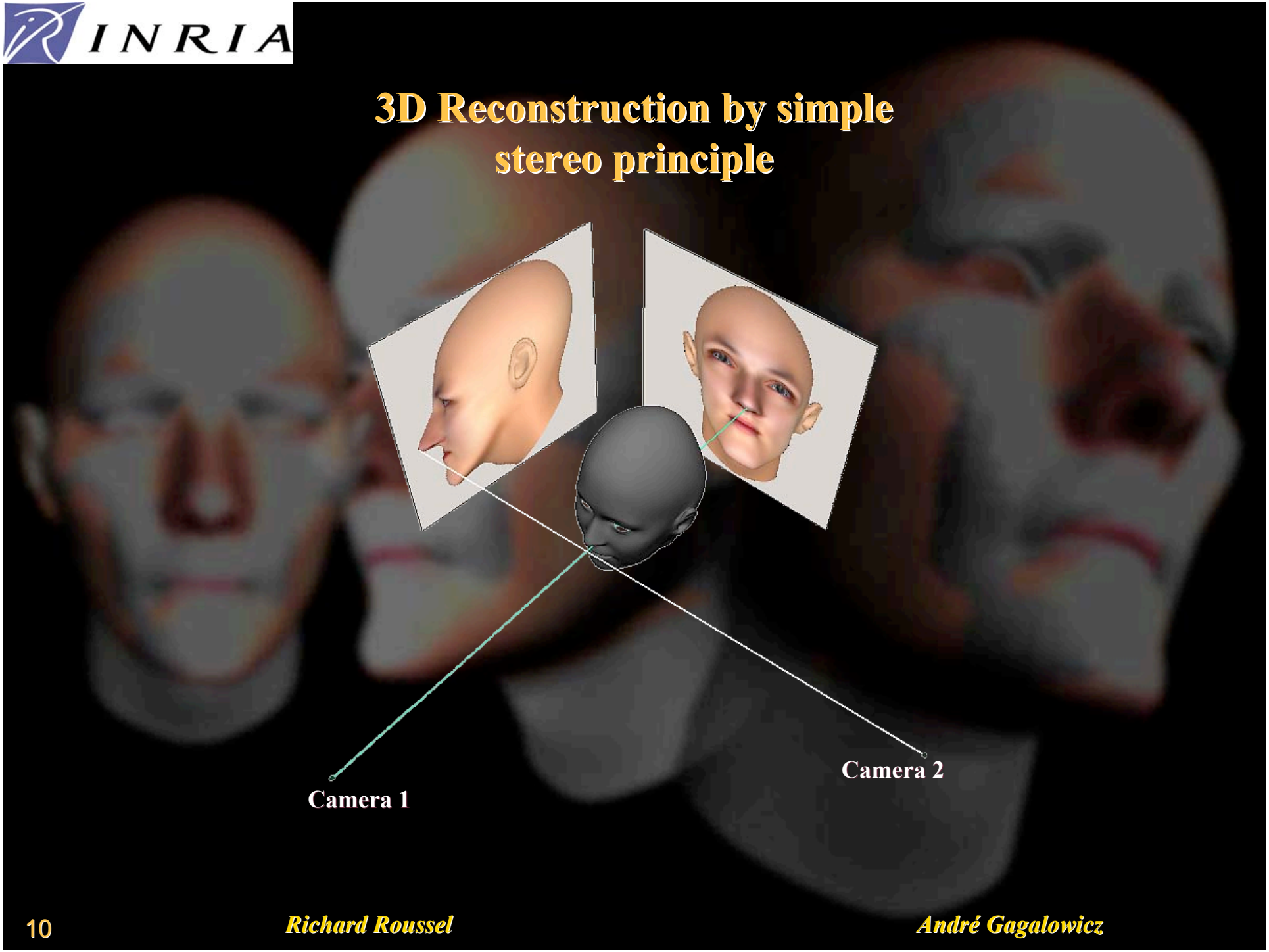
CAMERA CALIBRATION USING POSIT

A priori KNOWLEDGE:

N 3D points and their 2D projection, where $N \geq 5$

Intrinsic parameters of the cameras (focal length, pixel ratio, optical centre)

3D Reconstruction by simple stereo principle



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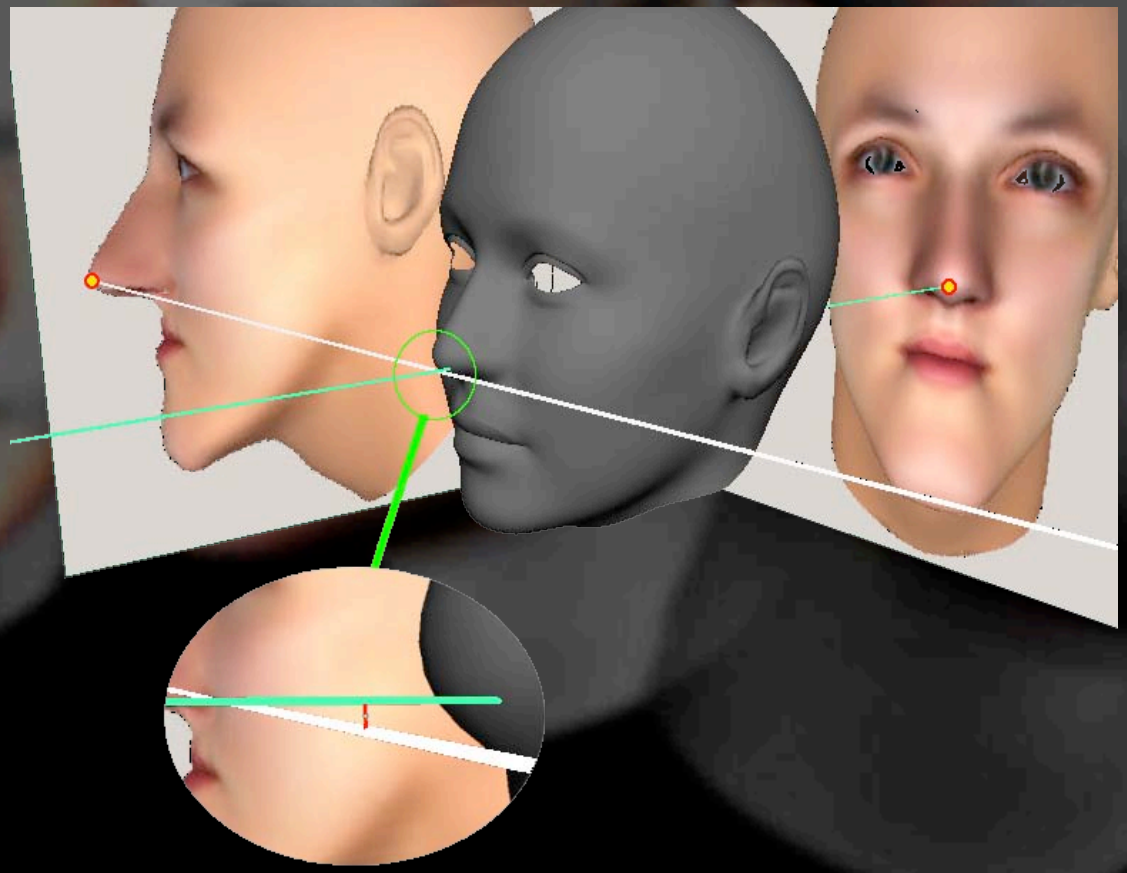
3D Reconstruction by simple stereo principle

Calibration was not perfect



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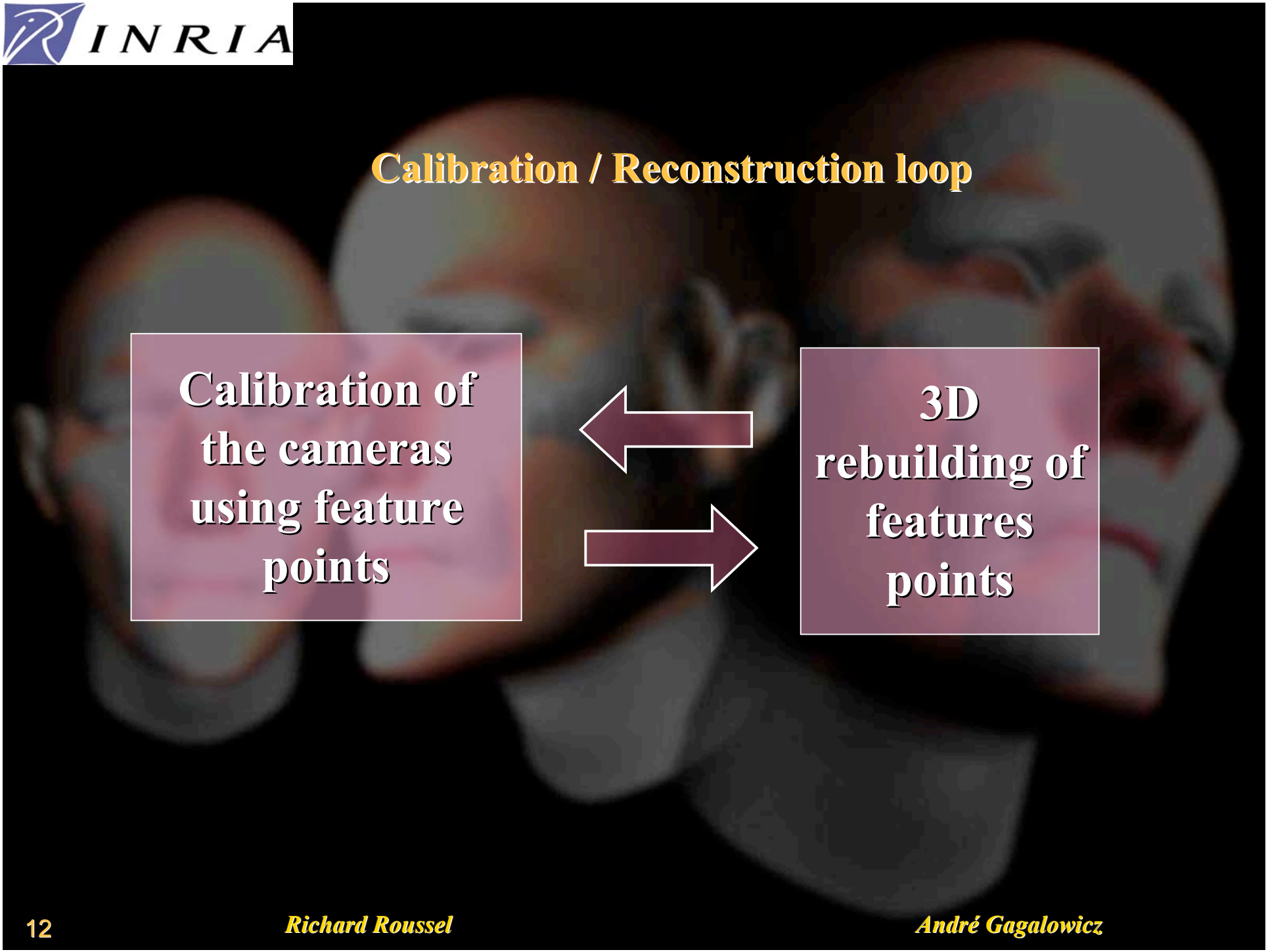
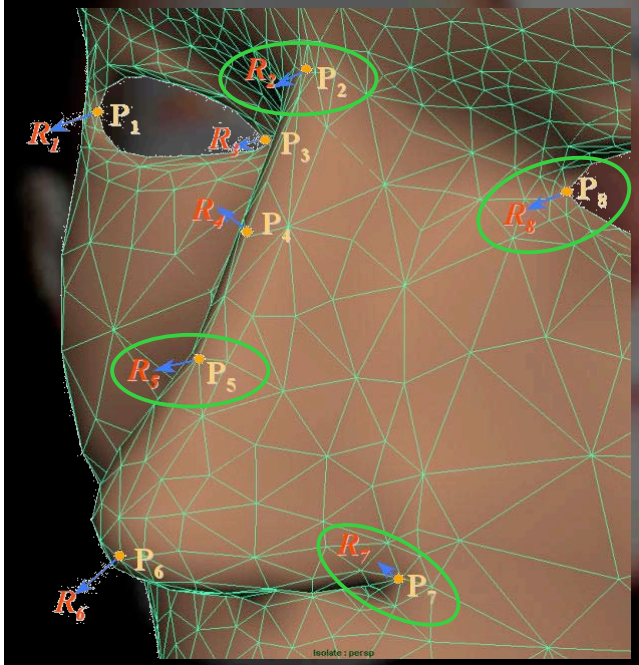
Calibration / Reconstruction loop



Radial Basis Function

Given a set of deformation vectors



Basic idea:

1. Calculate the deformation at each feature point

2. Interpolate the deformations on the whole face

   → Radial Basis Function (RBF)

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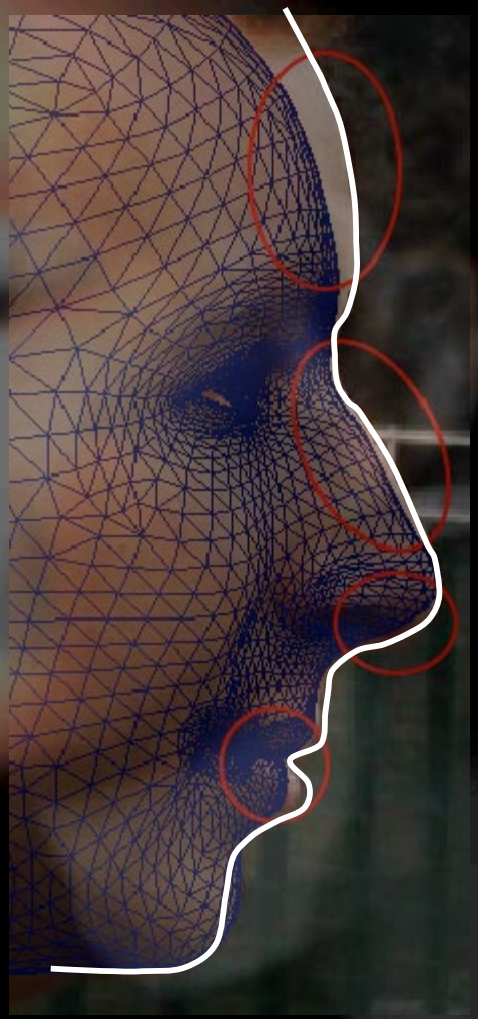
Remaining Problems:



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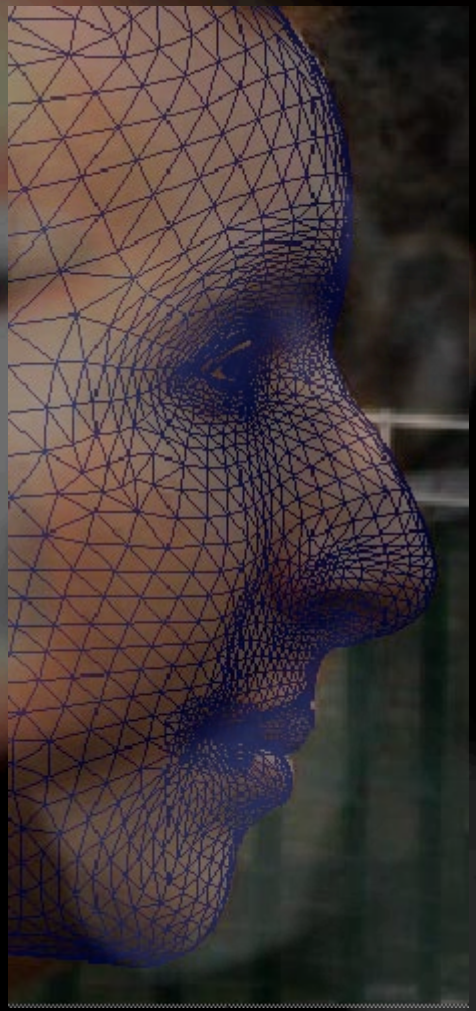
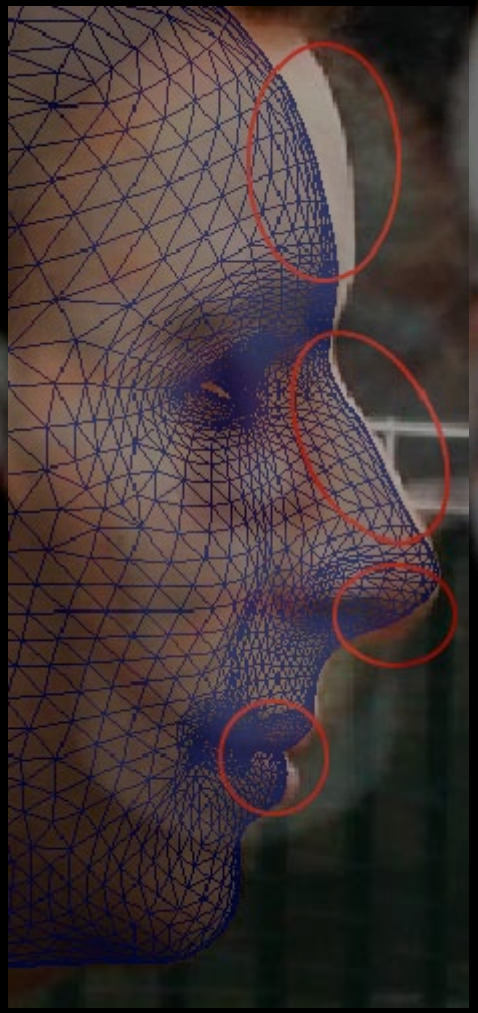
We want:



REFINMENT OF THE MESH BY ITS SILHOUETTES



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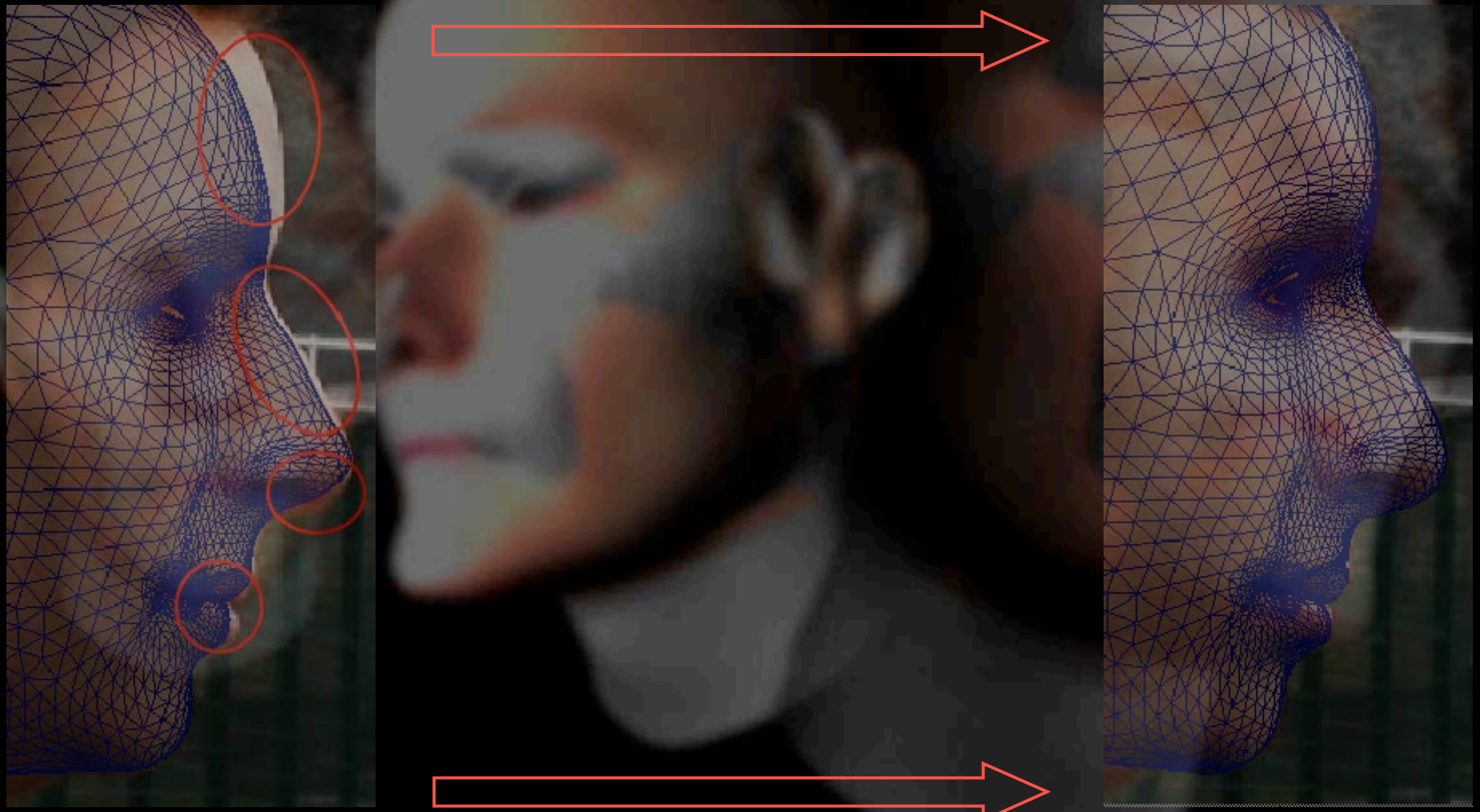

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REFINMENT OF THE MESH BY ITS SILHOUETTES

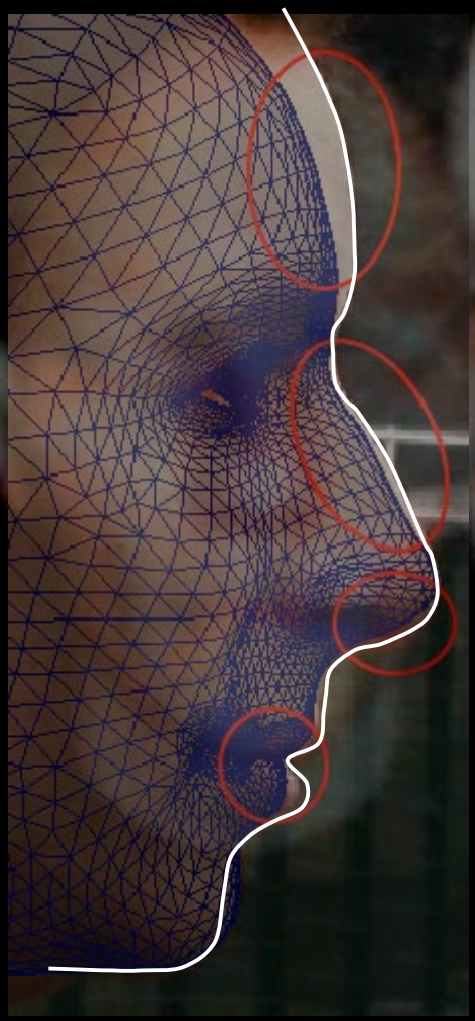
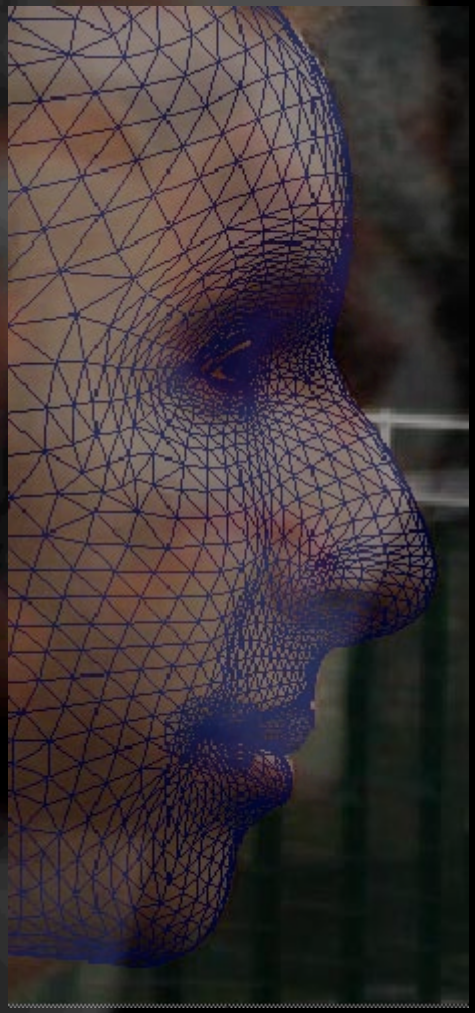


Image silhouette drawing



Caption:

- ■ Control Point of the curve of Bézier
- \+ Following tangent, in the curve's direction
- ■ Preceding tangent, in the curve's direction

REFINMENT OF THE MESH BY ITS SILHOUETTES

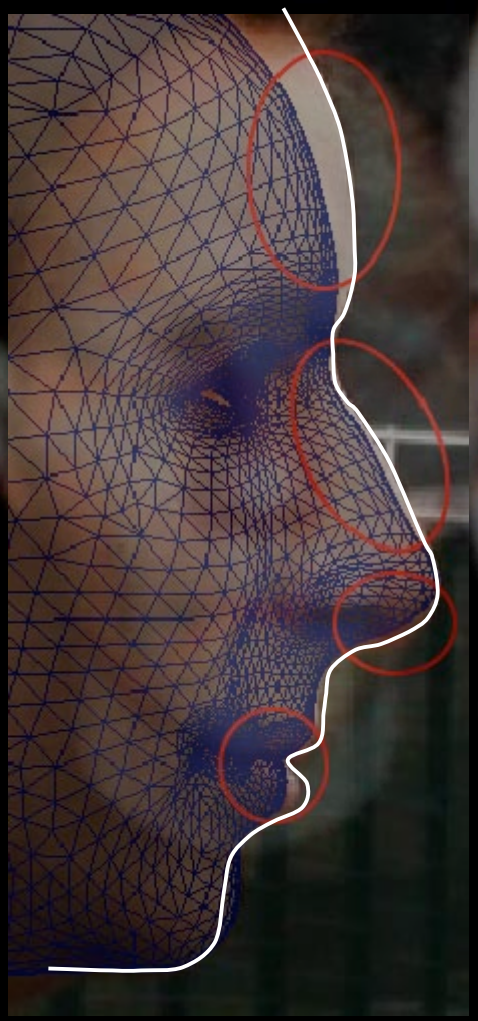
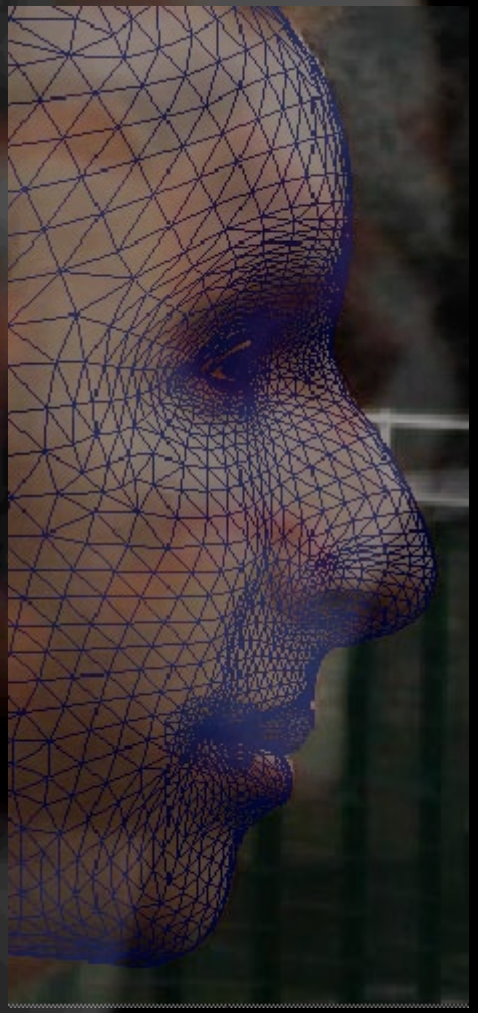
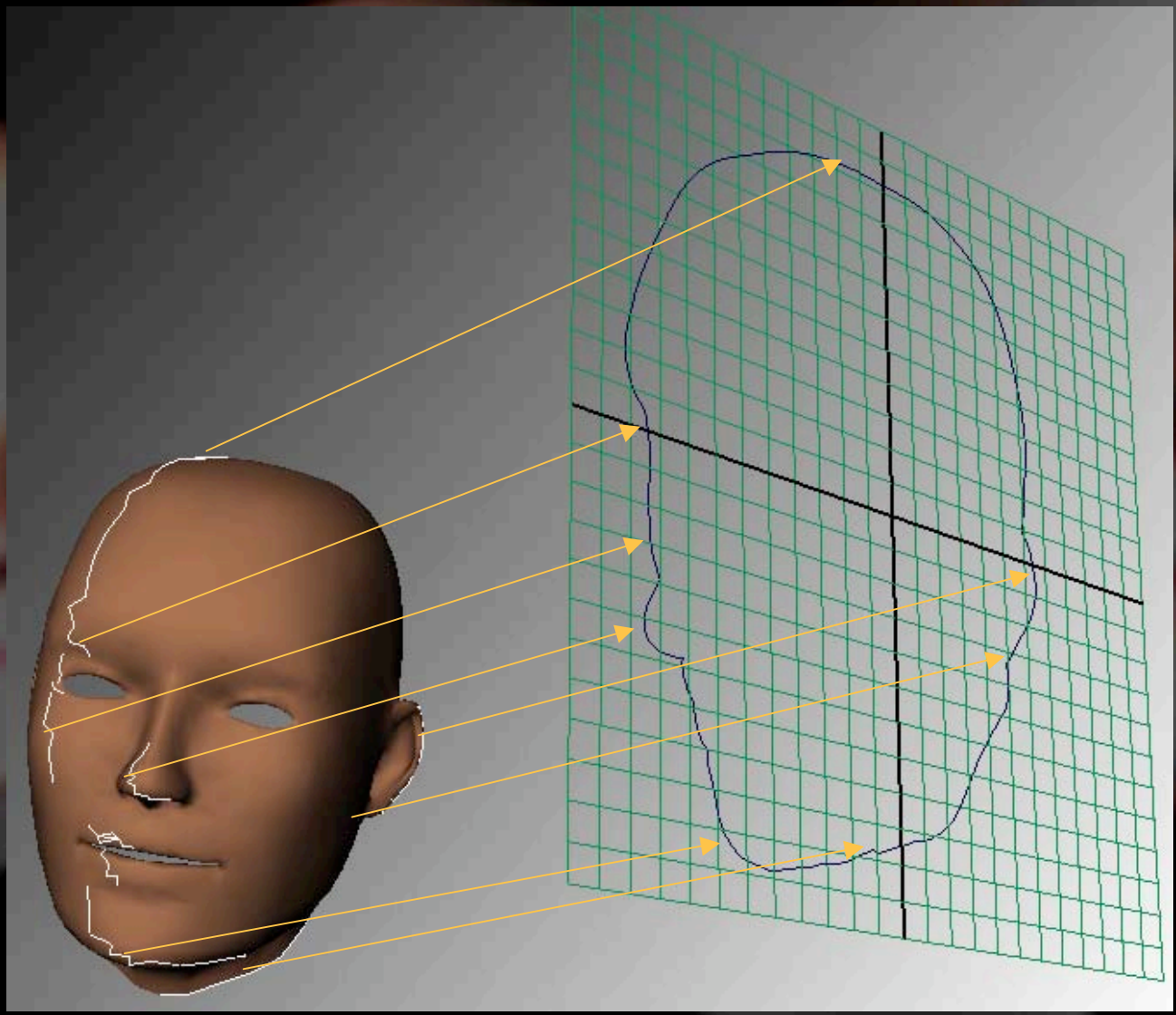


Image silhouette drawing

For each camera, computation of both

3D silhouette and its 2D projection





REFINMENT OF THE MESH BY ITS SILHOUETTES

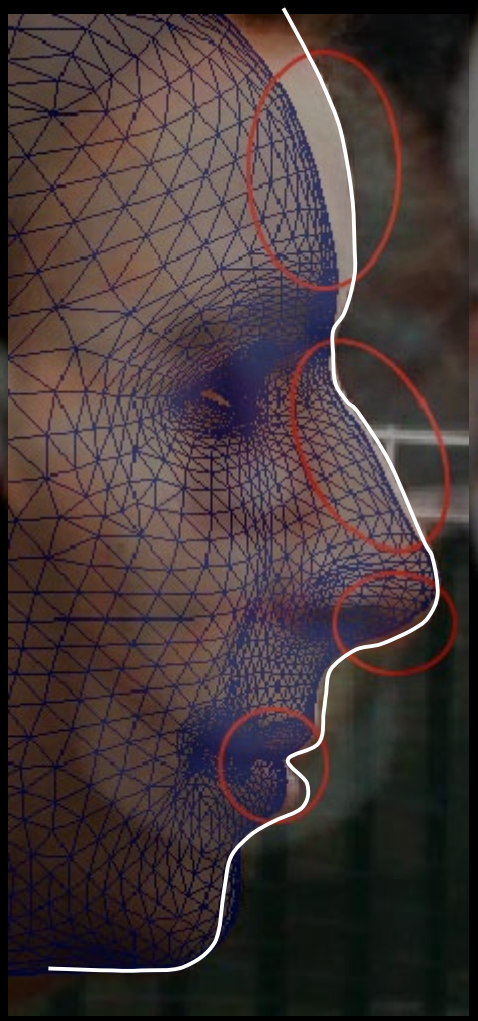
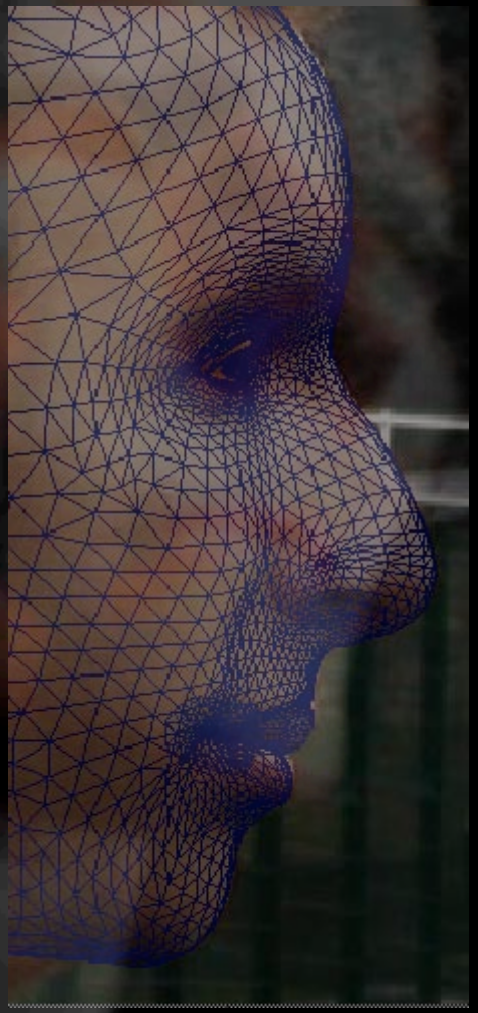


Image silhouette drawing

For each camera, computation of both

3D silhouette and its 2D projection

Computation of the distances between the projected and the image silhouettes.



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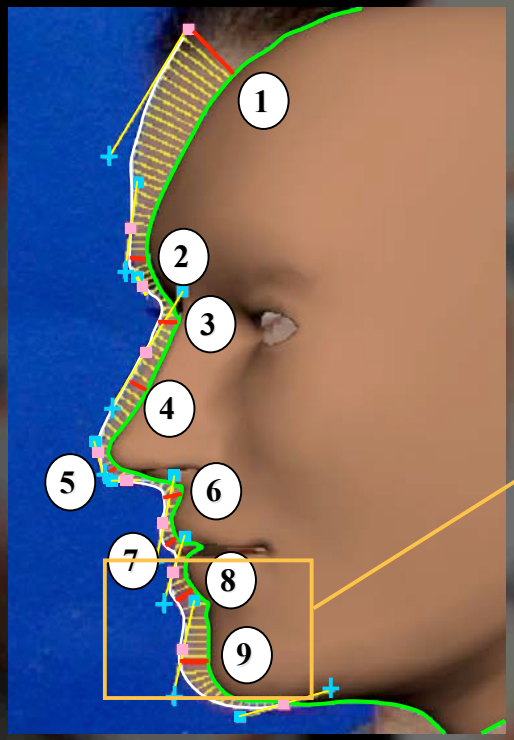
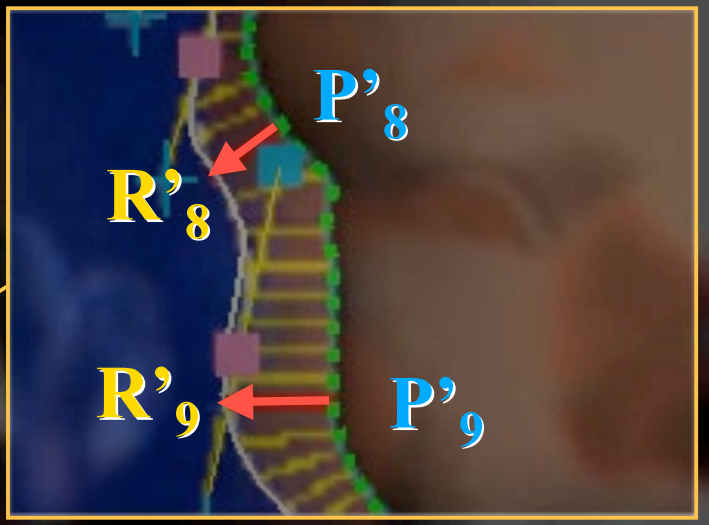
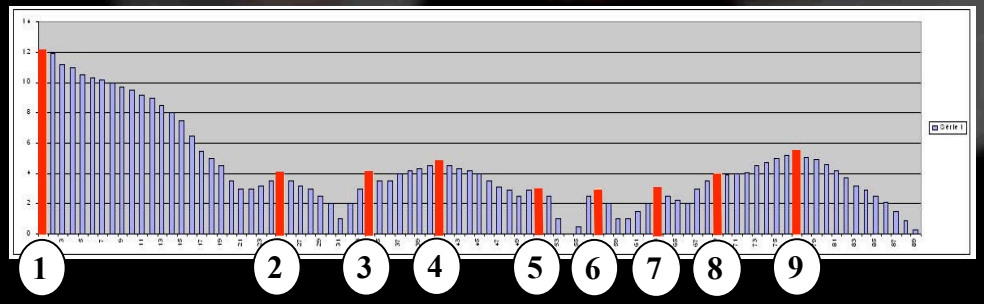




2D Deformation vectors



REFINMENT OF THE MESH BY ITS SILHOUETTES

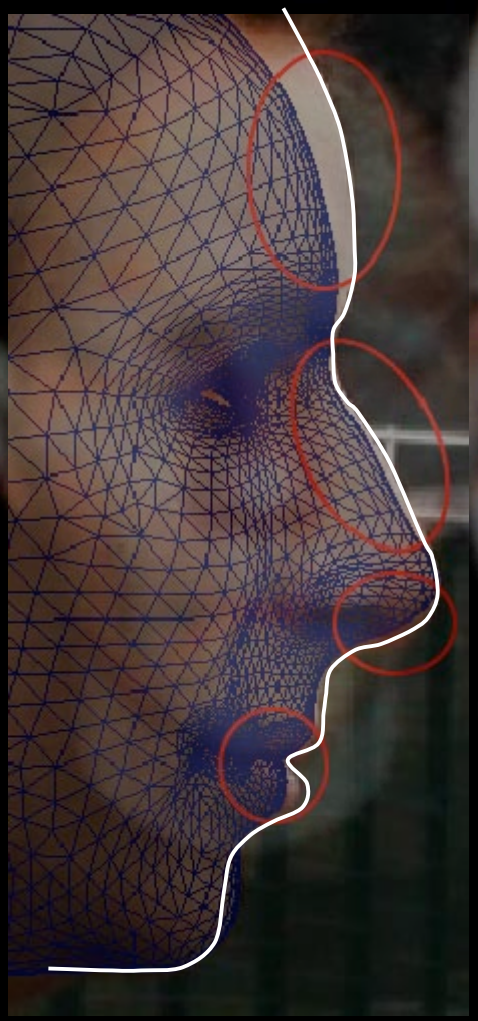


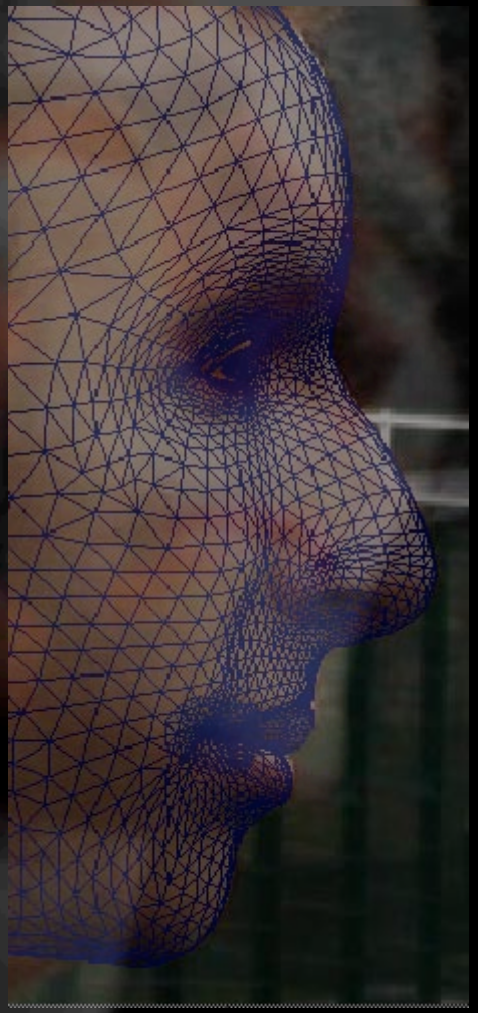
Image silhouette drawing

For each camera, computation of both

3D silhouette and its 2D projection

Computation of the distances between the projected and the image silhouettes.

Computation of the corresponding 3D deformations



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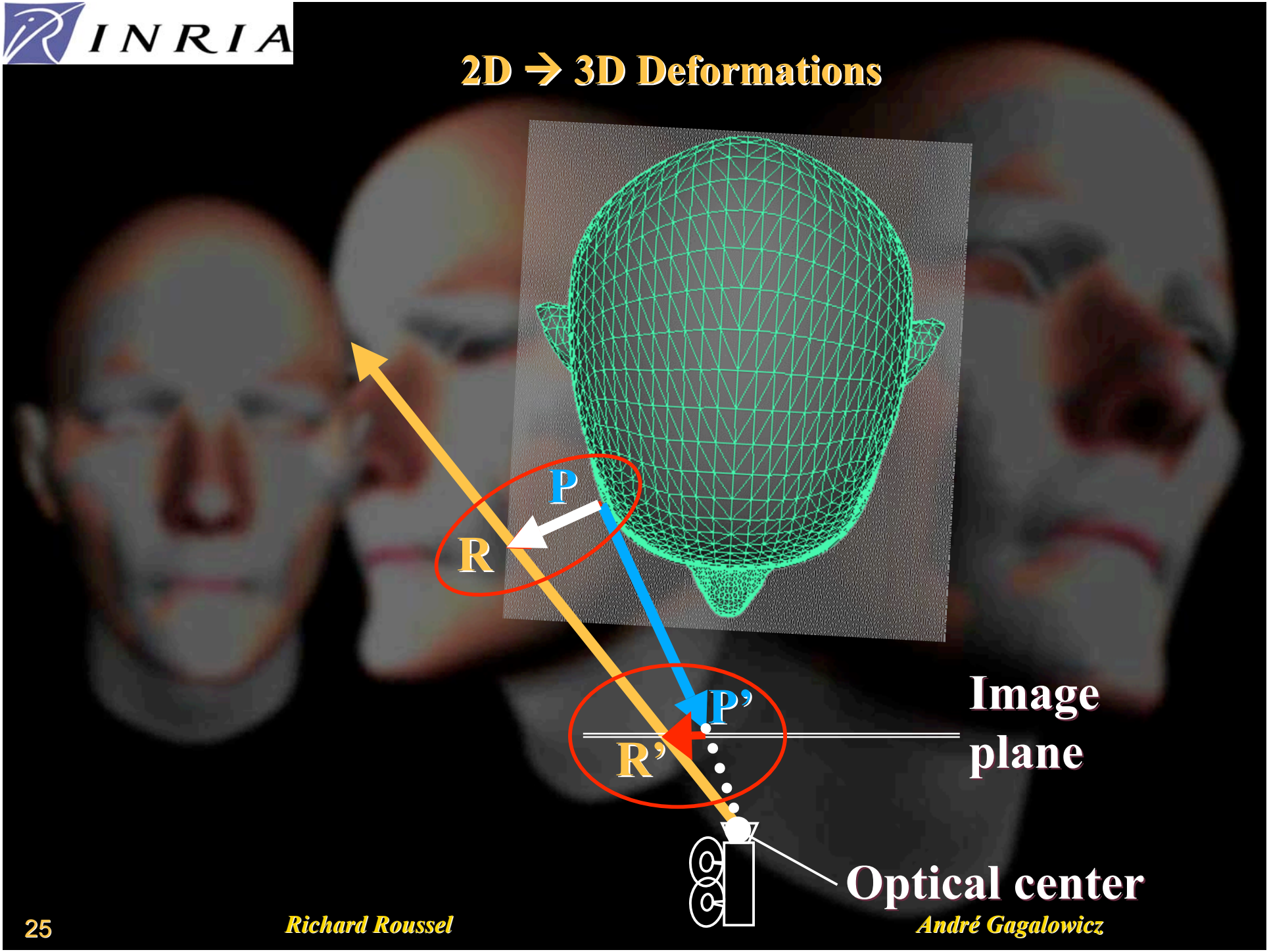
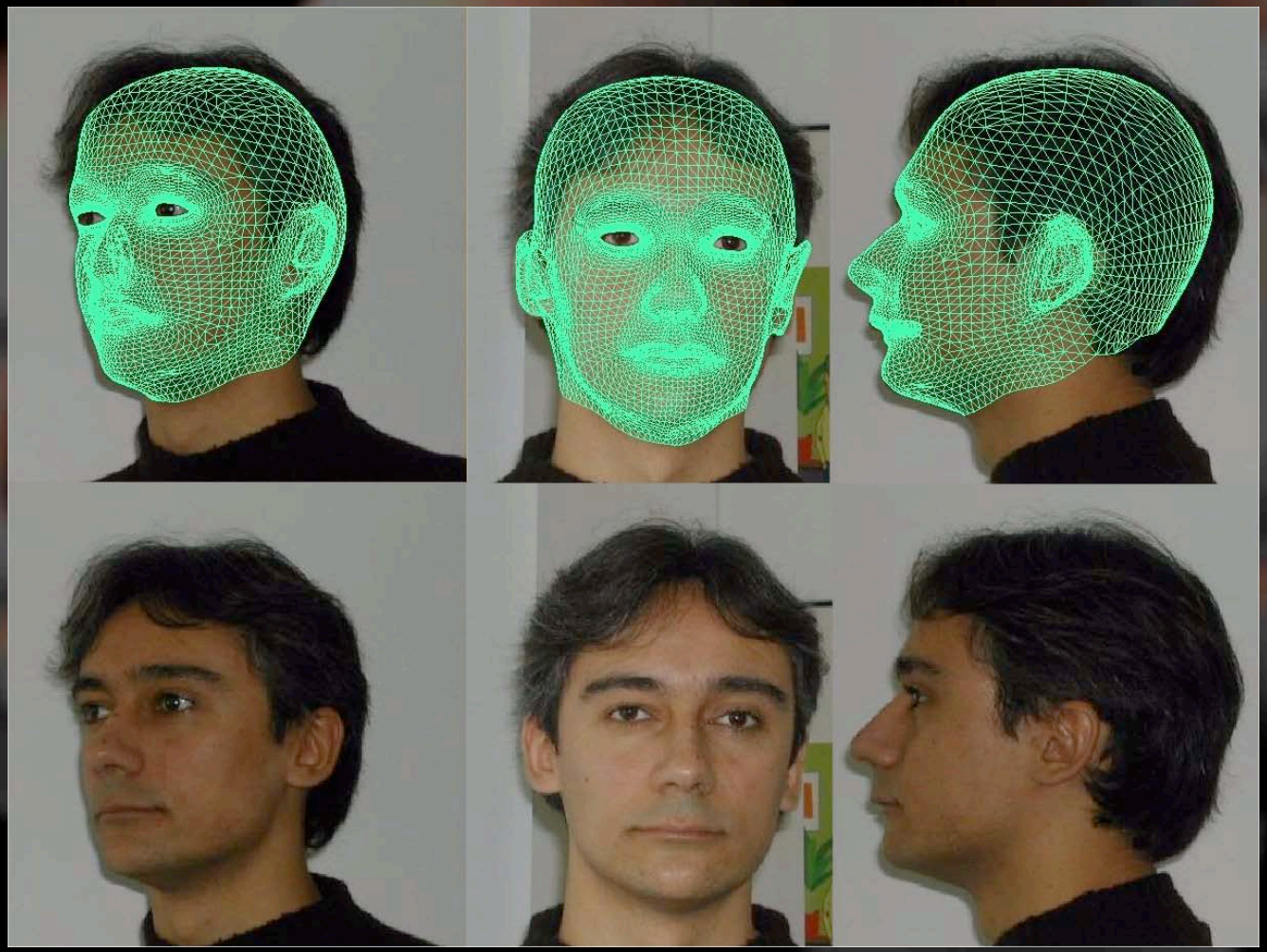
2D → 3D Deformations

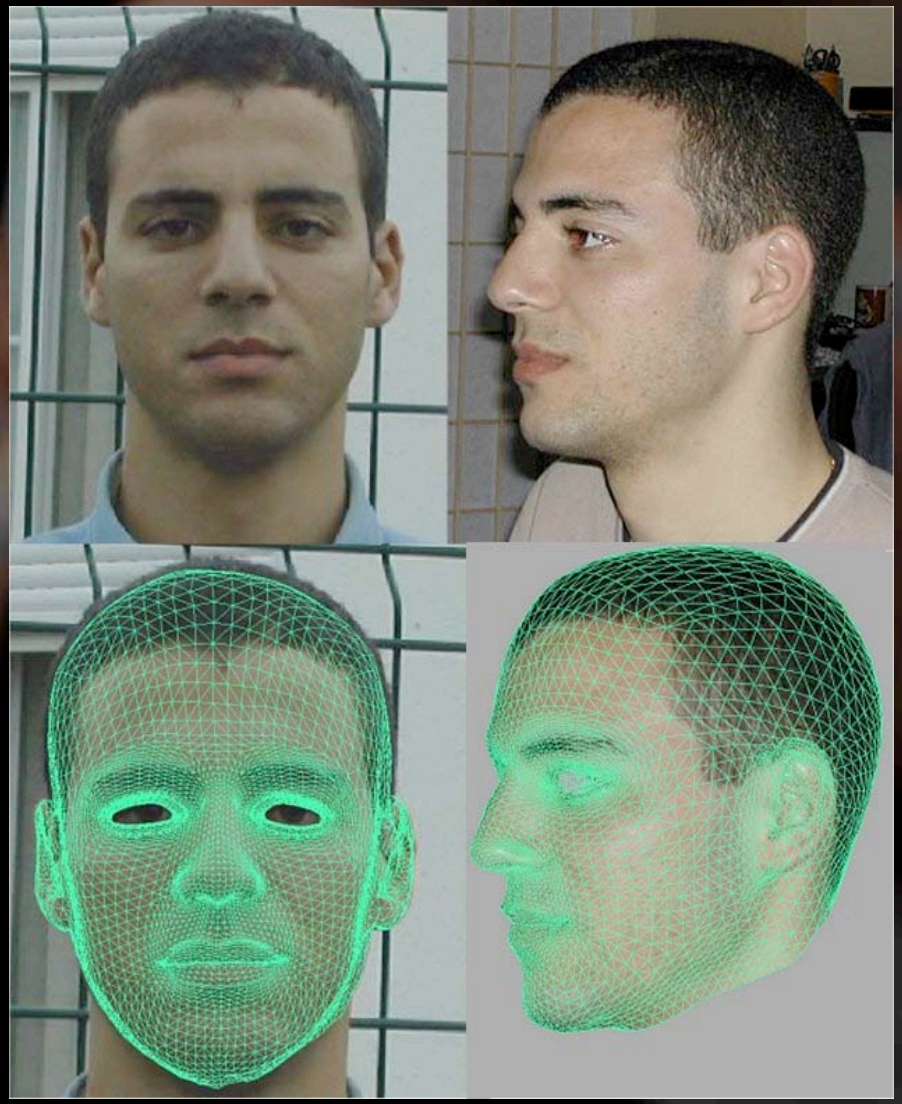



Results

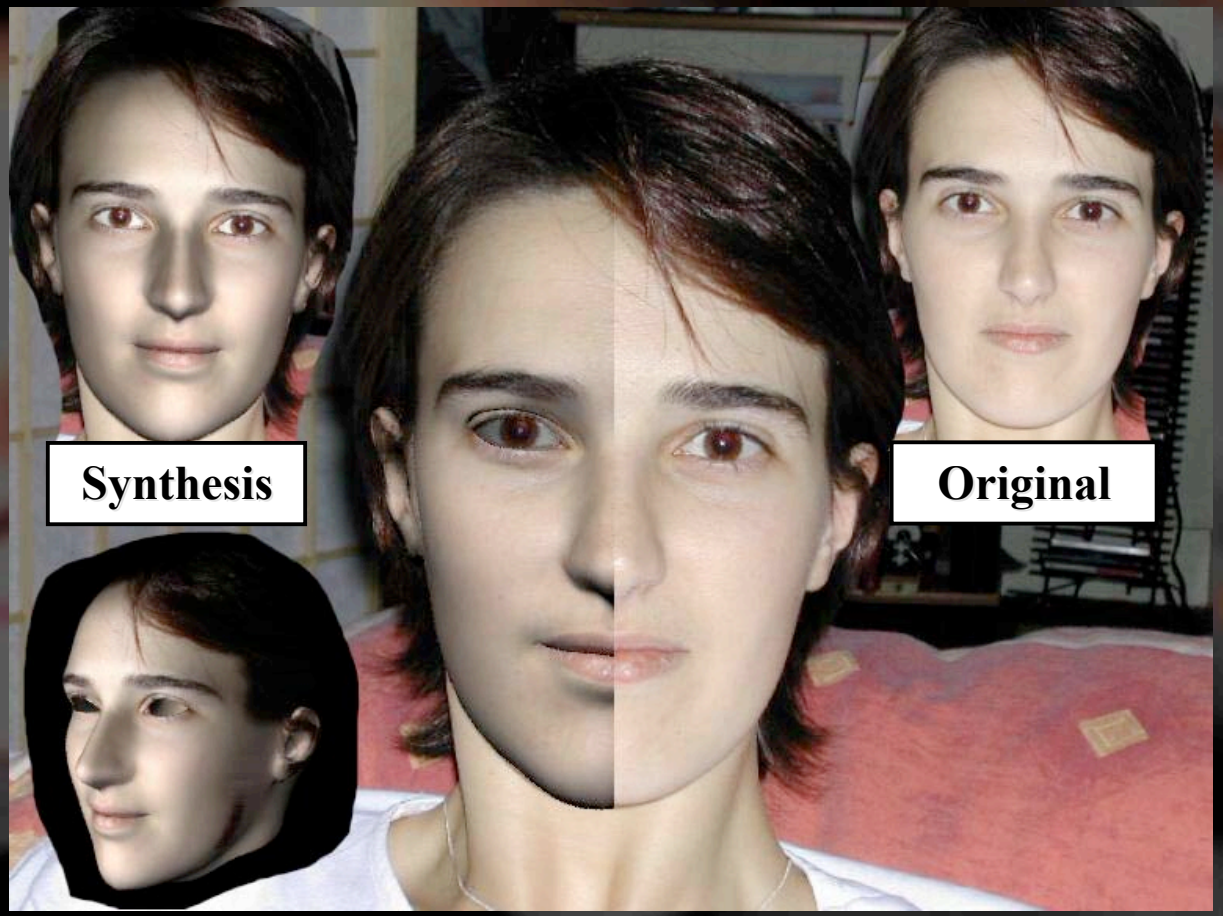
Results

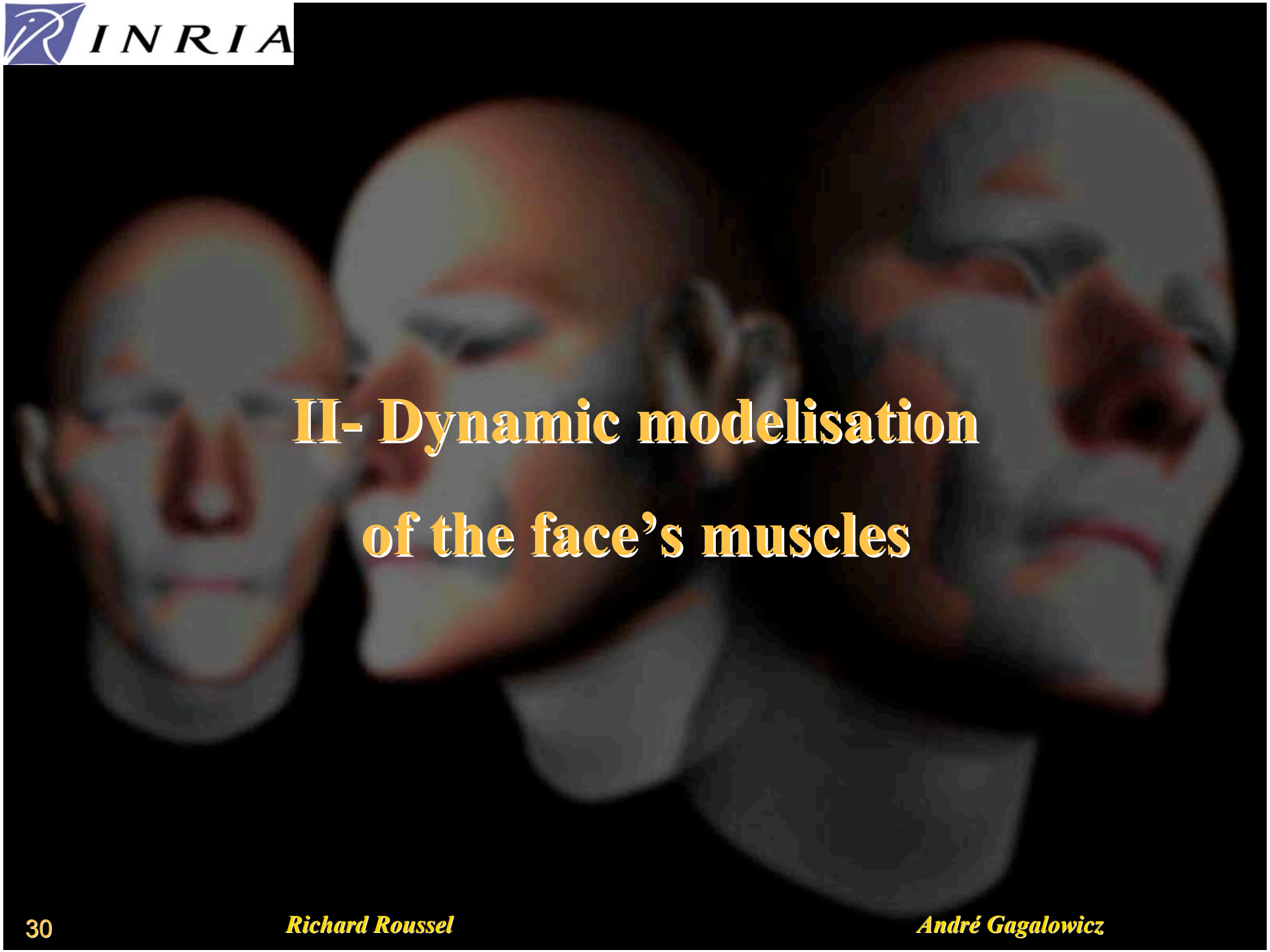


Results



Results




II- Dynamic modelisation
of the face's muscles

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Our model is based on study of muscles that effectively create expressions on the face

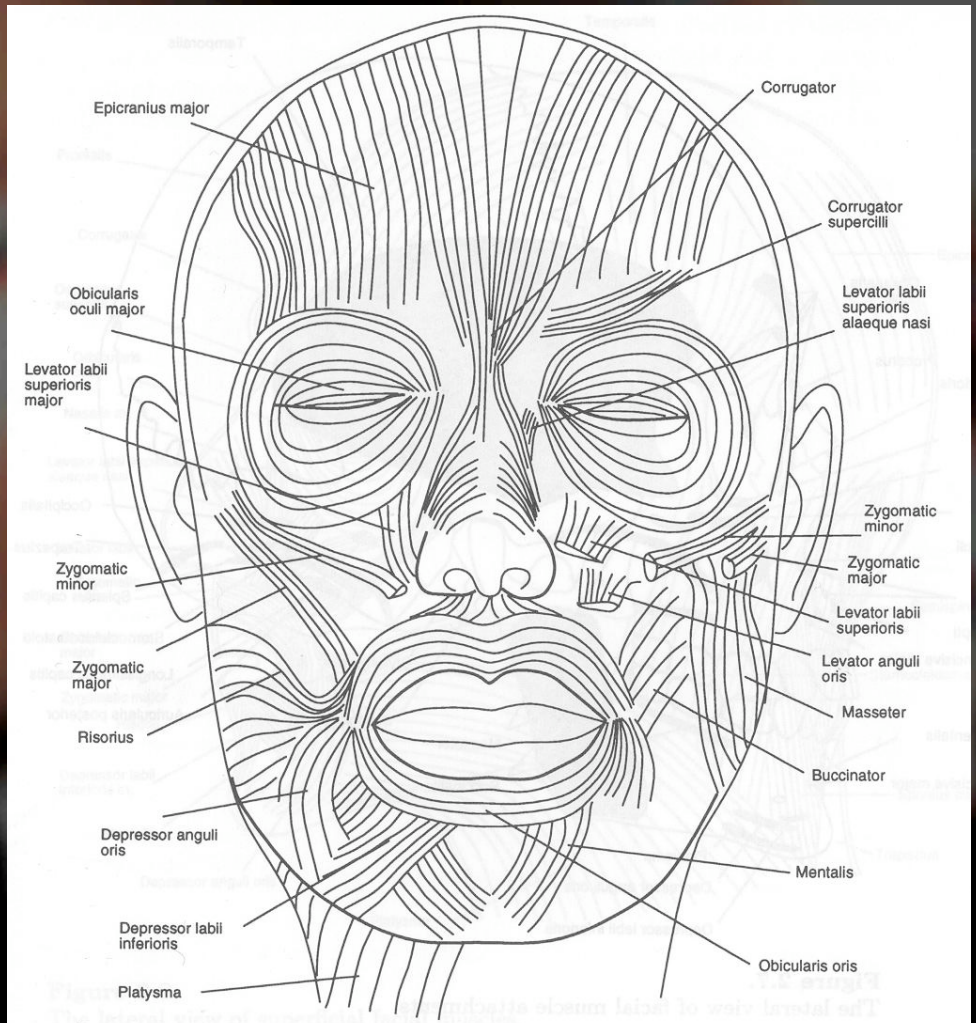

Figure 2.6.
The frontal view of facial muscles.

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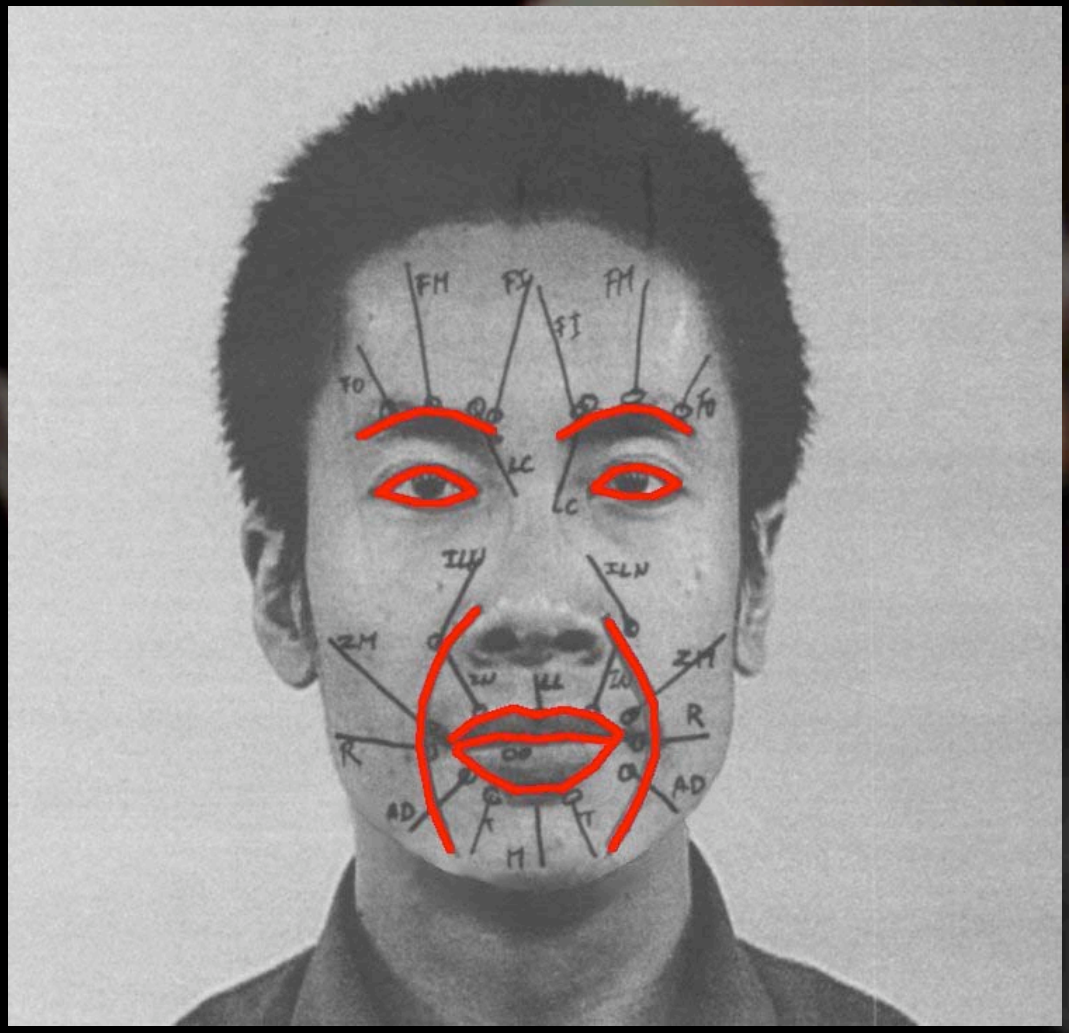
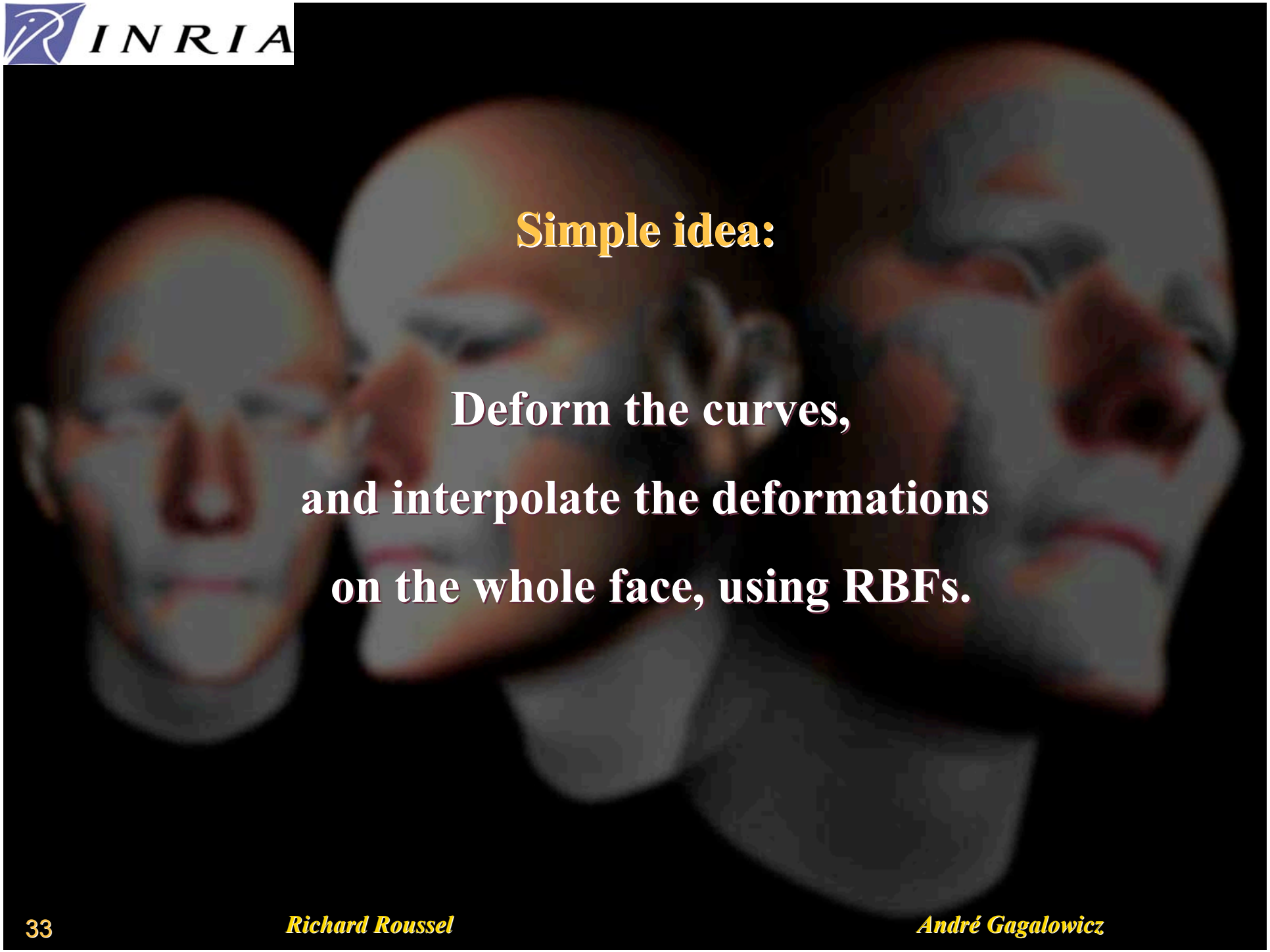
II- Dynamic modelisation of the face's muscles

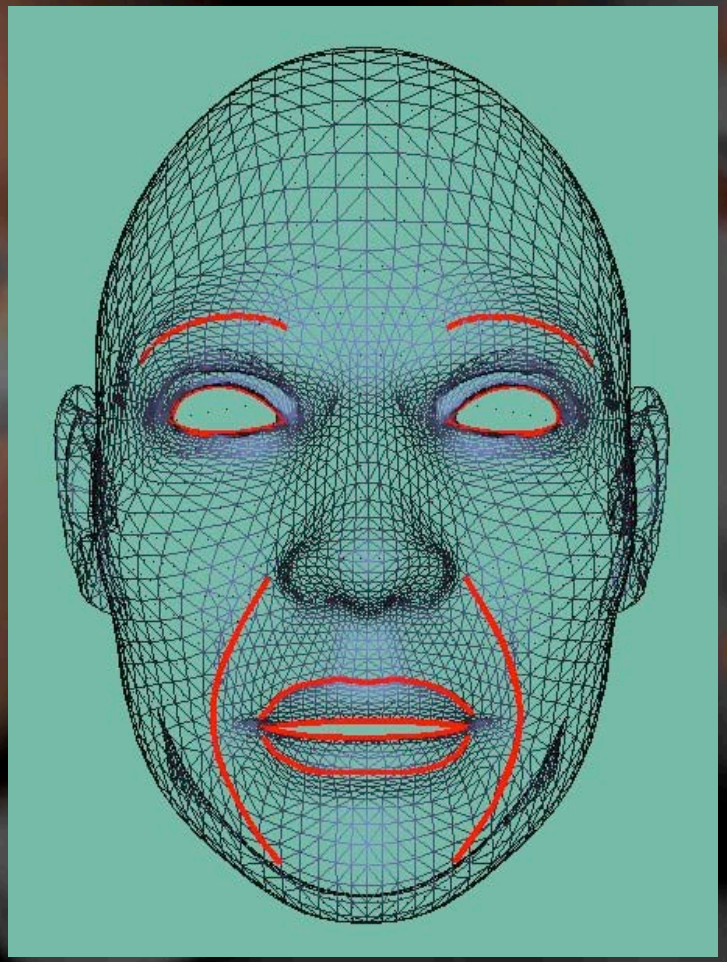


FO : Frontalis outer (x2)	FM: Frontalis Major (x2)
FI: Frontalis Inner (x2)	LC: Lateral Corrugator(x2)
ILN: Inner Labii Nasi(x2)	LL: Levator Labii
LN: Labii Nasi(x2)	ZM: Zygomatic Major(x2)
R: Risorius(x2)	AD: Angular Depressor(x2)
T: Triangularis(x2)	M: Mentalis
OO : Orbicularis Oris(x3)	


Simple idea:
Deform the curves,
and interpolate the deformations
on the whole face, using RBFs.

II- Dynamic modelisation of the face's muscles

Neutral Generic face with its deformation curves



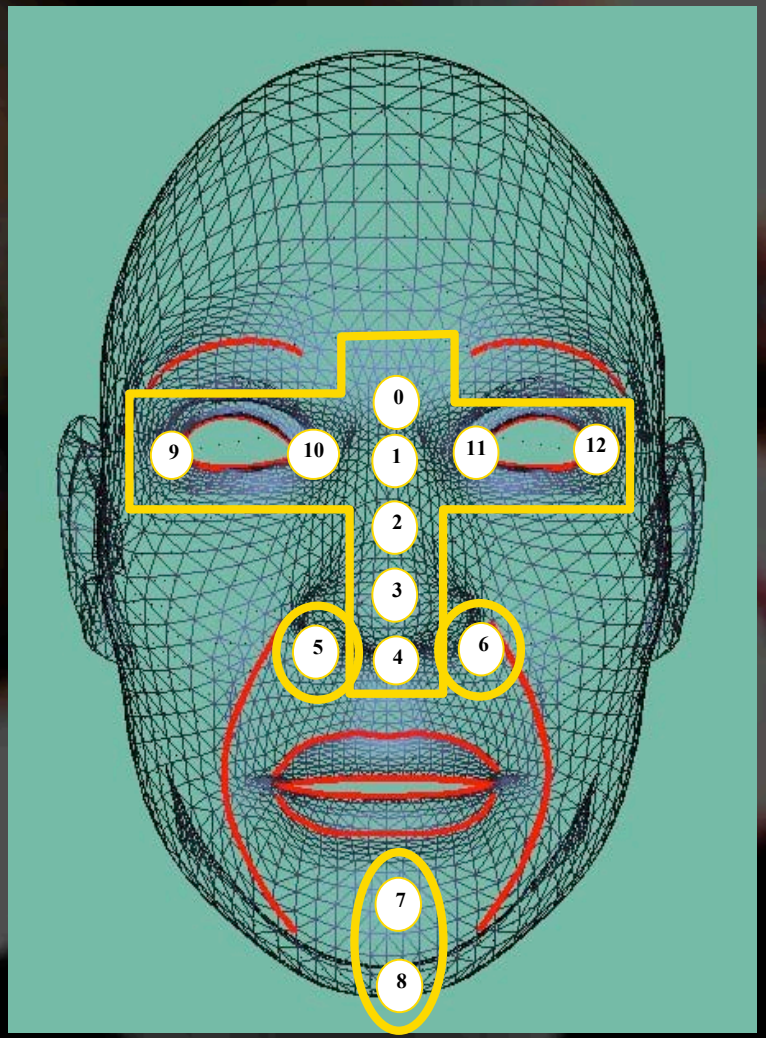
III- Dynamic modelisation of the face's muscles

Static points (force a zero deformation)

- Points on the nose
- Corners of the eyes

Dynamic Points

- On the Chin
- Nostrils



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This model is controlled by 15 behaviours:

7 behaviours for the lower part of the face. (mouth and cheeks)

- Lower lip height
- Upper lip height
- Mouth width
- Mouth corner height
- Lower lip advance
- Upper lip advance
- Chin

2 behaviors for the eyes.

- Right eyelid
- Left eyelid

6 behaviours for the upper part of the face. (eyebrows and forehead)

- Inner right eyebrow height
- Inner left eyebrow height
- Central right eyebrow height
- Central left eyebrow height
- Outer right eyebrow height
- Outer left eyebrow height

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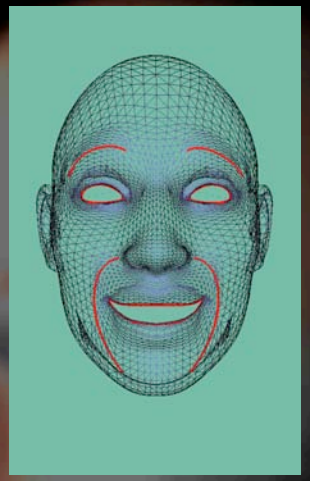
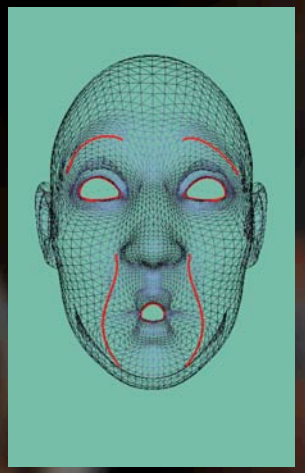
6 universal expressions

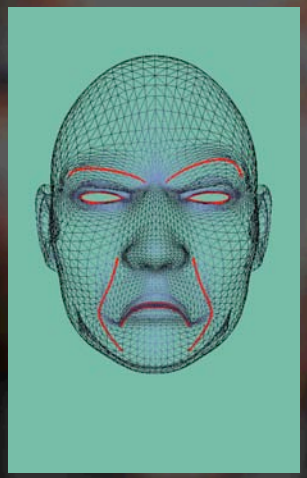
Happiness



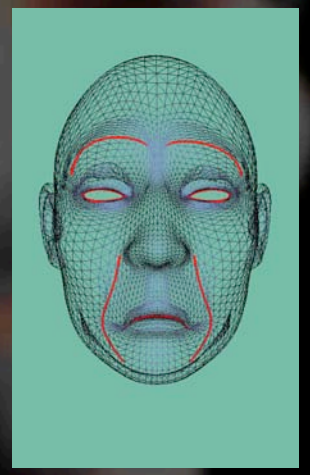
Surprise



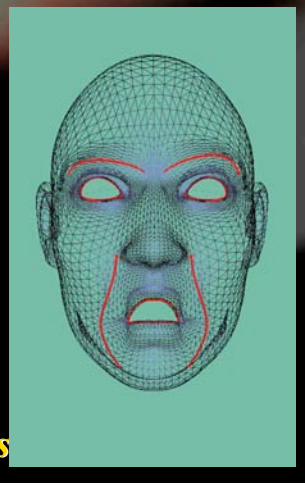
Anger



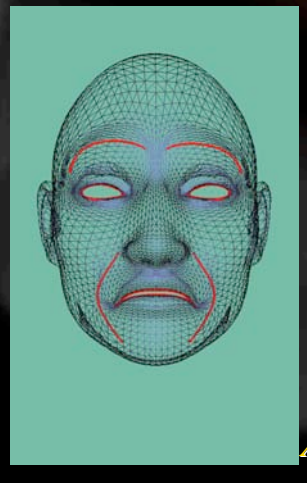
Sadness



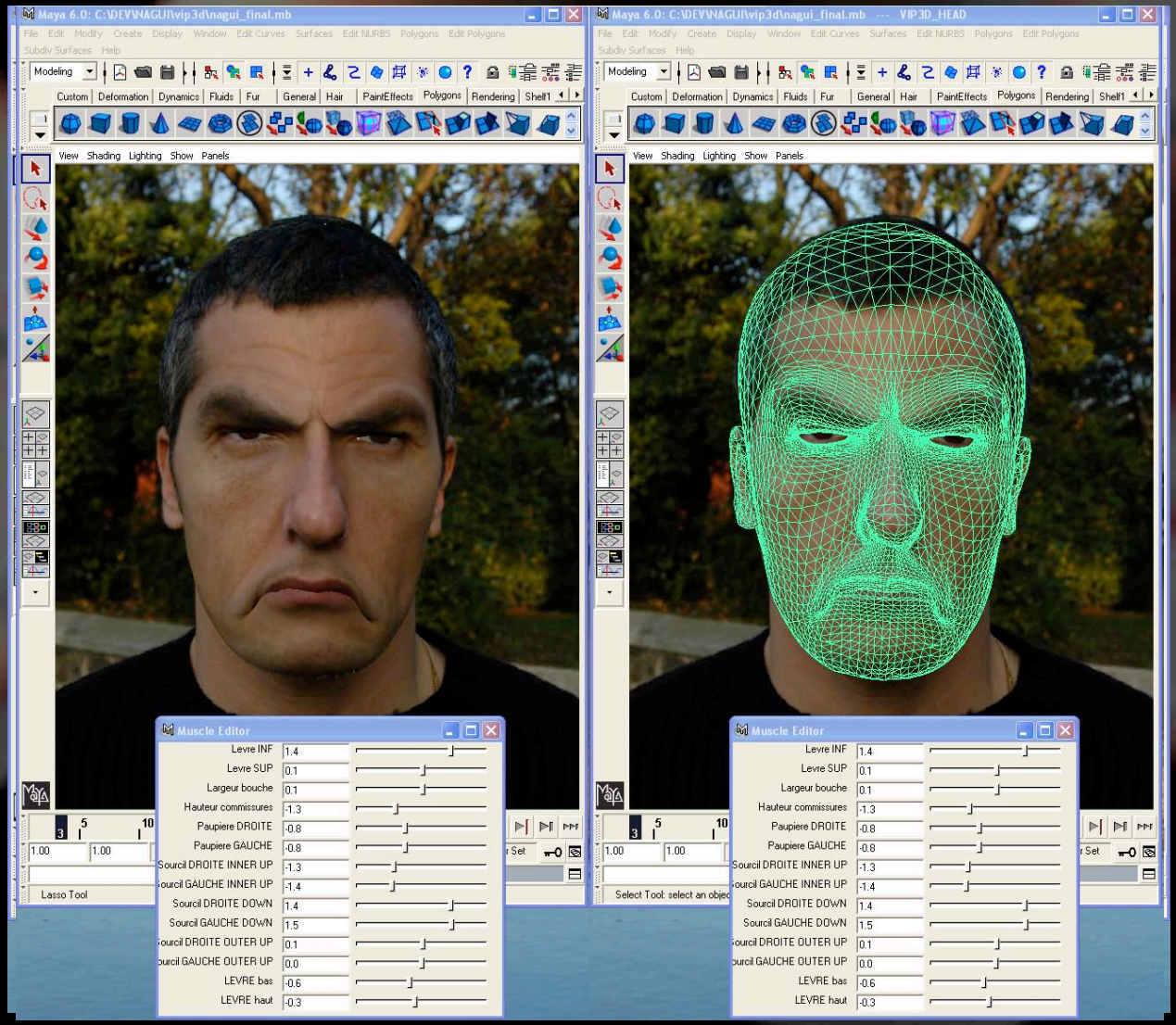
Fear



Disgust



II- Dynamic modelisation of the face's muscles



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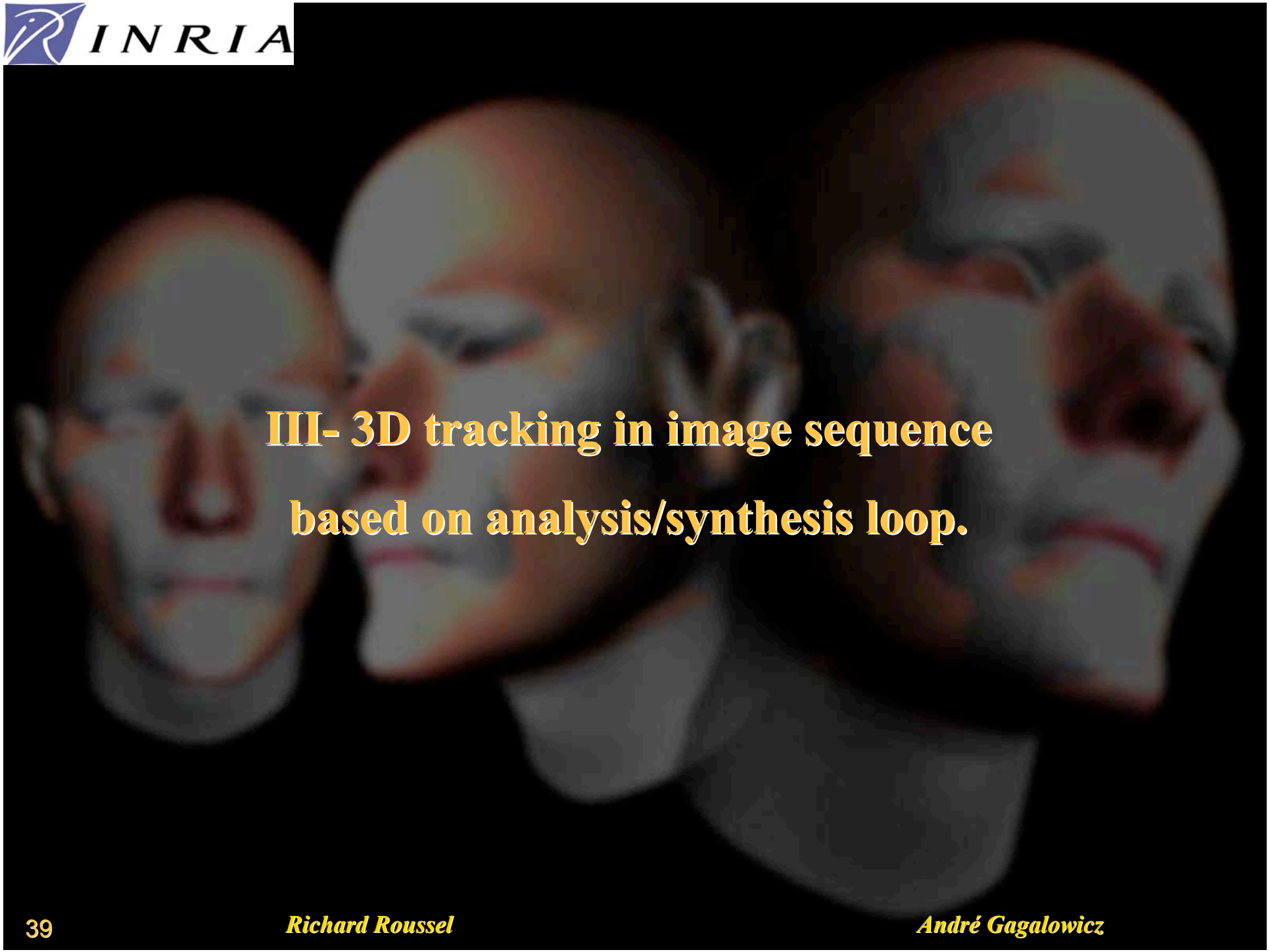
III- 3D tracking in image sequence
based on analysis/synthesis loop.

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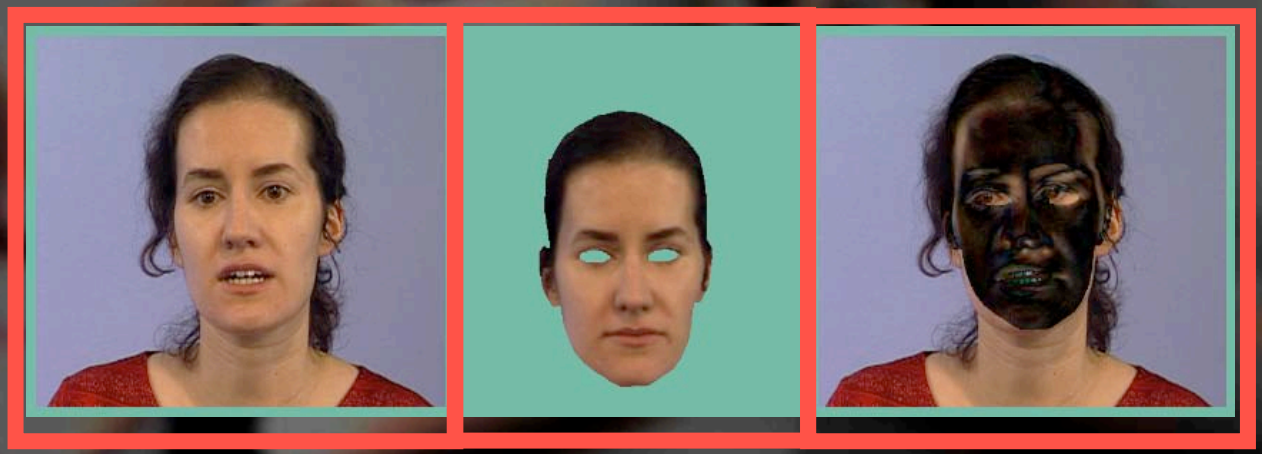


Image to compute

Textured 3D mesh

Error

III- 3D tracking in image sequence based on analysis/synthesis loop.

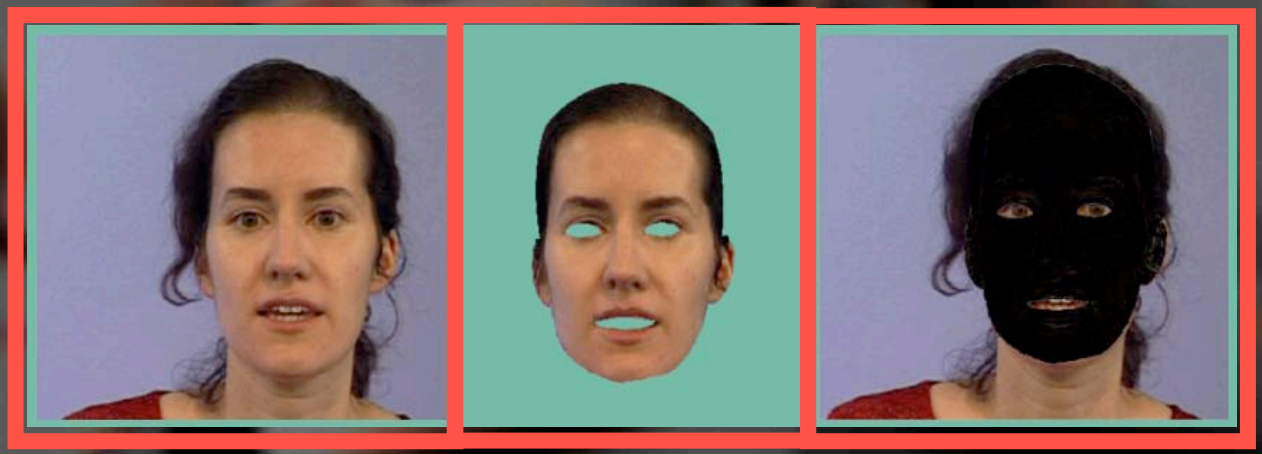
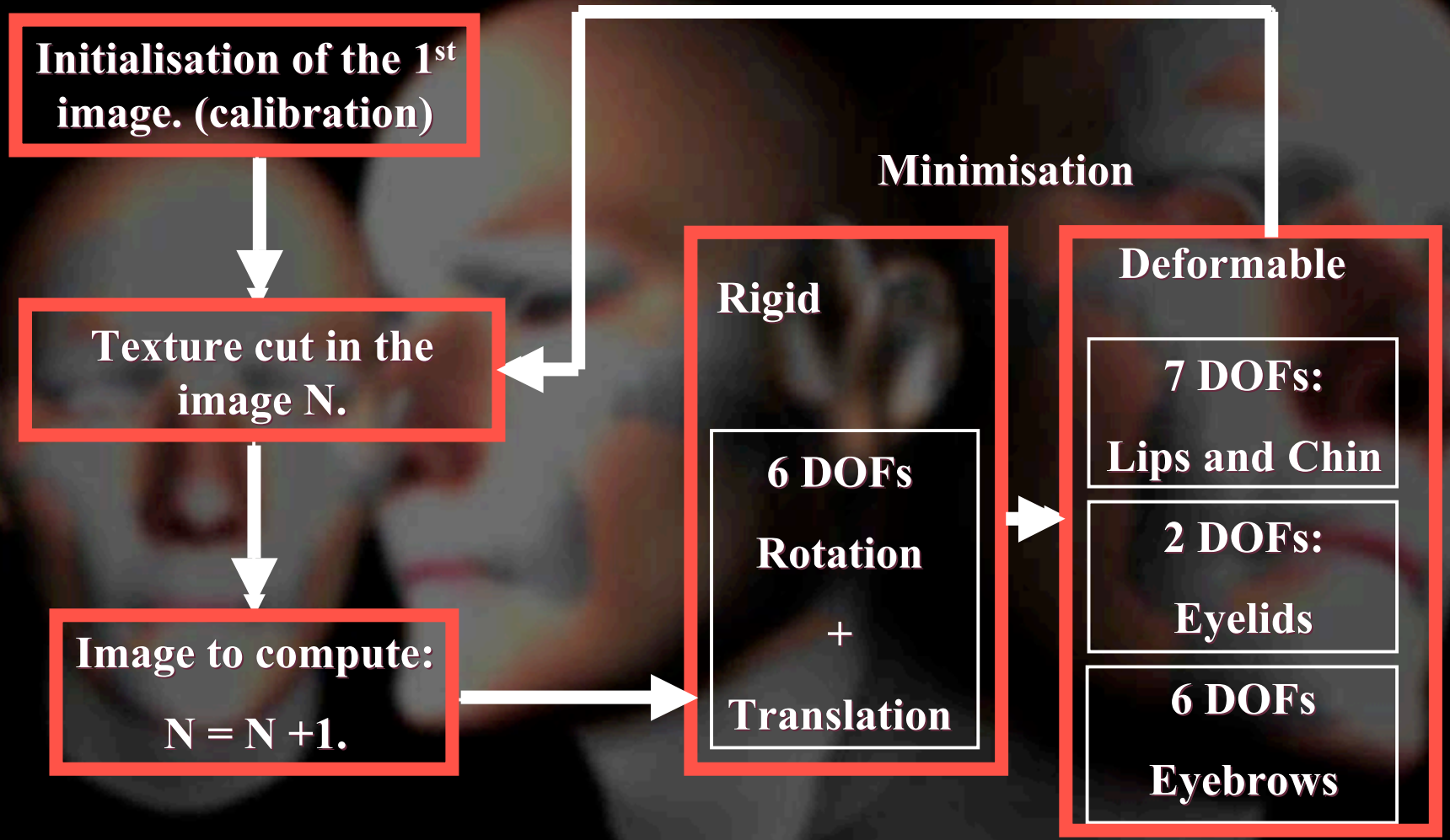


Image to compute

Textured 3D mesh

Error

Tracking global scheme




Shading Lighting Show Panels
View Shading Lighting Show

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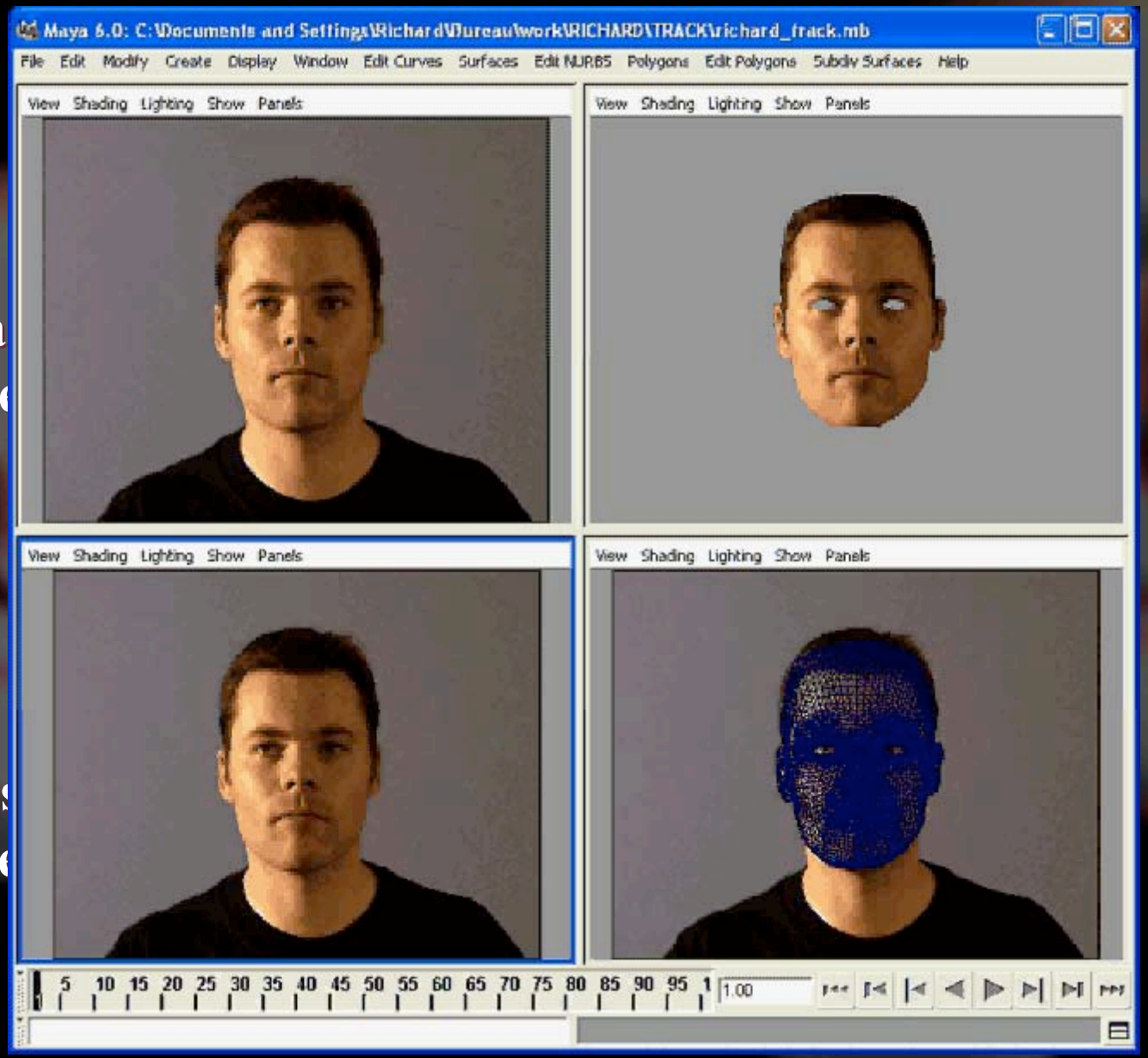
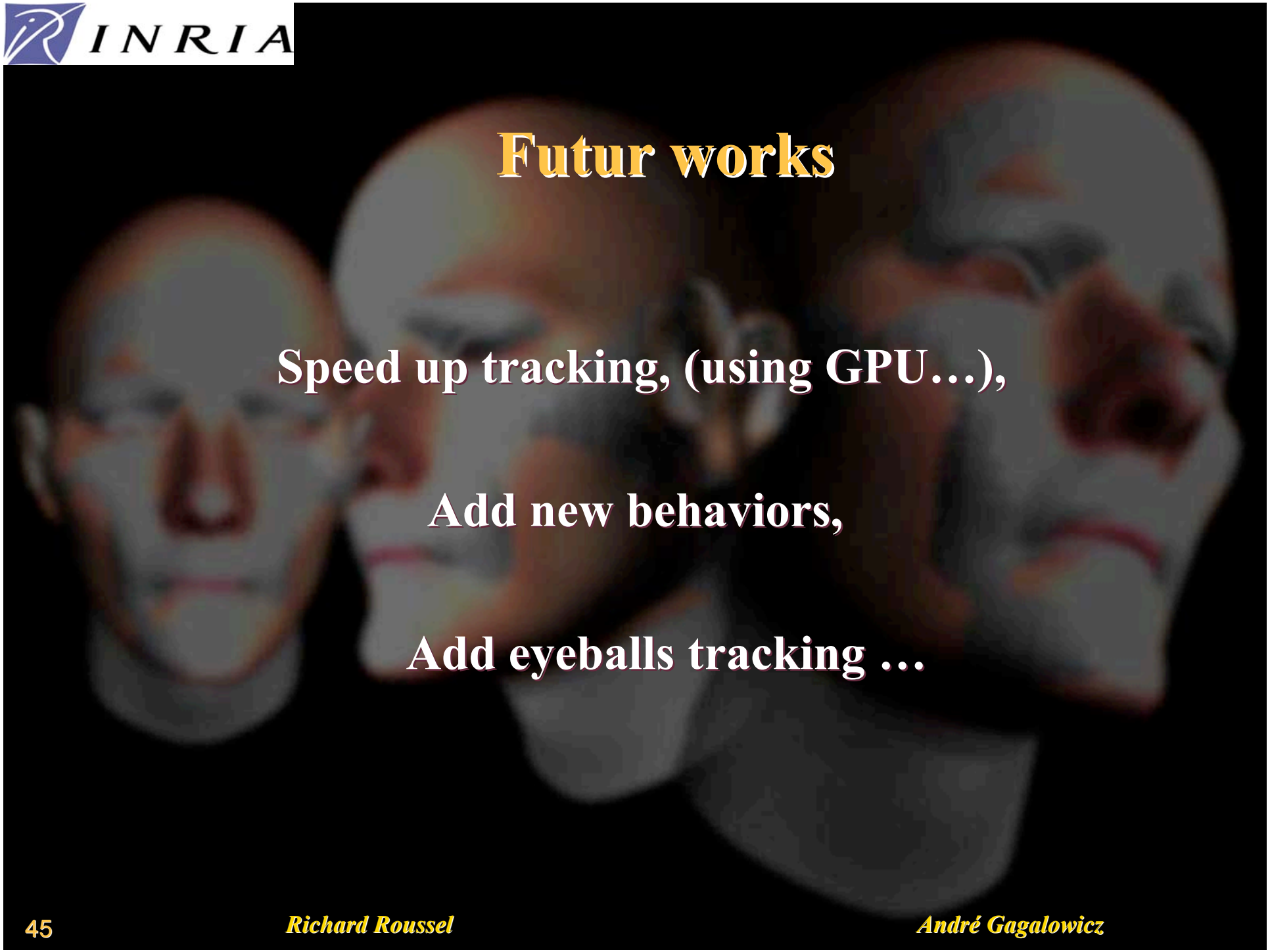


Textured
face

3D mesh



Futur works

Speed up tracking, (using GPU…),

Add new behaviors,

Add eyeballs tracking …


Any question ?