

# Virtual 3D drawing tool for stage performances

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Vision3D Laboratory

Lighttwist and the Cyclorama



Vision3D Laboratory

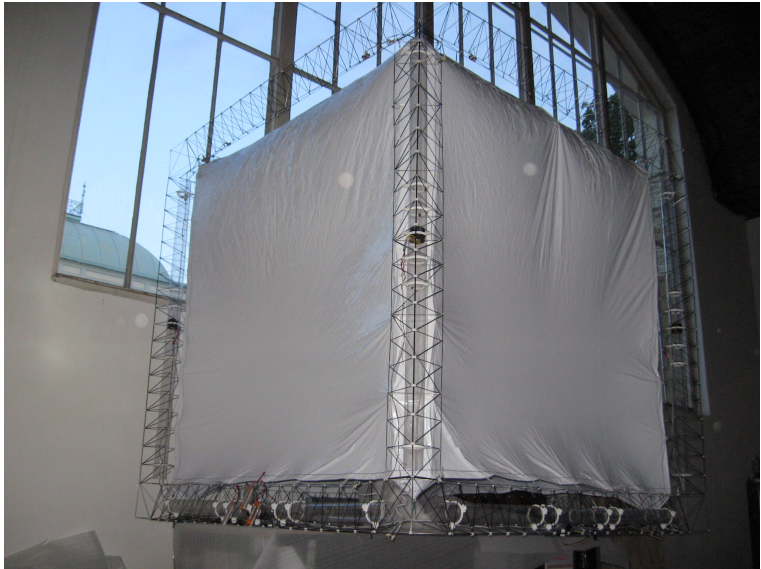
Lighttwist and the Cyclorama

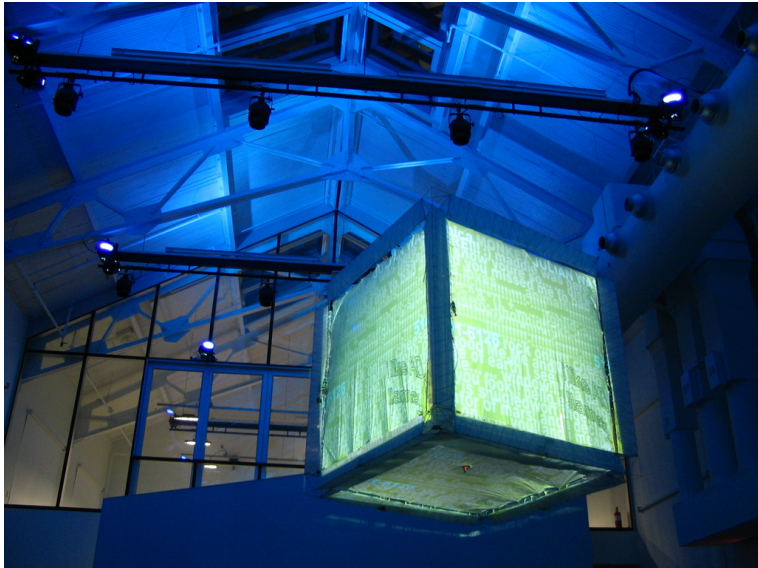


Vision3D Laboratory

The Mascarillons

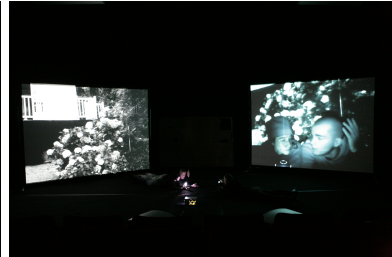
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Daniel Danis

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## The birth of a collaboration

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## Stage performance constraints

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- Affordable
- Easy to setup
- Flexible
- Intuitive
- Easily available

## Stage performance constraints

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- Cheap
- Wireless
- Fast framerate (100 Hz)
- Very robust on-board segmentation
- Easy to interface (bluetooth)
- Very popular product

## Introducing multi-camera calibration

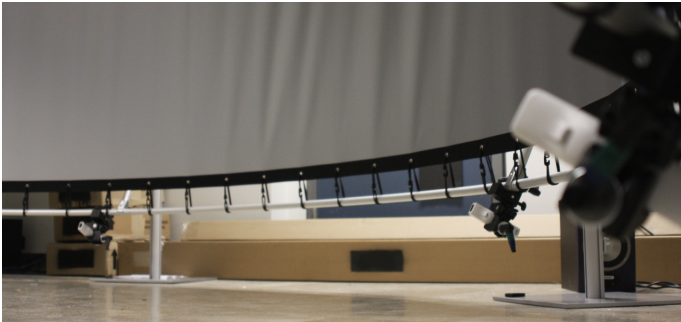
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### Why so many wiimotes?

- We need depth information
  - We want a larger tracking area
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- 1 wiimote = no depth
  - 2 wiimotes = depth by triangulation
  - 3 or more wiimotes = freedom of movement

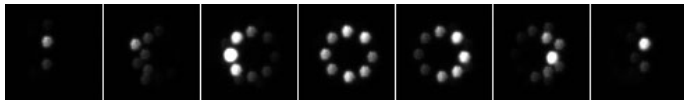
## Introducing multi-camera calibration

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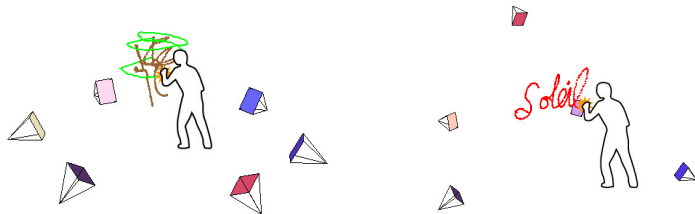
## IR pen design

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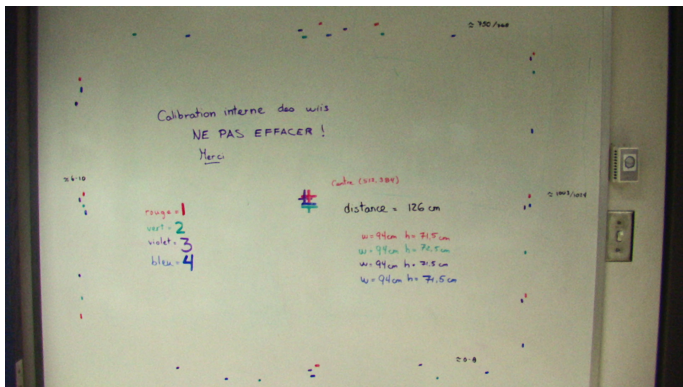
## Goal

Calibrating any configuration of wiimotes automatically



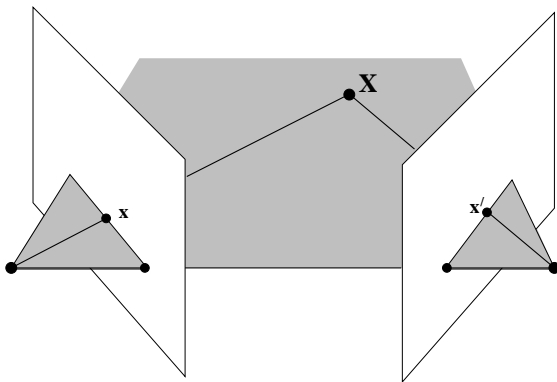
## Internal calibration

$$(u, v) = (512, 384)$$
$$f_x = 1340.43 \quad \alpha_x \approx 42^\circ$$
$$f_y = 1318.13 \quad \alpha_y \approx 32^\circ$$



## Two wiimotes: pose from epipolar geometry

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### Why using epipolar geometry?

- Does not require any calibration object
- Point correspondences given directly by the wiimotes



Two wiimotes: pose from epipolar geometry

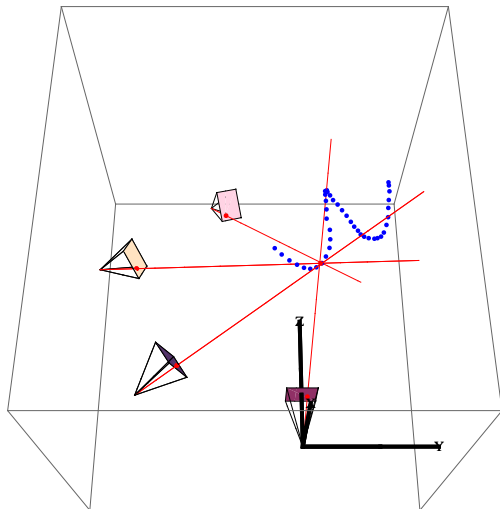
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## Why care about two wiimotes when you can have more?

- Points are not always visible by all wiimotes
  - People are not transparent
  - Wiimote configuration may not provide complete visibility
- We want maximum freedom of movement

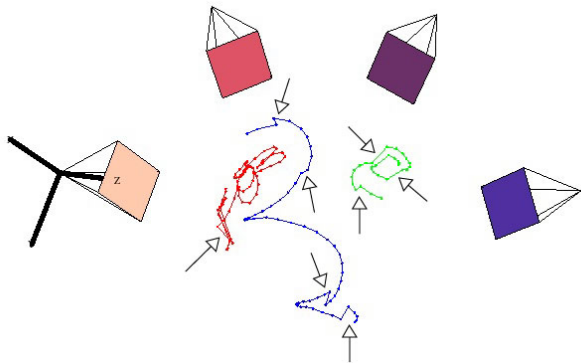
## Two wiimotes: pose from epipolar geometry

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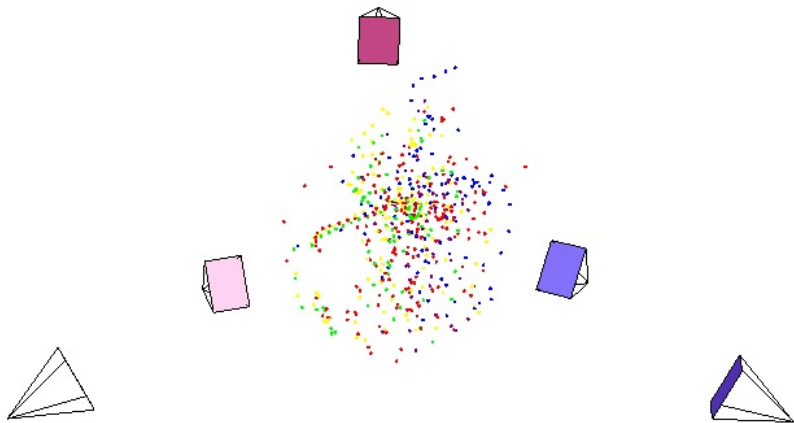
## Two wiimotes: pose from epipolar geometry

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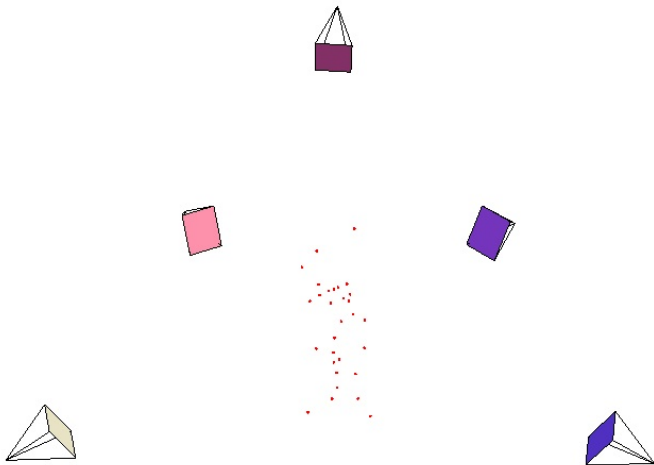
## Pose minimisation

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## Pose minimisation

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## The method

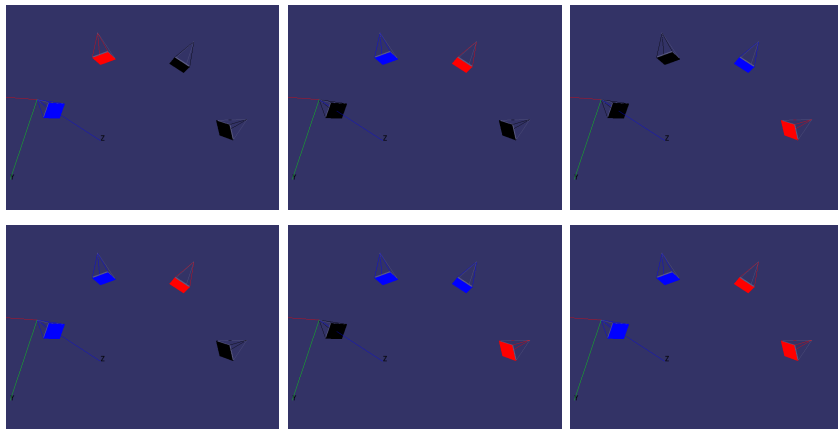
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- Calibrate pairs of cameras that have common points
- Calibrate triples of cameras that have common points
- ... and so on with more and more cameras each time
  
- The initial pose is given by epipolar geometry
- Use the previous calibration as the starting point for the next minimisation

## The method

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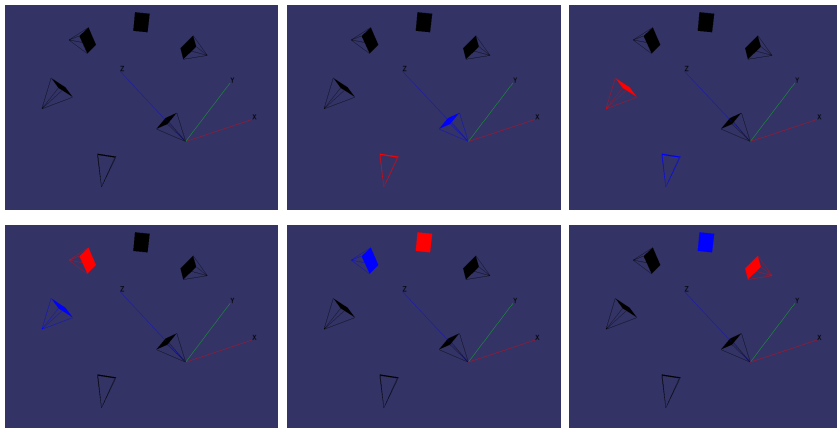
Minimisation steps for a network of 4 wiimotes covering  $180^\circ$



## The method

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Minimisation steps for 6 wiimotes covering 360° [2-tuples]



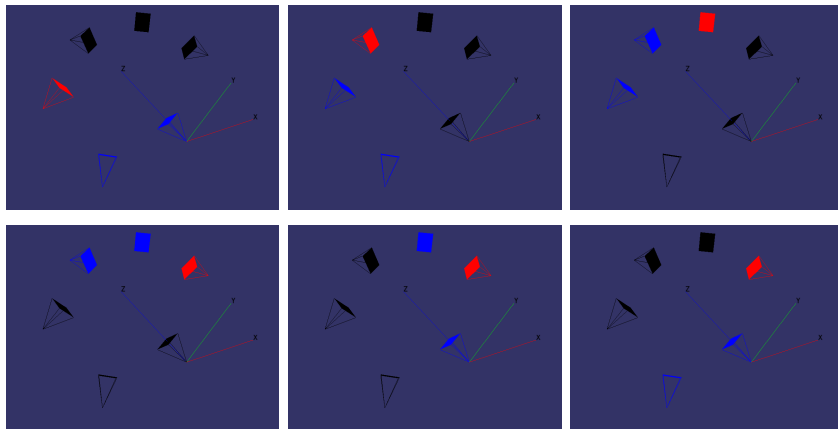
...



## The method

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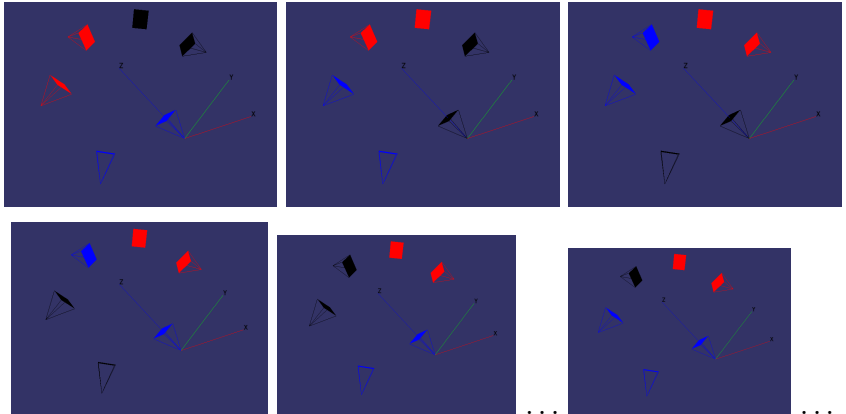
Minimisation steps for 6 wiimotes covering 360° [3-tuples]



## The method

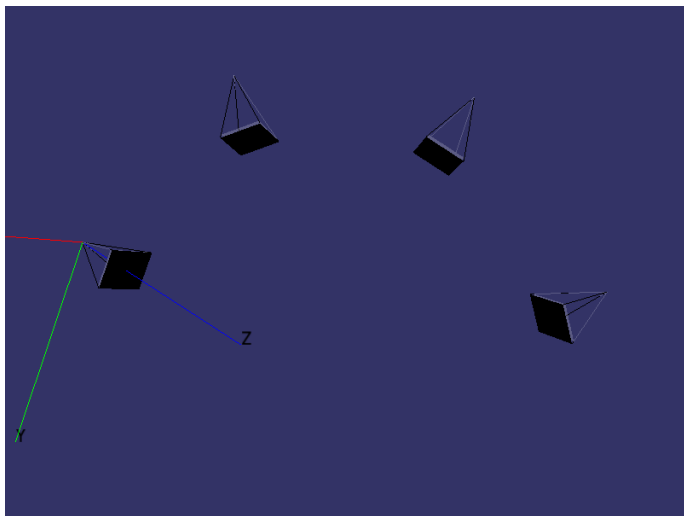
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Minimisation steps for 6 wiimotes covering 360° [n-tuples]



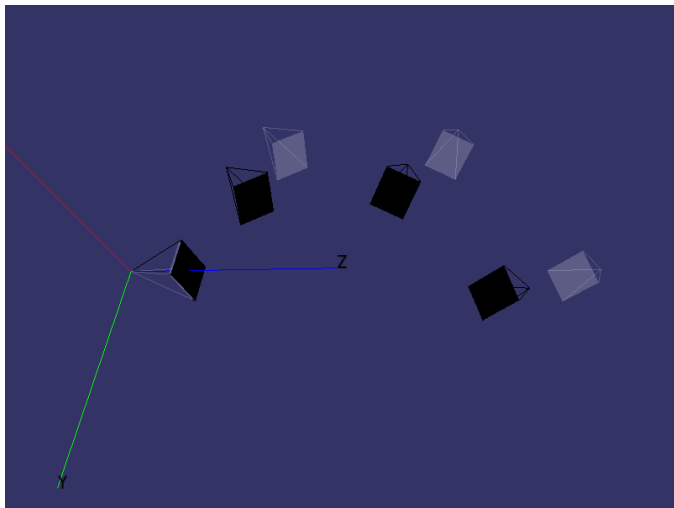
## The method

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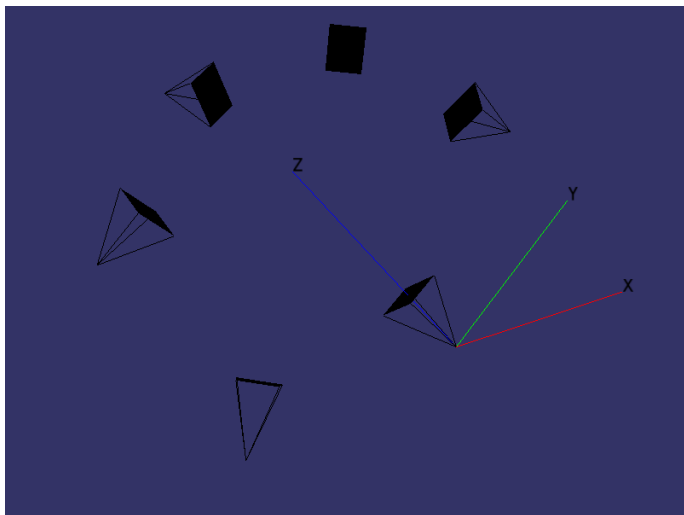
## The method

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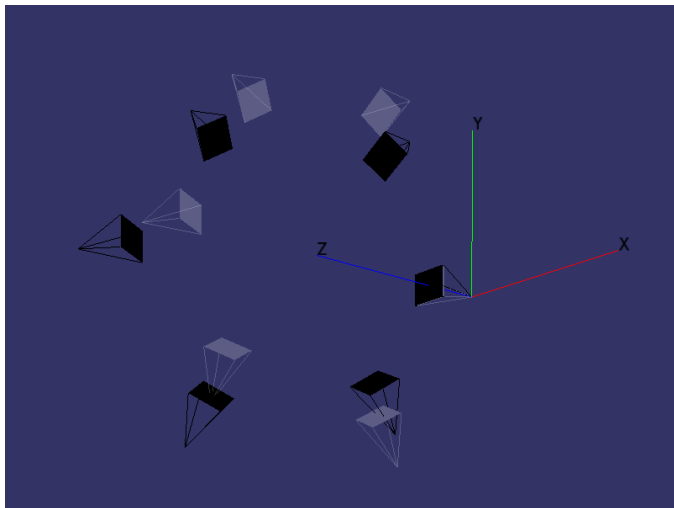
## The method

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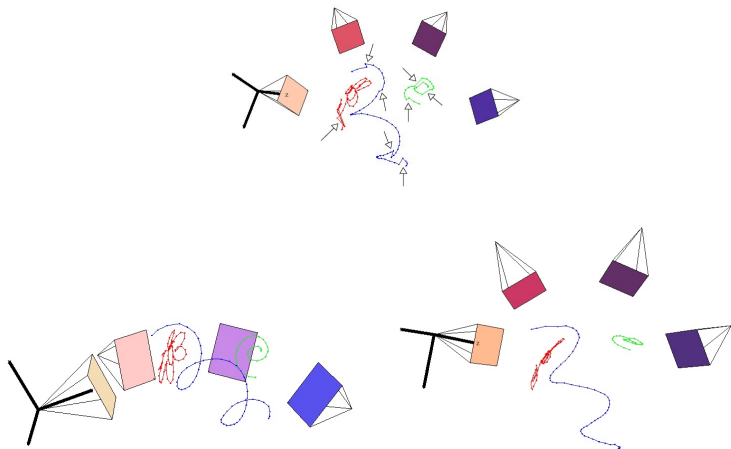
## The method

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## Results

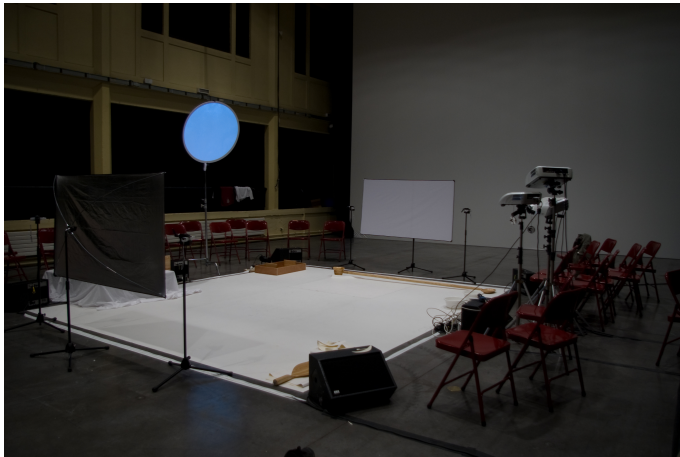
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Global reconstruction error: 2.1 cm (volume 4m x 4m x 2m)

## Reneiges

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June 8<sup>th</sup>-14<sup>th</sup>, 2008



## Reneiges

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June 8<sup>th</sup>-14<sup>th</sup>, 2008

## La Trilogie des Flous

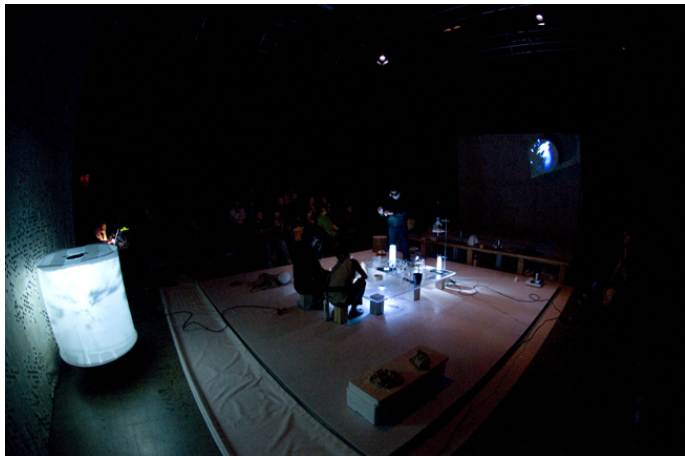
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November 11<sup>th</sup>-16<sup>th</sup>, 2008

## La Trilogie des Flous

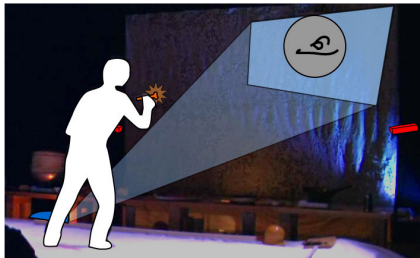
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November 11<sup>th</sup>-16<sup>th</sup>, 2008

## La Trilogie des Flous

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## La Trilogie des Flous

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## Conclusion and future work

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- Tracking with multiple wiimotes is feasible and can be accurate
- The wiimotes field of view is not a constraint anymore
- Tracking multiple infrared sources (limit is 4)
- Develop a control interface for 3D objects
- Integrate the visualisation into our stereoscopic immersive screen
- Distribute the calibration software in open source

There are MANY applications to technological arts!