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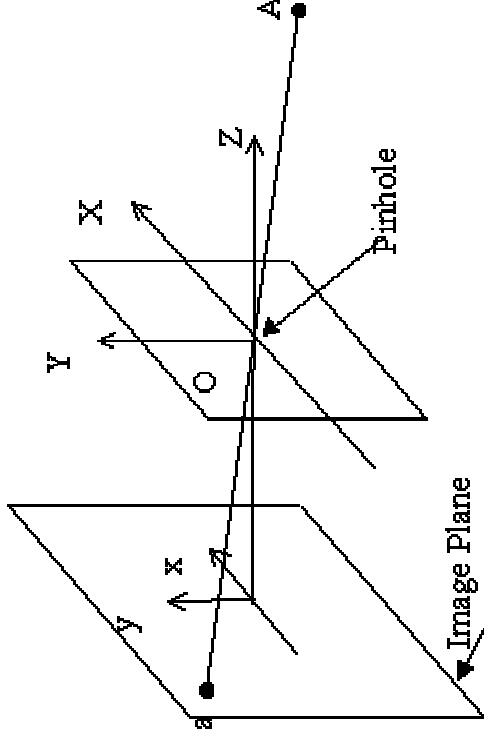
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# Illustration



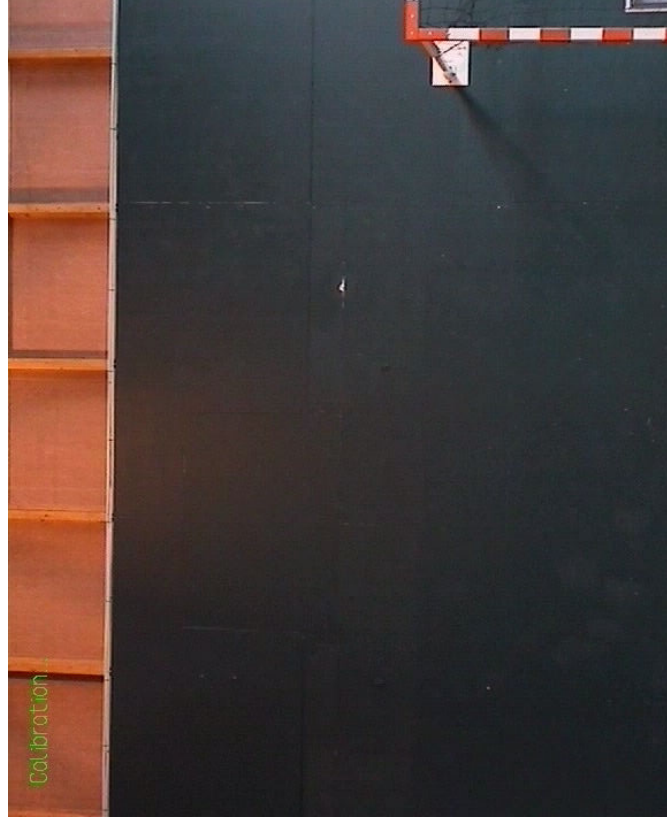
# Calibration

- Camera calibration in order to conform to a « pinhole » model
- Zhang's method is used
  - Relative error on focal estimation is about 0.3%
  - Absolute error on optical center position is 1px



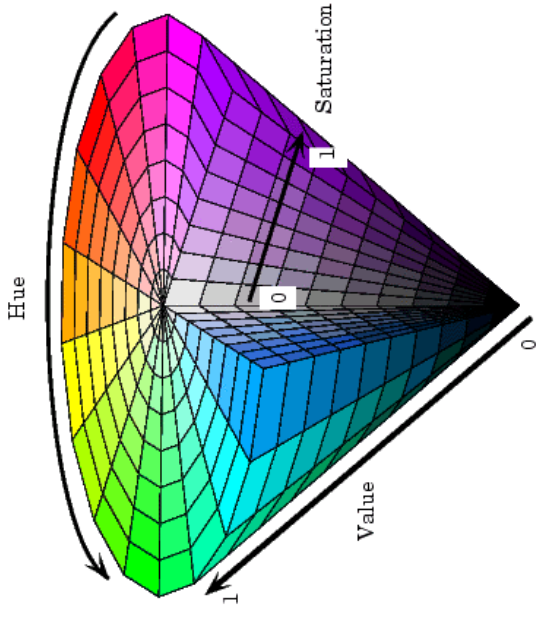
# Calibration

- About 15s of film are needed
  - 10 images of a checkerboard grabbed at 2 Hz
  - 7x7 tiles of 2x2cm
  - Tilt the board  $\sim 45^\circ$

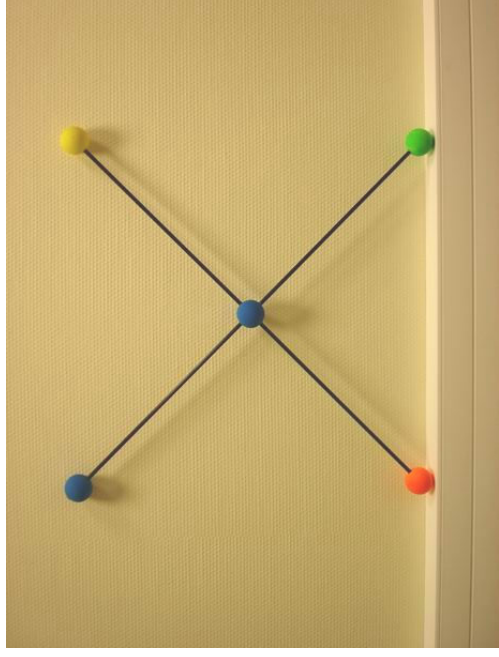


# Colour detection

- HSV space
  - Hue (*Teinte*)
  - Saturation
  - Value (*Luminance*)

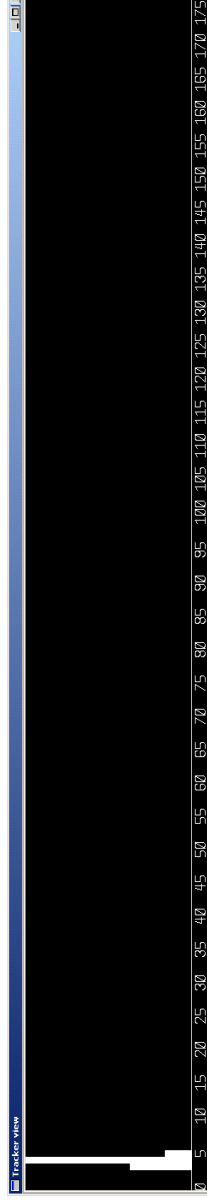


- A cross is used as a visual target, method is based on blob tracking

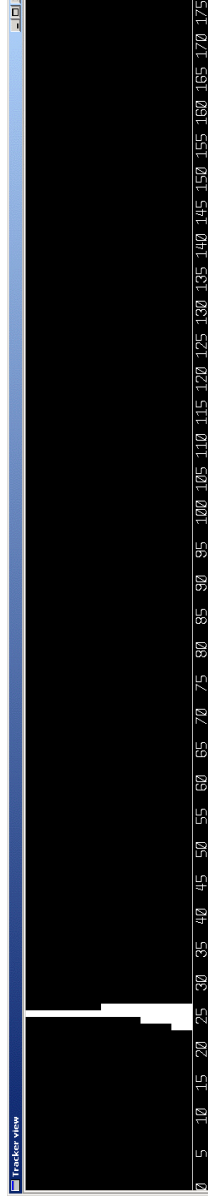


# Histograms

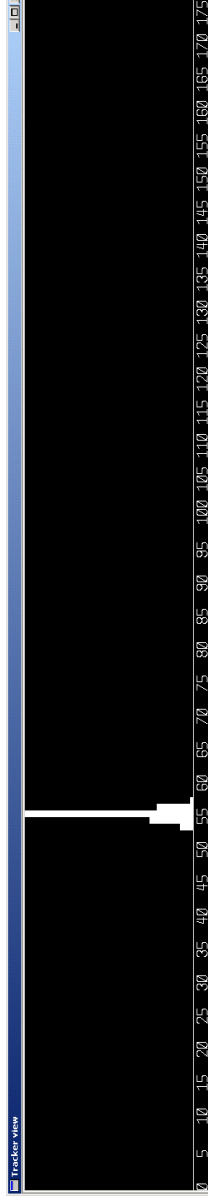
- Red



- Yellow



- Green

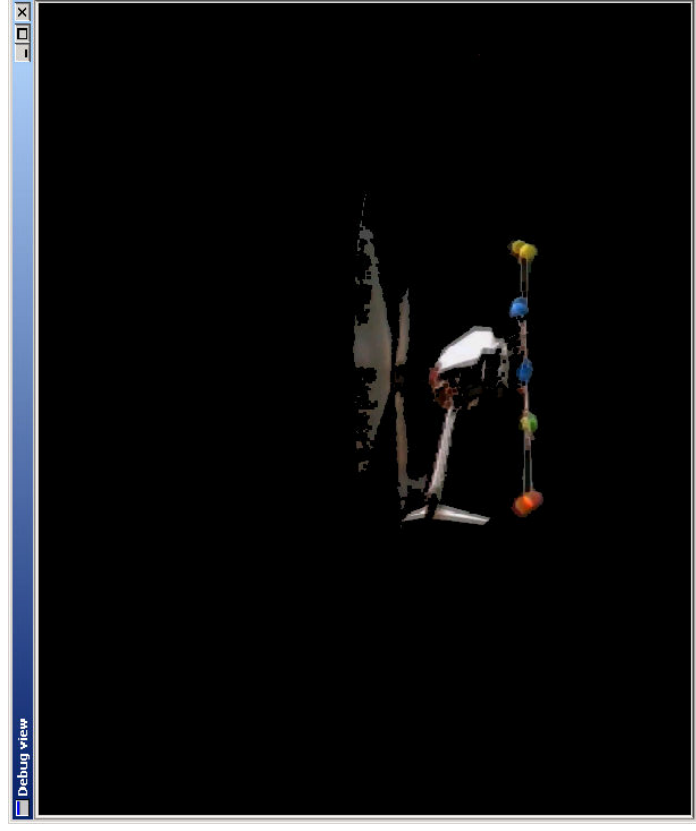
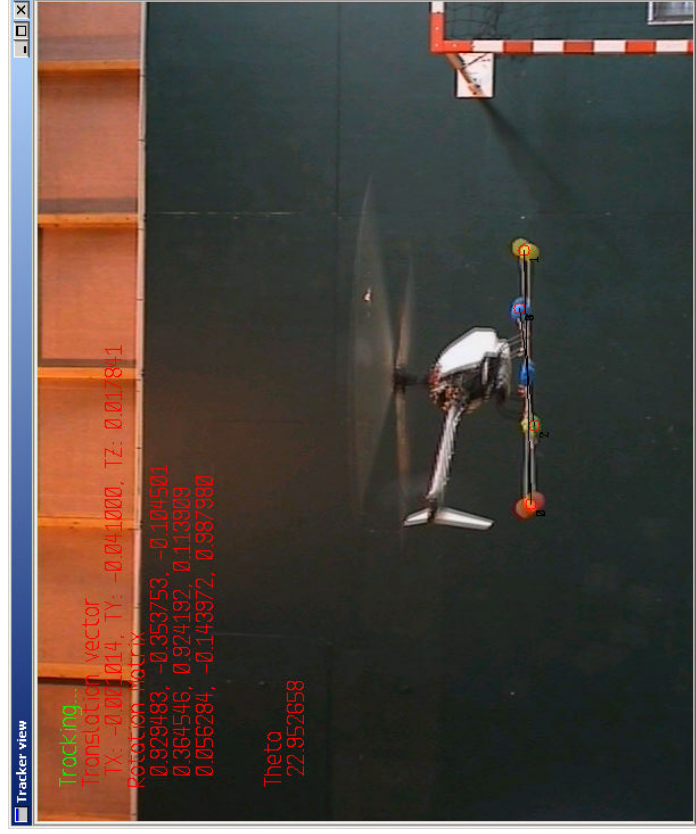


- Blue



hue space in x axis

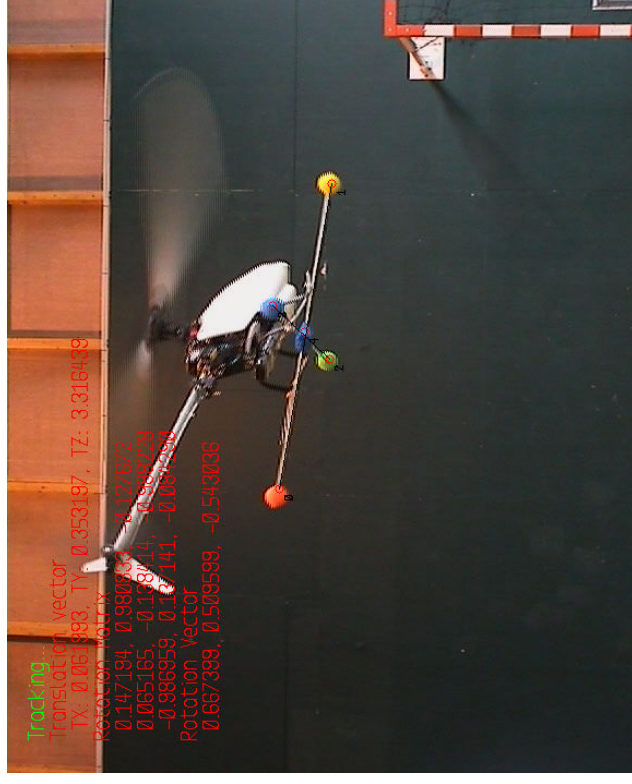
# Background subtraction





# Outputs available

- Video
  - Saving of the control window
- Text file
  - Timestamps
  - Rotation matrix and translation vector for each image

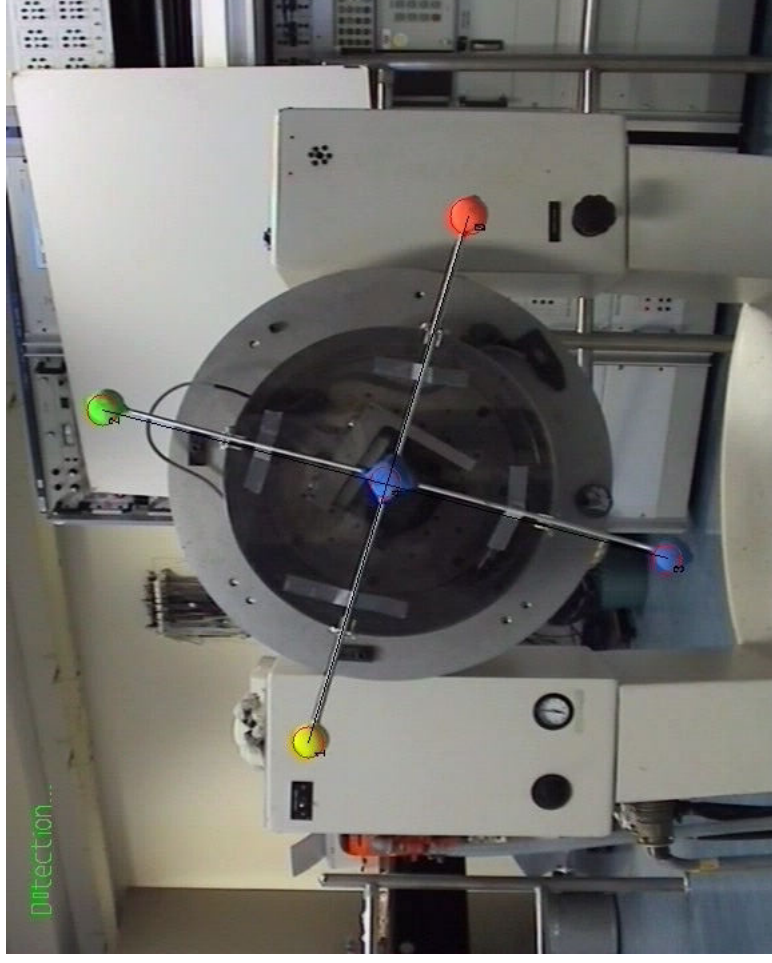


# Performances 1<sup>st</sup> sequence

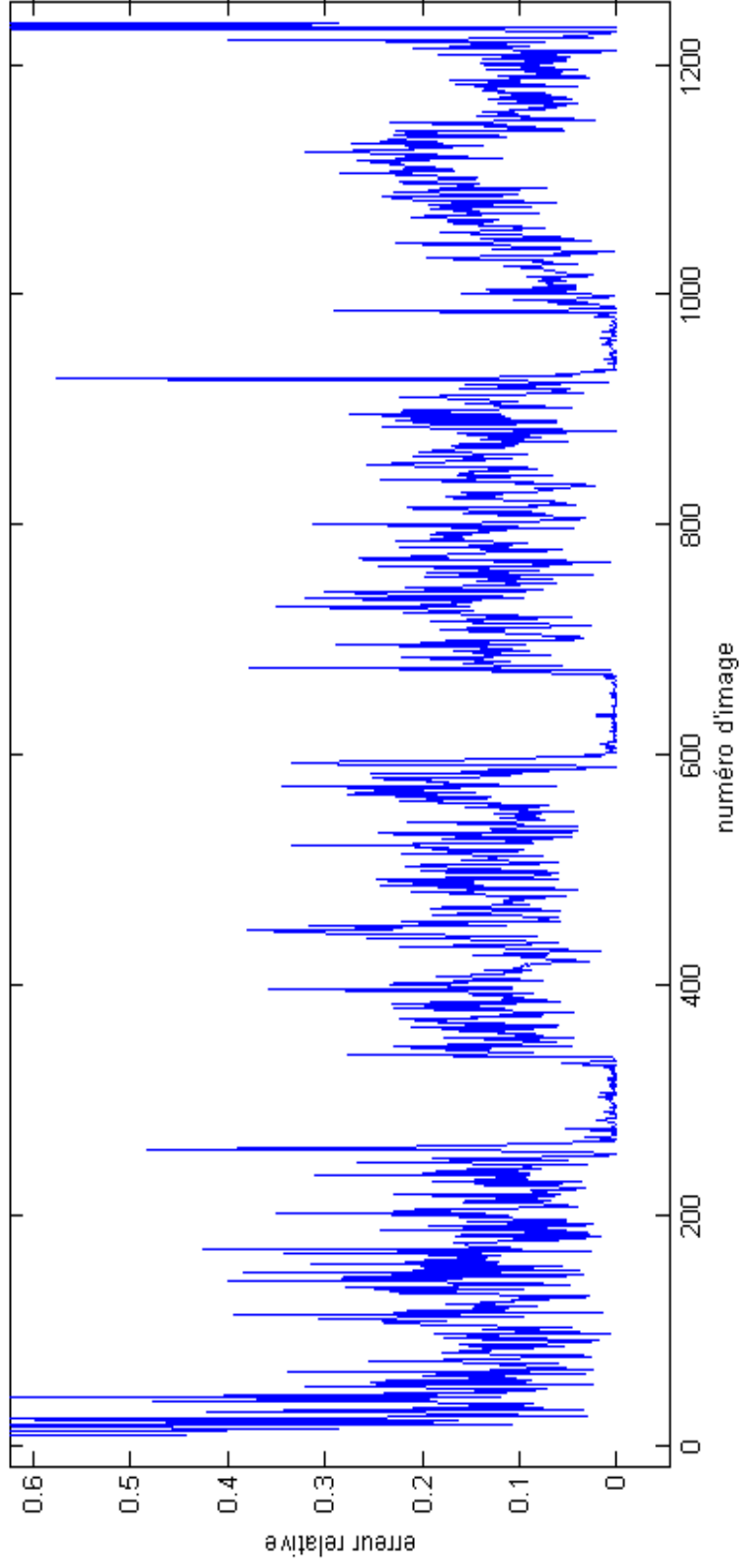
- 1st sequence
  - Dynamical validation of the accuracy
  - In front
  - 4x90°

$$R = R_0^t R_i$$

$$\theta = a \cos((\text{trace}(R) - 1) / 2)$$



# Results

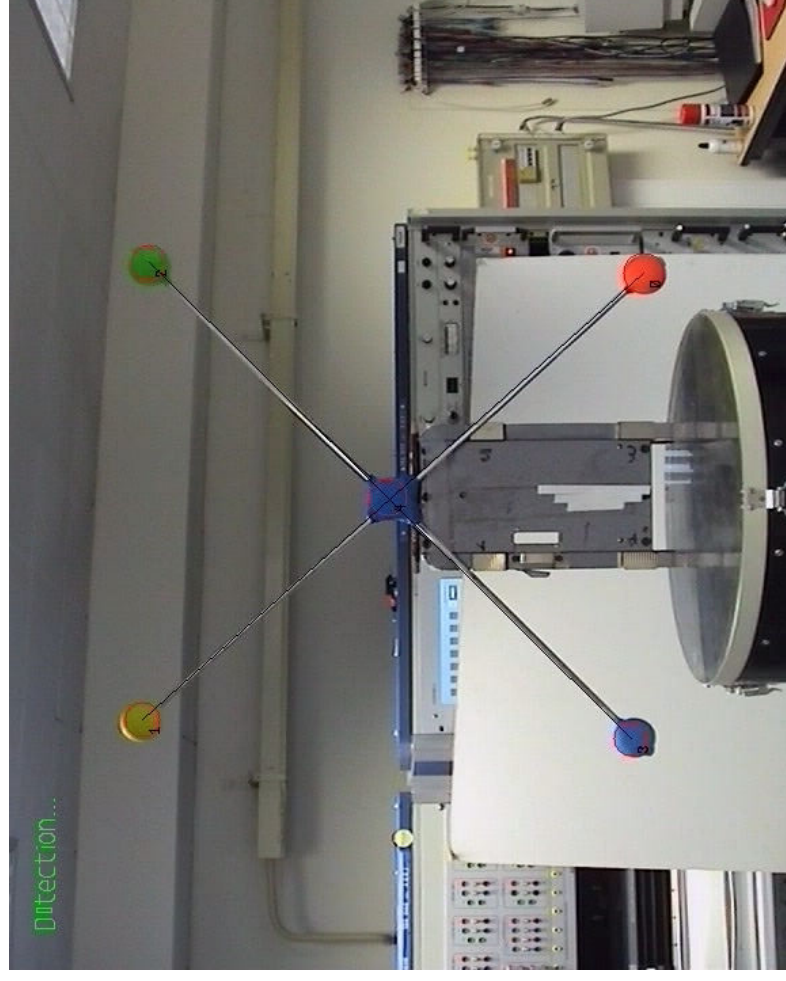


# Performances 2<sup>nd</sup> sequence

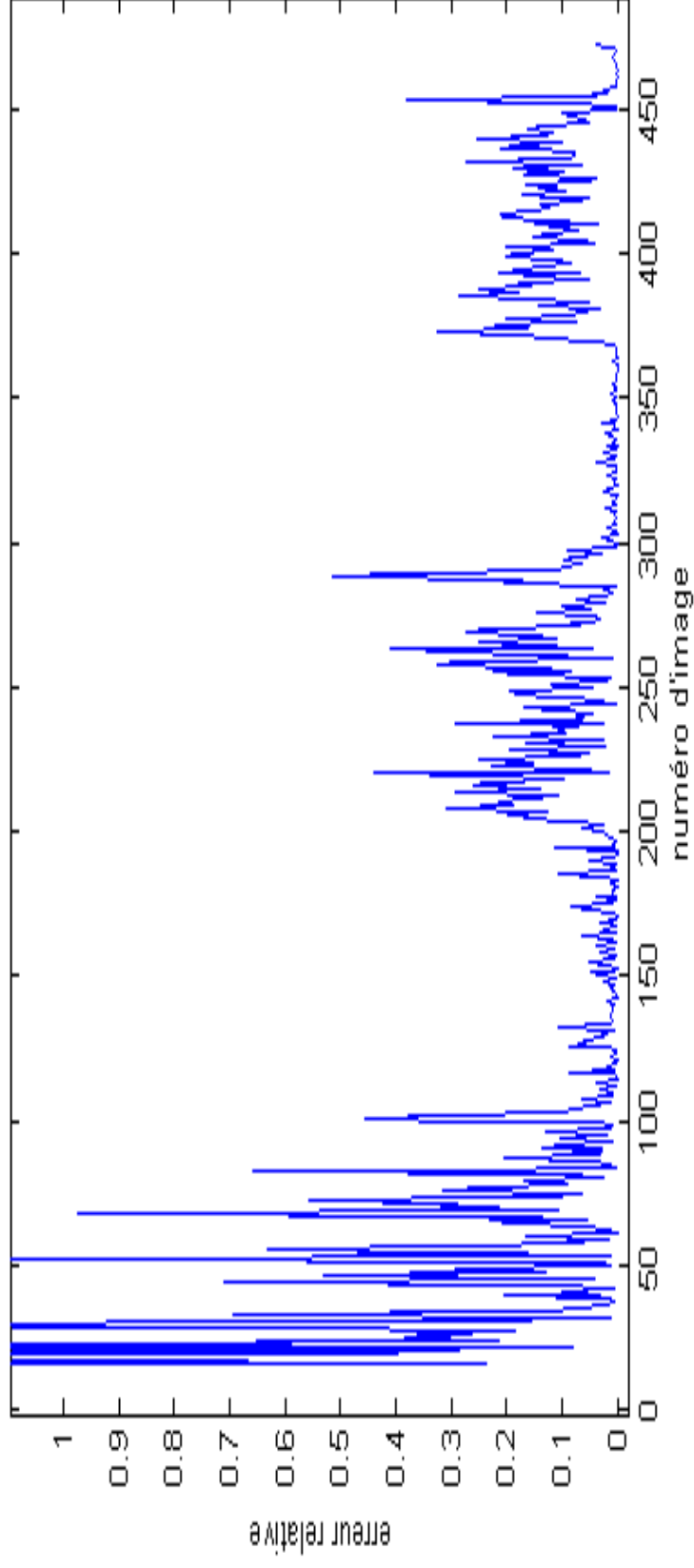
- 2<sup>nd</sup> sequence
  - Target seen from the side
  - 3x30°

$$R = R_0^t R_i$$

$$\theta = a \cos((\text{trace}(R) - 1) / 2)$$

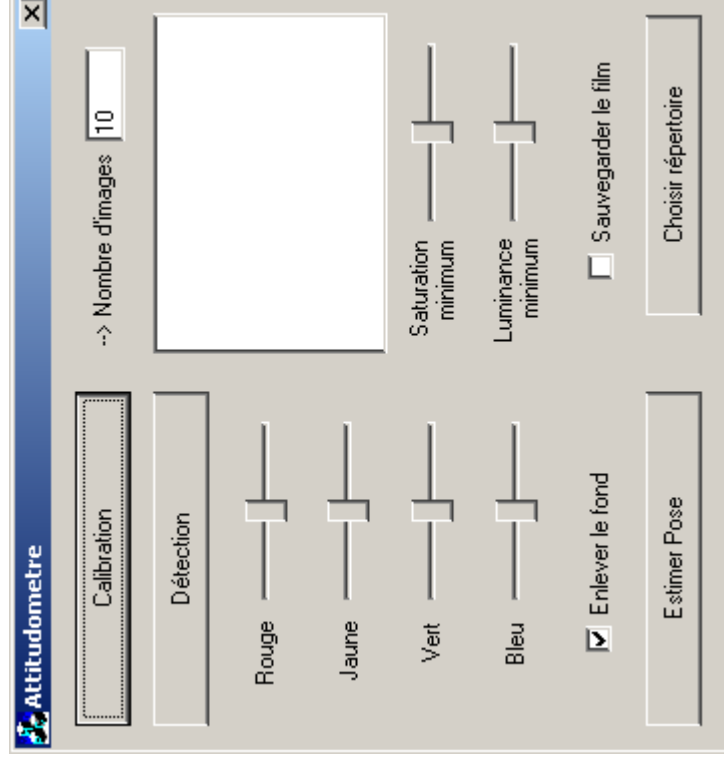


# Results



# Software

- Inputs : 2 video sequences
  - 15s of calibration
  - Helicopter sequence  
(First image : background)
- Outputs:
  - Text File
  - Video



# References

- Open Computer Vision library  
→ <http://www.sourceforge.com>
- “Camshift Tracker Design Experiments “  
Author : Alexandre R.J. François
- “A flexible new Technique for Camera Calibration”  
Author : Zhengyou Zhang