



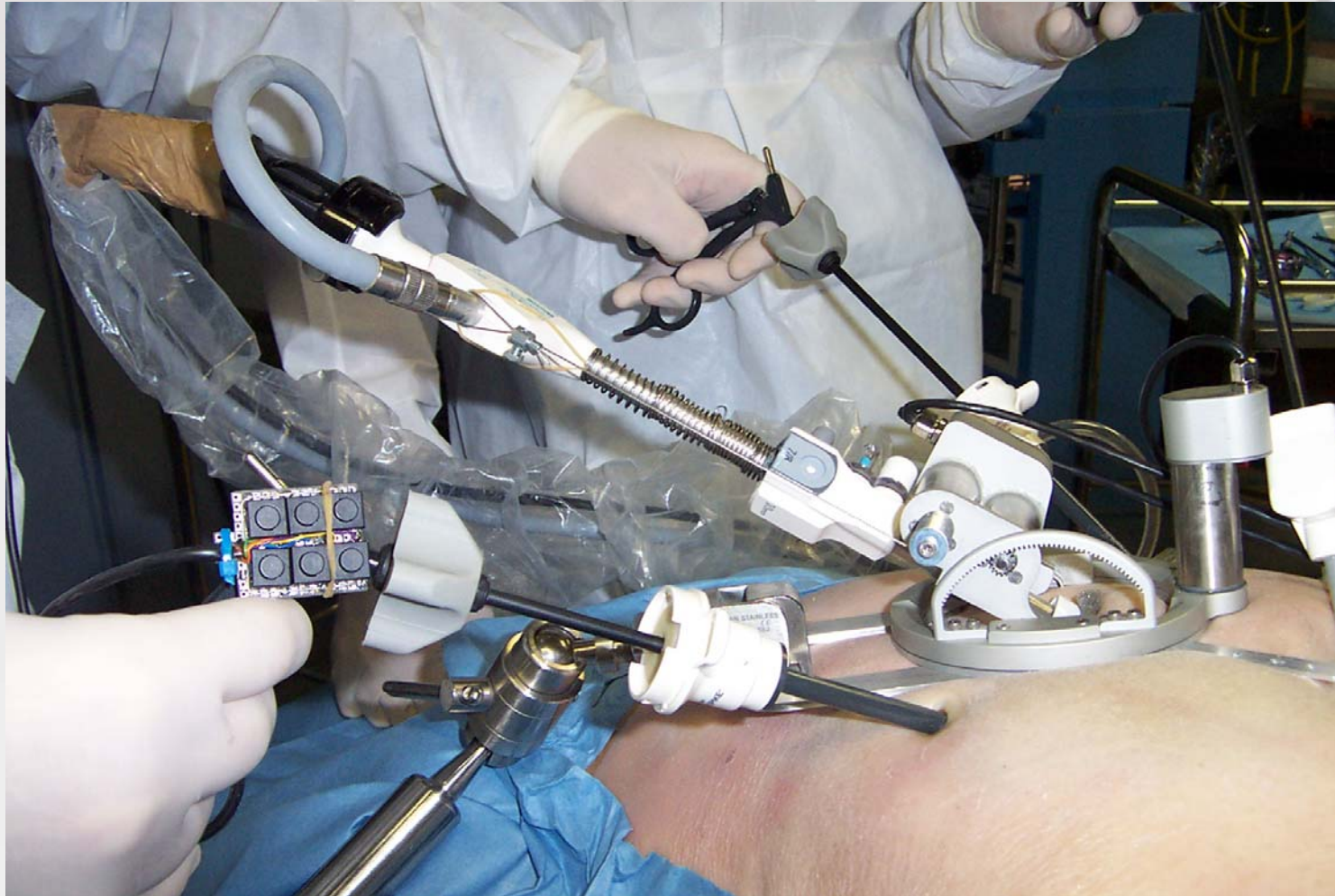
**Towards high level command of a  
robotized camera holder**

***Automatic detection of instruments  
in laparoscopic surgery***

**Sandrine Voros,**

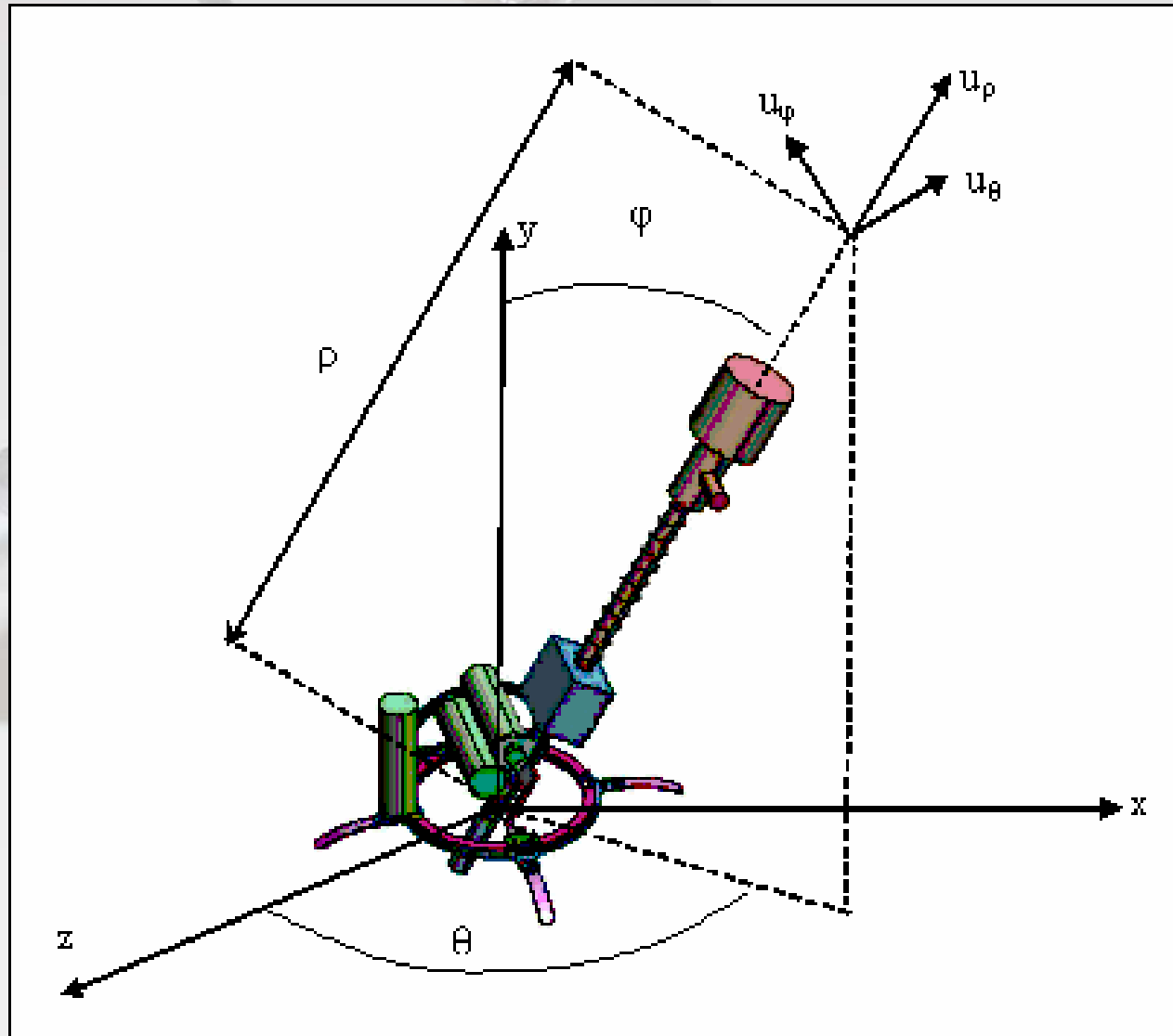
**TIMC lab, GMCAO team**

# 1) The Light Endoscopic Robot (LER [1])



An intelligent third hand for the surgeon ?

# Degrees of freedom of the LER



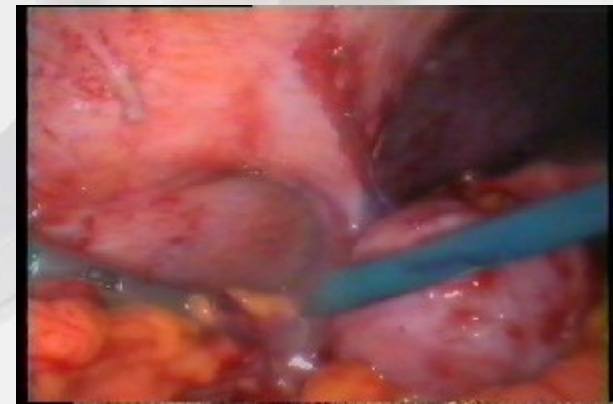


## 2) Tool tracking for the development of high level commands of the LER

- Today : simple commands (“left”, “right”,...)
- Use an instrument as a « mouse » to guide the camera
- Supervise the insertion or removal of an instrument

To do this we need to be able to :

- Identify the instrument to track
- Detect the instrument
- Track the instrument





**Complexity of laparoscopic images  
(soft tissues=complex background)**

**Variation of color & illumination  
(depending on patient and video system, light source)**

**Surgical instruments variability  
(shaft color, tip shape...)**

**→ Quick treatment of images difficult**

**Solutions today based on :**

**Design of specific devices [2]**

**Addition of special marks on instruments [3]**

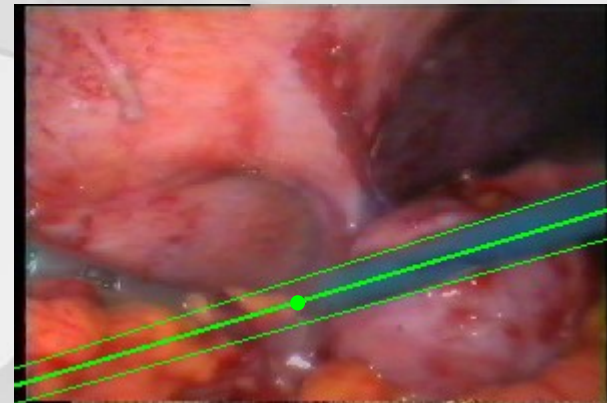
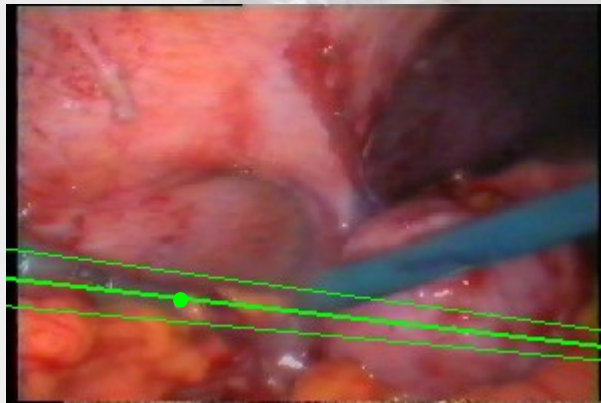
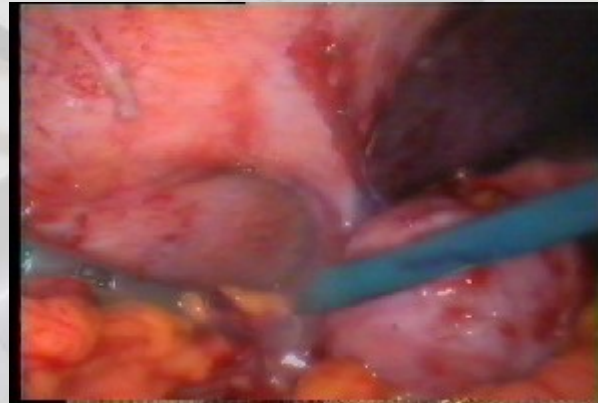
**→ Cost issues & feasibility in clinical conditions ?**



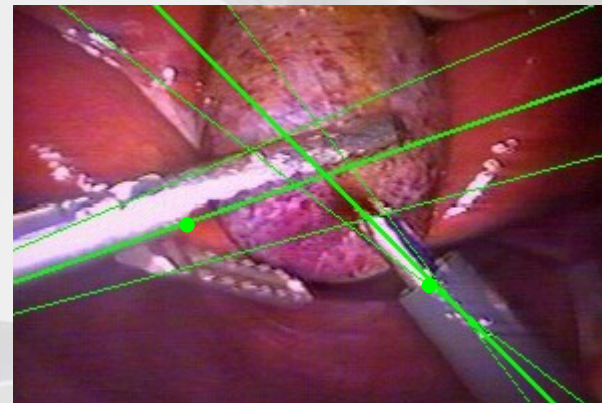
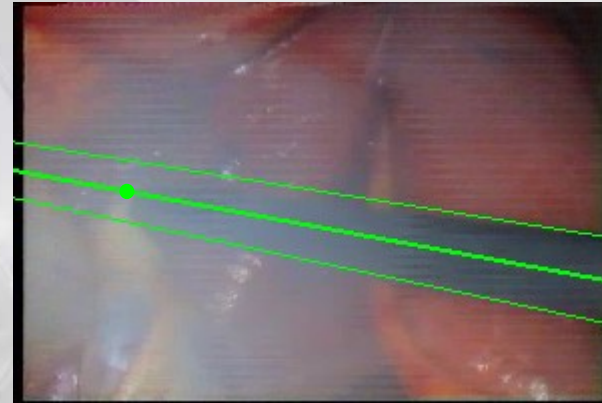
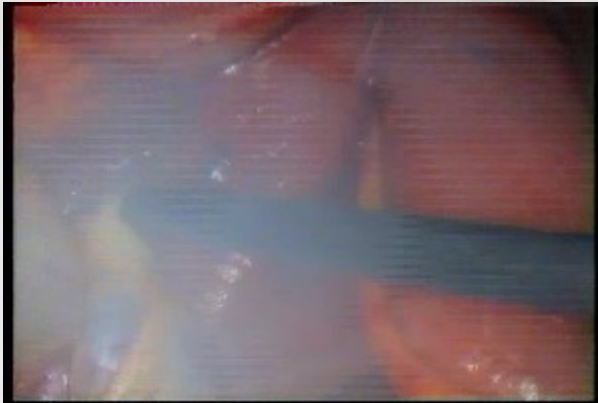
# Proposed solution

- Gather information with the calibrated robot + camera at the beginning of each intervention
- Use this information to constrain the search for the instruments in the images

# Results on endoscopic images (1/2)

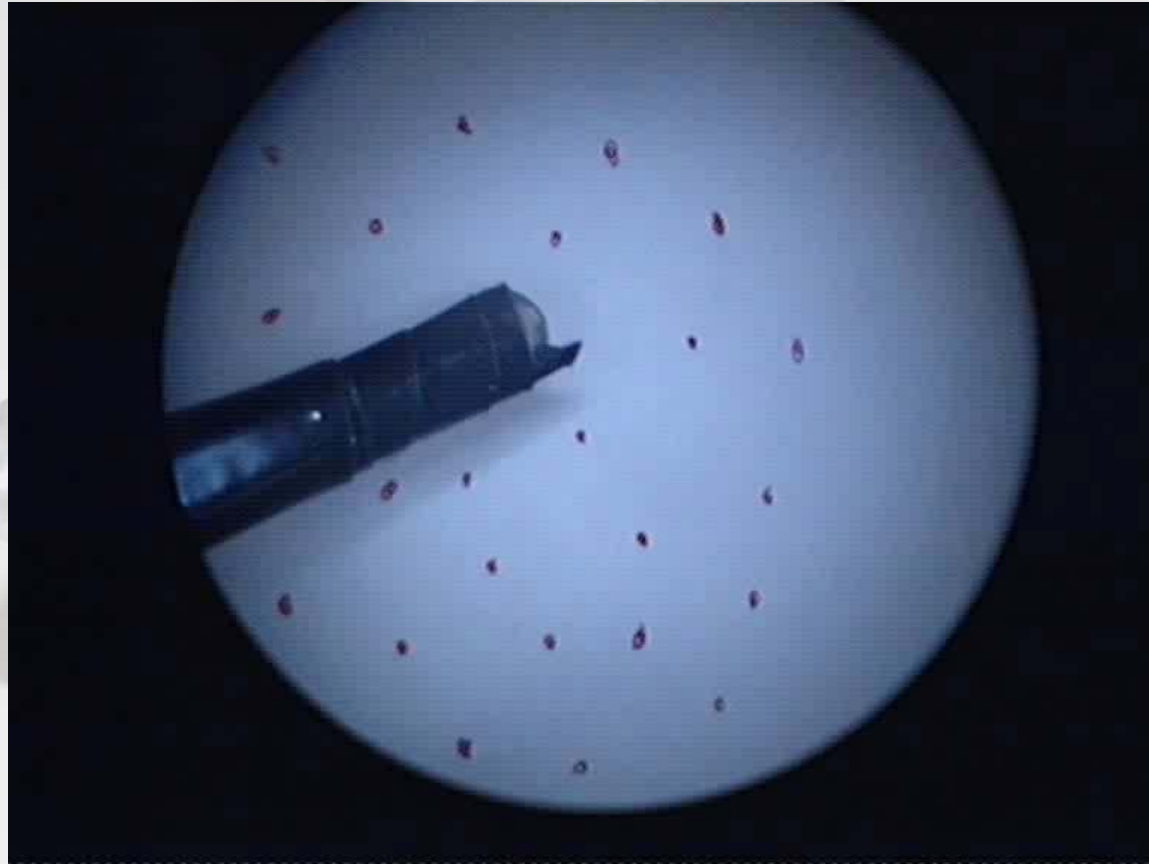


# Results on endoscopic images (2/2)





# Early results with the visual servoing





### 3) Conclusion – future work

- Early results encouraging
- Improve instrument detection (specularities, edges of the instrument, more robust determination of the tip)
- zoom not included in visual servoing yet
- Tests in real conditions (cadaver / pig tests)
  - validity of our constraints in real conditions ?
  - robustness, rapidity, precision of the method ?
- Assessment of the added value of this command mode compared to simple vocal commands or other interaction means



# References

- [1] P. J. Berkelman, Ph. Cinquin, J. Troccaz, J-M. Ayoubi *et al.* Development of a Compact Cable-Driven Laparoscopic Endoscope Manipulator. MICCAI 2002, Vol. 2488, pp. 17-24, 2002.
- [2] A. Krupa, J. Gangloff, C Doignon, M. de Mathelin *et al.* Autonomous 3-D positioning of surgical instruments in robotized laparoscopic surgery using visual servoing. IEEE Trans. on Robotics and Automation, (5):842-853, 2003.
- [3] G. Wei, K. Arbter, G. Hirzinger. Real-Time Visual Servoing for Laparoscopic Surgery. Controlling Robot Motion with Color Image Segmentation. IEEE Engineering in Medecine and Biology, pp 40-45, 1997.