Biomechanical analysis of surgeon’s gesture for evaluating skills in virtual laparoscopy

Filippo Cavallo, PhD Student

Computer Assisted Surgery
CRIM Lab Scuola Superiore Sant’Anna
Pisa – Italy

Dipartimento di Oncologia Trapianti e Nuove Tecnologie in Medicina
Ospedale Cisanello
Pisa – Italy
Introduction

• MIS procedures ensure many advantages to patients

• Surgeons undergo a long and difficult training

Perceptual limitations:
- lack of stereoscopic view
- limited field of view
- reduced force and tactile sensing

Motor limitations:
- reverse motion
- movement scaling
- limited degrees-of-freedom
Instrumentation
- LapSim Basic Skills 2.2 (Surgical Science AB, Göteborg, Sweden)
- 2 laparoscopic instrument handles fixed to a mechanical frame
- Sensorized instruments for position tracking

Methods
- 4 novices
- 2 expert surgeons
- Session of 4 consecutive trials
- Reaching exercise (10 balls)
- Alternatively use of the right and left hand

Purpose
- Definition of skill evaluation metrics
- Assess the surgeons’ experience and performances
- Distinguish expert surgeons from less experienced surgeons
Results

Duration of experiments:

(novices)
- greatly inconstant
- decreasing trend
- high standard deviation

(experts)
- lower mean value
- constant trend
- low standard deviation
Averaged speed:
- experts faster
- novice slower

Normalized jerk:

(novices)
- decreasing trend
- higher values

(exerts)
- constant trend
- smoother movements
Discussions and Conclusions

- Evaluation of:
  Bi-manual management of surgical instruments
  Depth perception
- Necessity to use different biomechanical parameters
- Distinction between expert and inexpert surgeons
- Different levels of ability