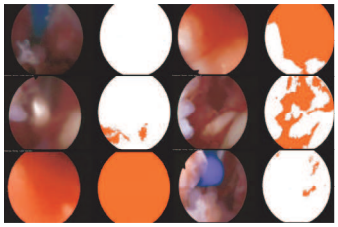
Measuring Surgical Behavior

G.J.M. Tuijthof
Dept. of BioMechanical Engineering, Delft University of Technology, Delft, The Netherlands
Mekelweg 2, 2628 CD
g.j.m.tuijthof@tudelft.nl
+31(0)15-2786780

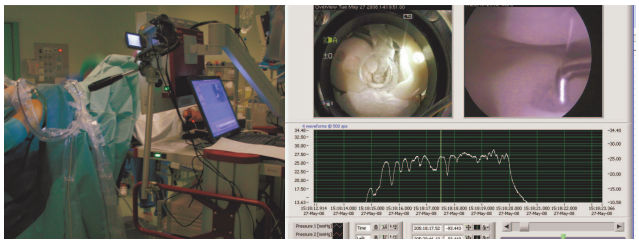


Example of automated blood detection in surgical images

Medical technology is evolving quickly. This is also true in the operating theatre, where the introduction of minimally invasive surgery has brought many benefits for the patient: less morbidity, and quicker recovery. Despite these advances in technology, patient safety cannot be guaranteed for 100%. Several factors can be summed that contribute to this:

- New surgical devices are not always sufficiently evaluated. In the operative setting, it should be demonstrated that the usefulness and usability of a new device is superior to conventional techniques.
- The quality and skills of surgeons have been considered to be at a constant competent level. In reality, this is not the case as every surgeon is different and his/her competency can fluctuate over time.
- The traditional training methods of surgical skills have not been adjusted according to the advances in technology. The result is long learning curves and increased risk of surgical errors.
- Emergency and critical situations occur in the operating theatre, which make it a highly dynamic environment. Lack of protocol and proper communication can increase the risk of surgical errors.
- All patients are unique. This implies that basically each operation requires a new learning experience.

As the demands from government and society increase for high quality and affordable medical care, initiatives are taken to guarantee predefined surgical quality and reduce the risk of surgical errors. To achieve this, measurements are performed in the operating theatre to document surgical behavior. Physically this is not an easy task, as patient care has number one priority, patient privacy and the sterile operating zone should be respected, and the operating theatre cannot be transformed into an experimental set up.



Example video recording equipment in the OR and a software interface that enables simultaneous recording of two video images and data signals

Besides these practical issues, interpretation of recorded data is another huge challenge. How do you define surgical performance or surgical error, and how do you interpret video images or spoken language? A growing number of research initiatives attempts to address these challenges.

- First, analysis of the current operative setting is performed to document surgical actions, communication and instrument usage for identification of key problems and constructing base line reference. Video and sound recordings with multiple cameras are usually performed for this purpose, with off-line time-action analysis.
- Second, assessment of surgical performance receives huge attention. A wide range of methods is applied to determine this: checklists, global rating scales, motion analysis, force measurements, video-assessment and (virtual reality) simulators. The variety of methods and application purposes are not fully explored.
- Third, development of a digital operating room assistant has been started, which should automatically register deviations from a routine operation. It warns the operating team to prevent errors and increase patient safety. Automated image detection and Hidden Markov models are a few examples that are applied to achieve this.

This symposium aims to give an overview of different methods as developed by researchers in the surgical field. They will all discuss their own efforts to meet the challenge of measuring surgical behaviour. Finally, we can point out a direction towards a future ultimate registration tool.

Symposium content (confirmed speakers)

J. van Oldenrijk (AMC, Amsterdam, NL), Identifying Surgical Pitfalls Using Time-Action Analysis

L. Bouarfa (TU Delft, Delft, NL), Modeling Surgical Phases with Hidden Markov Models

G. Chami (General Hospital, Scunthorpe, UK) Haptic Feedback Provides Objective Assessment of Surgical Skills

T. Blum (TU München, München, GE), Methods for Automatic Statistical Modeling of Surgical Workflow

N. Howells (U of Oxford, Oxford, UK) Methods for Objective Assessment of Arthroscopic Skills

G. Kerkhoffs (AMC, Amsterdam, NL), Verbal Communication During Surgical Resident Training