Measuring Situation Awareness of the Microneurosurgeons

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Microneurosurgery is performed using miniature movements of microinstruments. The conduct of any procedure consists of complex series of actions with microinstruments hold in the right and left hand. The operative field is illuminated and magnified by a neurosurgical operation microscope. The microscope can be linearly focused onto the operative plane where the tips of the micro-instruments are functioning. The microneurosurgery processes require concentration and any distraction prolongs the procedure and may lead to iatrogenic errors. In Europe usually in order to become a board certified neurosurgeon, trainee should conduct at least 800-1000 surgeries during the five years training (www.eans.org).

It is essential to understand behavioral processes involved in the microneurosurgery such as situation awareness. The situation awareness is a perception of the available information, events, resources, and environment within a given time and space. Humans have limited abilities to obtain and maintain situation awareness, as they need to carefully orchestrate the available resources. A failure to maintain situation awareness may lead to serious errors in human behavior [2]. For example, in the miconeurosurgery when micronsurosurgeon manually repositioning microscopes to obtain a new view on the brain or when modifying the parameters and settings of the device, the surgeon needs to remove hands from the site and this might reduce situation awareness of the microneurosurgeons.

The amount of existing evidence shows that the users' behavior, including situation awareness, could be modeled where the accurate measure of user's behavior exist. Measuring the situation awareness of microneurosurgeons in operating room is a key challenge for deeper understanding of microneurosurgeons' behavior and it is one of the main motivations for this research project.

There are different techniques to gain access into the users' behavior patterns. For example, recording think aloud or eye movement protocols. Both think aloud and eye tracking methods have been indicated as measurement techniques that often are used to show operator situation awareness during a defined task [4]. Since past decade the eye tracking methodology has become attractive both in everyday activities and controlled laboratory studies. Analysis of the relations between eye movements and users' behavior has indeed proved fruitfully in different domains, such as reading comprehension, visual search, selective attention, and studies of visual working memory. As accuracy of the eye trackers increased, recording eye movements has become a popular method in the medical research. For example, radiology image perception, eye-controlled microscope for surgical applications, and finding differences between medical specialties.

We first aim to measure microneurosurgeons' situation awareness using an eye tracker outside of the operating room and second we plan to integrate a binocular eye tracker within a neurosurgical microscope to record the eye movements of microneurosurgeons in the operating room. The measuring microneurosurgeons' behavior help us to study surgeons' interrupting factors, purposefulness movements, hazardous tendencies, decision making errors. The result of the captured and analyzed knowledge, will allow to more explicitly describing the processes involved in critical situations:

1. To find the various strategies which surgeons applying during surgery.
2. To find the primary factors in accidents attributed to the surgeon error.
3. To find the differences between surgeons (experts) and resident (novices).
4. To be used in training surgeons- to continuously show gaze orientation of experts in educational videos-
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5. To be used in intelligent proactive monitoring of on-going operations.

In an eye-tracking study of skill differences between surgeons and residents shows a marked difference in the way expert and novice microneurosurgeons attend to snap shots of a surgery video. In the Eivazi and Bednarik study [3] the finding related to the mean fixation duration was confirm the fact that the microneurosurgeons have to be able to focus for prolonged times at cretin points due to the limited size area of the surgery. While little has been done in the field of microneurosurgery in regard to measuring behavior, Eivazi and Bednarik [3] study motivated us to build a system that is able to record microsurgeons' eye movements in the operating room. The goal is to define the characteristics of the microneurosurgeons' behavior, and search for the underlying eye movement features. We believe that understanding microneurosurgeons' strategies in the operating room will help to develop an advance method to support surgeons and residents during the surgery.

References

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