Digital Health – Connected Healthcare
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# Two Hearts, One Rhythm?

## Stress-Level Interplay Between Patient and Surgeon in Open Heart Surgery

In open heart surgery, there are minimally invasive procedures where the patient's **heart remains beating** throughout the intervention. This provides benefits to the patient but makes the surgery more **challenging for the surgeon** – as s/he must anticipate the heart's movements when grafting a bypass. In this setting, stress on the patient's heart might transfer to the **surgeon** who might **get stressed** or even hectic in return. This creates a **complex interplay of stress levels** between patient and surgeon which may reciprocally intensify through positive feedback and could negatively influence the surgery outcome.

**Worldwide, nobody has ever observed a mutual influence of heart rhythms of human beings in such close associations**. But now we have the chance to do just that! The cardiac surgery team at Klinikum Dortmund headed by Prof. Dr. med. Alexander Albert is a world leader in beating heart and minimally invasive bypass surgery. They provided us with **hundreds of hours of recordings from within the operating theatre**. These are **many gigabytes of signal data** that show the electrocardiogram of patient, surgeon, and anaesthesiologist during open heart surgeries.

With these data, we want to investigate the stress-level interplay between patient, surgeon, and anaesthesiologist. In close cooperation with the cardiac surgery team at Klinikum Dortmund, our practical objective is to build a **surgery assistance system** that helps the surgeon to maintain low stress levels throughout the procedure. This can help to improve surgery outcomes for the patient.

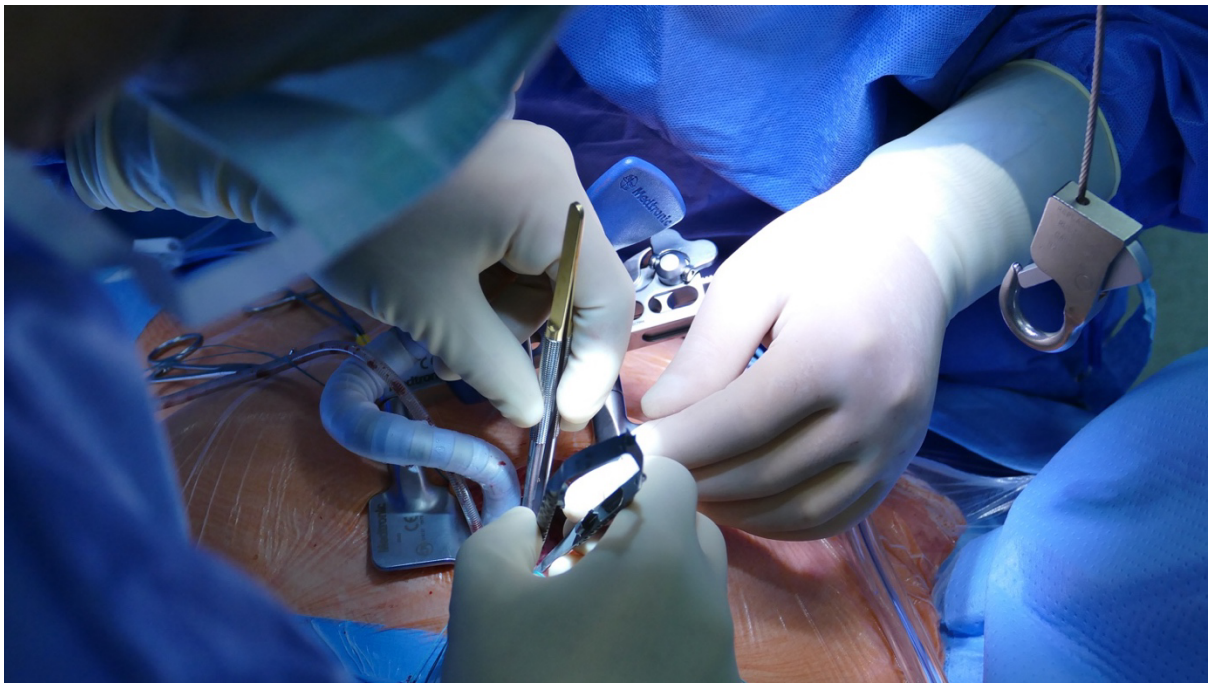

**Figure 1**: Cardiac surgery team at Klinikum Dortmund during open heart surgery.

## Your Tasks

Our ultimate goal is to improve the surgery outcomes through a **surgery assistance system**. But the path to this is laced with technical challenges in electrocardiogram analysis. Reliably detecting heartbeats amidst all the artefacts from the surgery is not a trivial endeavour.

In this project, some of your tasks will be:

1. **Develop algorithms** to identify the usable parts of the signal. The electrocardiograms contain lots of margin before and after the surgery that you need to identify and discard. Also, artefacts from the surgery occasionally obscure the signal so that intermediate parts are unusable as well. You also need to discard these.
2. Apply and **compare different heartbeat detection algorithms** to select the one with the best performance on our data set. The detector should correctly identify all heartbeats but disregard artefacts to avoid any false detections. This is a complicated trade-off that you need to address.
3. **Compute metrics** – such as heart rate or heart rate variability – from the heartbeat positions to investigate how stress levels influence each other. Does stress transfer from the patient to the surgeon and/or vice versa? Is there an interplay that facilitates the build-up of stress levels throughout the procedure? How does this affect the procedure's outcome?

Your findings might lead to a prototype **surgery assistance system** that warns the surgeon when s/he becomes hectic or stressed out. When this happens, slowing down or taking a break could improve surgery outcomes. Through this, your work can help surgeons and patients alike. Further, this work may give insight into interpersonal communication on a non-physical level, which has never been studied before.

If you are interested or have any questions, please contact:


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