Posteroversigt 2017

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DTU	Jacob Petersen	BRAIN COMPUTER INTERFACE FOR POST STROKE NEUROREHABILITATION OF HAND MOTOR FUNCTION
AAU	Rasmus Elbæk Andersen	CASE STUDY: VIBROARTHROGRAPHY AND KNEE PAIN DURING ACTIVITIES OF DAILY LIVING IN OSTEOARTHRITIS PATIENTS
SDU	Christian Dam	FACILITATING RESEARCH IN AUTOMATING SURGICAL PROCEDURES
DTU	Katrine Skodborg	Optimering af rekonstruktion af PET billeder
AU	Christian Bech Christensen	Ear-EEG-based hearing threshold estimation
AU	Lise Skytte Brodersen, Joakim Lindhardt og Line Skov Larsen	fracture of bioprosthetic valves before valve-in-valve therapy
SDU	Jacob Kristian Holm Andersen	IDENTIFYING DIABETIC RETINOPATHY IN EYE IMAGES USING DEEP CONVOLUTIONAL NEURAL NETWORKS
SDU	Sara Beck Larsen	Development of interface for PEP-flute system
SDU	Jackline Bamdeg	Kompakt Dropstativ i Hjemmeplejen
SDU	Trine Straarup Winther	Tracking Endoscope Movements I Laparoscopy

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FACILITATING RESEARCH IN AUTOMATING SURGICAL PROCEDURES

A prototype of an adapter named EUA (Endowrist Universal Adapter) has been developed to enable da Vinci Endowrist surgical tools to be mounted on and used with a Universal Robot 5 arm. The purpose is to facilitate research on how to automate surgical procedures, such as cutting and suturing tissue. This solution is cheaper, easier to use, and more precise than the current Raven II system available to SDU. The adapter consists of primarily 3D printed parts, four servo motors, timing gears and an Arduino microcontroller. It is controlled by a serial connection to a terminal PC program, which sends commands to the servos, which then operates the four tool joints. It can also be programmed to respond to inputs directly from the UR5. Tests reveal that currently, the adapter can control the Endowrist tool with a mean accuracy of 0.1 deg, a 3-sigma precision of 4 deg, and a resolution of 0.44 deg. It can produce a sufficiently high torque for the intended procedures, and the position can be updated at an estimated rate of 20Hz. The end manipulator will need a more rigid support, or the flexibility of the rod will become an issue when forces are applied perpendicular to the end manipulator. A new and improved version of the adapter is planned to be developed in the near future.

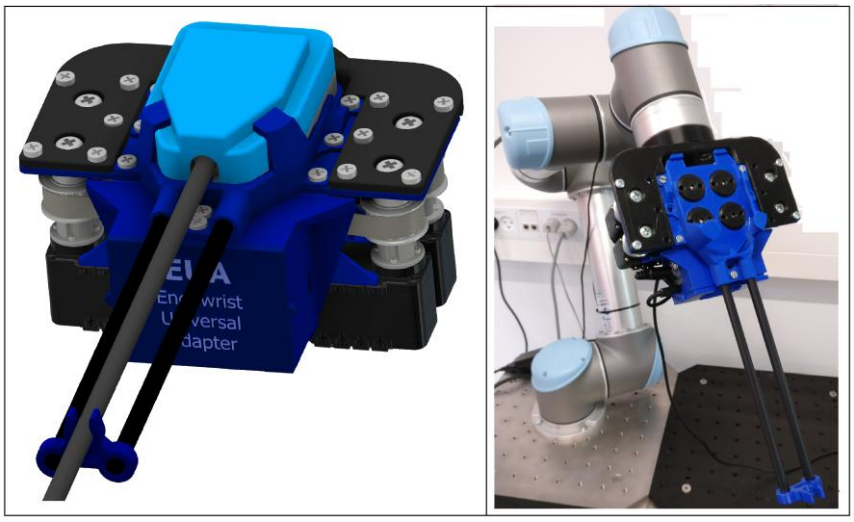

Image 1: The EUA Prototype

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CASE STUDY: VIBROARTHROGRAPHY AND KNEE PAIN DURING ACTIVITIES OF DAILY LIVING IN OSTEOARTHRITIS PATIENTS

Physiological alterations in the knee joint caused by osteoarthritis (OA) have been known to produce sounds known as crepitus. These are measurable as mechanical vibrations on the skin surface using a technique called vibroarthrography. In literature, these signals have been used to differentiate between OA and non-OA subjects highlighting their potential as a diagnostic tool. Several aspects of these signals are however not yet understood among these being their relationship with pain, which is one of the hallmarks of OA patients experience. Two OA subjects and two asymptomatic elderly subjects were recruited to investigate the relationship between pain and vibration signals. To assess subjects pain questioners and pain pressure threshold were used. A custom wireless device for recording vibrations was attached to the subjects with eight accelerometers at locations around the knee. Subjects were asked to perform three different activities of daily living associated with pain for some OA patients; walking on flat surface, sit-to-stand from a seated position, and walking up and down stairs. During the activities vibration was recorded and after each exercise subjects scored their pain using a visual analogue scale.

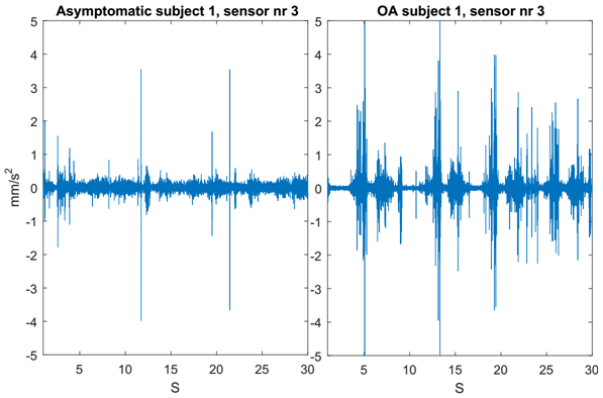

Fig. 1: Vibrations recorded from a single sensor located on the patella during 30 sec of repeated sit to stand activities form two subjects, one symptomatic and one with OA.

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OPTIMERING AF REKONSTRUKTION AF PET BILLEDER

PET/CT scannersystemer har den fordel at kunne vise både den funktionelle og anatomiske del af kroppen. PET erhvervelsesprocessen af data fra denne type scanner har mange trin undervejs, og betydelige mængder af information er samlet for større præcision af diagnosticering. Billederekonstruktion er en del af erhvervelsesprocessen, her kan forskellige algoritmer anvendes.
Målet er at finde den optimale billederekonstruktion, derfor undersøges to slags iterative algoritmer (Q.Clear og OSEM) med forskellige billederekonstruktionsindstillinger. Rekonstruktionsindstillingerne bliver analyseret ved brug af en billedkvalitetprocedure i kontrolleret forhold. Herefter bliver tre billederekonstruktioner udvalgt og brugt på patientdata fra en Myokardieperfusion kliniskundersøgelse. Patientdata er sammenlignet med data fra diagnosticeringbilleder. Samme patientdata bliver også evalueret af en overlæge, som bedømte billederne fra de tre forskellige billederekonstruktionsindstillinger. Bedømmelsen er efter kvaliteten af visualiseringen af hjertets tilstand og sammenlignet med den diagnosticering, allerede givet patienten.
Det viste sig at støj bliver introduceret i billederne med Q.Clear algoritmen grundet β parameteren. Q.Clear viste sig også at give den bedste billedkvalitet teoretisk, men giver den dårligste i patientundersøgelsen. Den optimale billederekonstruktion, i forhold til støj, pålidelighed og mulighed for korrekt diagnosticering, er VPFX algoritmen med to iterationer, 17 subsets og SharpIR (OSEM algoritmen).

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EAR-EEG-BASED HEARING THRESHOLD ESTIMATION

Traditionally, hearing aids are fitted in the clinic based on pure tone audiometry. Most hearing losses, however, evolve over time and therefore hearing aids should be re-fitted recurrently to maintain a high performance. Regular tests in the clinic are inconvenient for the users as they require travel. If the hearing instrument could obtain feedback on the neural activity in the auditory system of the user, this could enable regular physiological tests to be performed during everyday life.

Conventional electroencephalographic (EEG) systems are impractical during daily life and incompatible with hearing aids. The methodology of ear-EEG, however, provides a discrete and unobtrusive way of monitoring brain activity from electrodes embedded in a hearing aid-like earpiece (Fig.1 Left) placed in the ear canal and has great potential for use in everyday life.

Here, we investigated the feasibility of ear-EEG in estimation of hearing thresholds. Specifically, a custom setup including both conventional scalp EEG and ear-EEG was used to estimate hearing thresholds at 0.5, 1, 2 and 4 kHz using the method of auditory steady-state responses. Ear-EEG thresholds were found to be elevated relative to scalp EEG thresholds (Fig.1 Right), but nonetheless it was demonstrated that hearing threshold levels can be estimated from ear-EEG recordings made from a single ear. Overall, it was concluded that ear-EEG is a viable technology for hearing threshold level estimation.

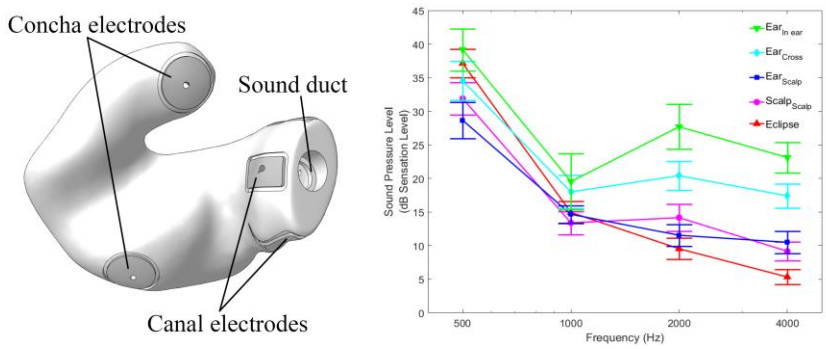

Fig. 1: Left: 3D model of earpiece. Right: Hearing threshold levels estimated from four electrode configurations using the custom setup along with threholds estimated using standardized equipment.

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IV Compac, **Jackline Bamdeg,** Vanessa Clausen, Cecilie Blomberg

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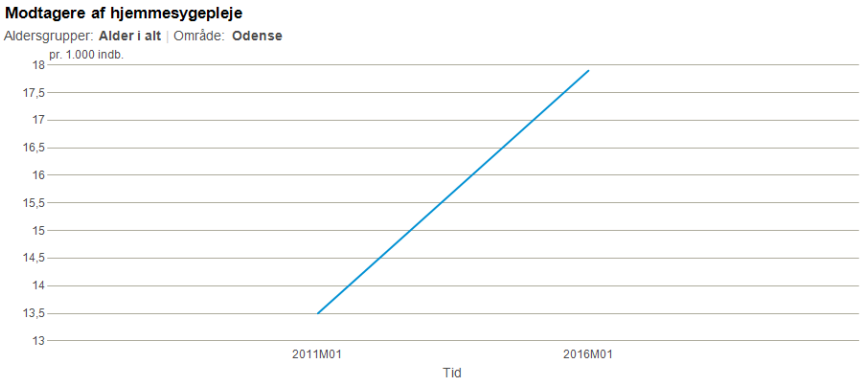
KOMPAKT DROPSTATIV I HJEMMEPLEJEN

IV Compac laver medico udstyr der har til formål at skabe borgersikkerhed, korrekt arbejdsstilling for sygeplejersken og mobilitet hos borgeren. Der udvikles et dropstativ, der kan foldes sammen til en lille æske der kan bæres i hånden af sygeplejersken, og som kan foldes ud til at ligne de traditionelle dropstativer med hjul, stativ og kroge. Dropstativet er lavet til hjemmeplejen, hvor den nuværende løsning er at hænge poserne op på et søm i væggen, således at borgeren er immobil i den tid behandlingen varer. Sygeplejersken har ikke mulighed for at bære de nuværende dropstativer ud i borgerens hjem, og derfor kan de belaste kroppen forkert, når de skal finde løsninger til at behandle patienten. IV Compac hjælper hjemmeplejen med et kompakt og transportabelt dropstativ, samt borgeren med tryghed, mobilitet og det genkendelige.

Modtagere af hjemmesygepleje er stigende siden 2011 og fremtiden peger på at borgeren skal behandles i eget hjem. Der kommer flere og flere ældre over 80 år og færre og færre hænder til at behandle dem. Målgruppen for IV Compac er derfor stor, da der er fokus på alle landets 98 kommuner; både de store og især de små.



Figur: modtagere af hjemmesygepleje stødt stigende i Odense kommune.

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WILLIAM K. JUEL & JAKOB K. H. ANDERSEN

The Maersk Mc-Kinney Moller Institute, University of Southern Denmark

IDENTIFYING DIABETIC RETINOPATHY IN EYE IMAGES USING DEEP CONVOLUTIONAL NEURAL NETWORKS

Deep neural networks were trained for detection of diabetic retinopathy (DR) in digital retinal fundus photographies. A total of eight convolutional neural networks (CNNs) were trained on images labeled according to the International Clinical Diabetic Retinopathy (ICDR) scale and one fully convolutional network (FCN) was trained for segmentation of specific DR features. The highest classification results were achived by doing transfer learning with a VGG16 model. A kappa score of 0.71 and AUC of 0.85 was achieved, with sensitivity and specificity of 0.73 and 0.96 respectively for binary classification (DR/No DR) on a test set of images (n = 5206) labled by a single expert. The same model achieved good agreemen (weigted kappa = 0.72) on a seperate test set of 25 images (n = 5 for each grade 0-4 in the ICDR scale) graded by three experts from Odense University Hospital, which was better than the average aggrement achieved by the experts (weigted kappa = 0.69).

(a) ROC Curve with AUC (b) Kappa scores

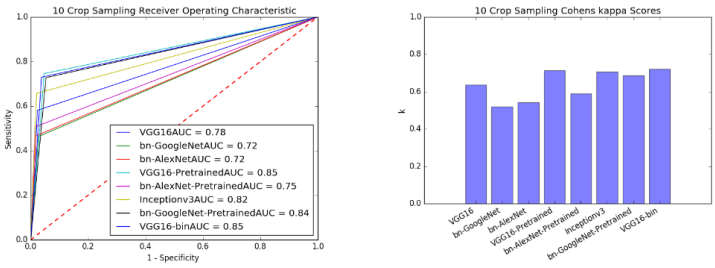

Fig. 1: Model performance – ROC curve with AUC (a) and Kappa scores (b) calculated on the test set at the networks' highest operating point.

Using FCNs for segmentation of clinical features achived promosing results despite limitations to the dataset used. A qualitative analysis indicated that the segmentation network detects early forming hard exudates while also finding potential features not marked on the ground truth. The segmentation model performed poorly at segmenting microaneurysm. A solution was provided to solve this problem by training on patches rather than full images.

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BRAIN COMPUTER INTERFACE FOR POST STROKE NEUROREHABILITATION OF HAND MOTOR FUNCTION

In 2013, there were 25.7 million stroke survivors worldwide and 10.3 million new incidents - a number that is increasing every year. From stroke survivors with a hemiplegic arm, up to 55-75 % still had problems after three to six months, indicating a need for improved rehabilitation techniques.
Motor imagery (MI) based Brain-Computer Interface (BCI) systems have shown to promote reorganizational processes in stroke patients, whereby such systems look promising to complement physical therapy for neurorehabilitation - especially when used to control functional electrical stimulation (FES) of the corresponding muscles. The aim of this project was to develop an MI based BCI system to potentially be used in neurorehabilitation of hand motor function in stroke patients.
Two co-adaptive, three-class MI based BCI systems for real-time processing was developed and compared using publicly available data from the BCI Competition III Dataset V, whereafter the winner was chosen for experiments. The first algorithm utilizes Filterbank Common Spatial Pattern (FBCSP) for feature extraction, and the other algorithm utilizes Separable Common Spatio-Spectral Pattern (SCSSP) – both combined with a Multi-layer Perceptron (MLP) for classification.
The system proved successful when using competition data showing an average accuracy of 64.71 % for the SCSSP. This proved superior to a related study using the same feature extraction methods, but with other classification methods. However, the system did unfortunately show unimpressive results for the experimental data - most likely caused by the difficult same-limb MI tasks. An improved performance in online experiments is necessary to realize such a system.

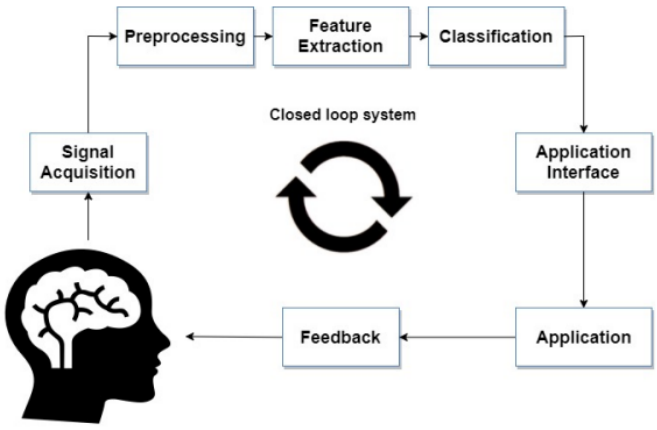

Fig. 1: General scheme of a Brain-Computer Interface.

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FRACTURE OF BIOPROSTHETIC VALVES BEFORE VALVE-IN-VALVE THERAPY

Line Skov Larsen[1], Lise Skytte Brodersen[1], Joakim Lindhardt[1], Henrik Engholt[1], Rasmus Fogh[1], Jens Erik Nielsen-Kudsk[2], Peter Johansen[1]

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Patients with aortic stenosis are most often treated surgically with implantation of a prosthetic heart valve. The diseased valve is removed and replaced with either a mechanical or a biological valve. The biological valves have the advantage over the mechanical by not requiring anticoagulation therapy. However, as they are prone to degenerate over time they may require a later surgical valve replacement. However, in high risk patients valve-in-valve therapy offers an alternative to surgery. A challenge with valve-in-valve therapy though is present in patients with small biological heart valve prostheses (sizes <21 mm) as the resulting effective orifice area becomes too small.

Our research group has recently demonstrated a new approach for valve-in-valve therapy in patients with small biological heart valves, where the degenerated heart valve is fractured by a high-pressure balloon leaving a more flexible anchoring site for the Valve-in-Valve insertion. However, knowledge on the effect off aortic root calcification on the fracture pressure is still warranted. Therefore, the aim of this study is to test the fracture pressure required for valves in aortic roots with various degree of calcification. Patient specific geometries will be used to produce dual material 3D printed aortic root in which a series of valve phantoms will be fractured. The results are expected to disclose how the amount and site of calcification may affect the required fracture pressure.

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DEVELOPMENT OF INTERFACE FOR PEP-FLUTE SYSTEM

New compact hardware and a new interface was developed to increase compliance in PEP-flute training. This required; a sensor monitoring the pressure in the PEP-flute, a Bluetooth signal sending the data and a tablet that receives, plots and saves the data, making the user and healthcare professionals able to see the progress.

This system is an upgrade from an earlier version, which was used in the user test. The user test showed that the five users did not use the PEP-flute as instructed. Fig. 1 is a typical example of that. In this case the test person has used PEP for 10 years as a treatment for COPD.

Through internship in Municipal Rehabilitation and at OUH we found that the time used to introduce PEP was only 20 minutes, with no further correction! Because of that the interface was made to ensure quality, thereby increasing the effect of the training, and increase the user compliance. This was done by an additional feedback function giving the user a live correction in how to breathe through the PEP-flute.

The interface is developed in cooperation with physiotherapists and users, to make the interaction between them as good and intuitive as possible. The users were positive about the live feedback, and the physiotherapists was happy to have insight into the training.

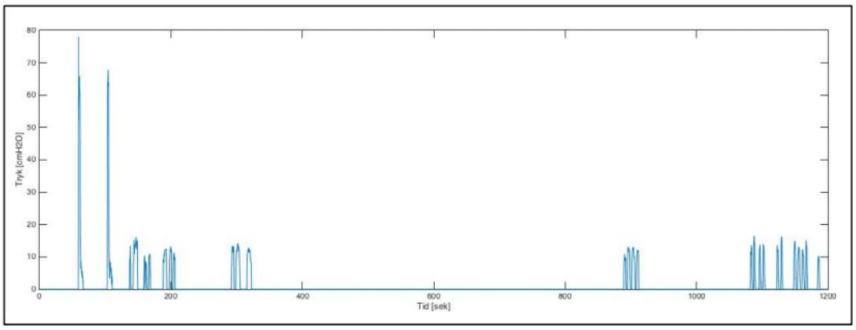

Fig. 1: Graphical view of PEP-flute training. Note that the first two peaks shows the blowing pressure the test person was used to, compared to normal.

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TRACKING ENDOSCOPE MOVEMENTS IN LAPAROSCOPY

In this study, we investigate and compare the endoscope movement differences during conventional (CLH)- and robot-assisted laparoscopic total hysterectomy(RAH) with the Da Vinci. Many studies compare the medical outcome of the two surgical technologies, but none have investigated the technical difference of the procedure itself. The positions and orientations are measured with electromagnetic sensors in 25 CLH and 25 RAH, all collected at Odense University Hospital. There was no significant difference in age, BMI and uterus size between the two groups. The surgical methods are compared with respect to the endoscope position, motion, orientation, surgery volume and time.

The result show that endoscope positions during RAH are placed in small non-overlapping clusters, compared to CLH which positions are continuously scattered in the surgery volume (fig1-top). The smoothly scattered positions during CLH are a result of hand tremble and surgeon correction of the endoscope position. Compared to RAH where the surgeon places the endoscope in a wanted position for some time, then move it to a new position which produces a more discrete and segmented position distribution. The orientations during CLH are more parallel compared to RAH which orientations are more fan-shaped (fig1-bottom). The fan-shaped orientations are a result of the Da Vinci's capability to mechanically fixate the trocar during the surgery, in contrast to the assistant who can move the trocar involuntarily which increases the skin tension. Significantly increased surgery time are also found for CLH(50.79±24.05Minute) compared to RAH(31.62±10.15Minute).

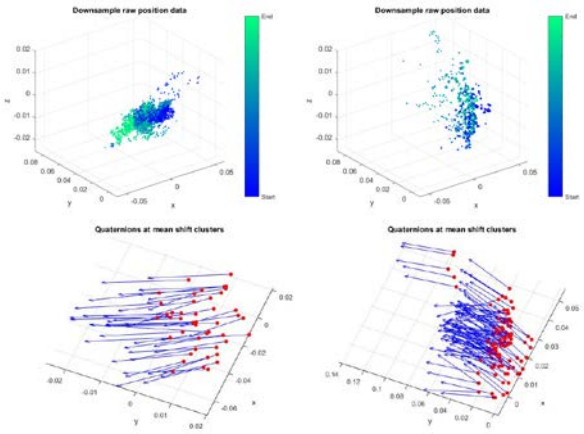

Fig1: Positions(top) and orientations(bottom) of the endoscope motion during similar length CLH(left) and RAH(right) surgeries. RAH(top-right) positions are segmented in small clusters compared to smoothly scattered positions during CLH(top-left). The endoscope during CLH (bottom-left) is parallel orientate compared to a fan-shaped orientation during RAH(bottom-right).

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