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Chapter 2 : ITAB : International Conference on Information Technology and Applications in Biomedicine

Research in digital libraries has many applications in the field of biomedical information. Our current research into the areas of concept extraction, indexing and searching in digital libraries has led to novel applications in information retrieval and indexing.

PD patients had sub-thalamic stimulation implantation for months. The PD patients performed the test twice: Bradykinesia and Tremor of hands in PD patients was quantified and strong correlation between this objective method and UPDRS clinical score was found. With progression of the disease the response to dopaminergic treatment fluctuates with an augmentation of rigidity, resting tremor and hypo or bradykinesia. Recently deep brain stimulation of the sub-thalamic nucleus STN-DBS has been introduced to treat highly fluctuating patients. This electrical stimulation has a continuous effect, similar to the one of medication, which can be substantially reduced or even stopped [3]. Several studies have tried to objectively identify and quantify different motor abnormalities of PD like dyskinesia [5-lo], tremor [I] and akinesia [ ]. Unfortunately, existing methods either do not have a good correlation to widely used score-based methods or are not ambulatory. In order to identify and to quantify hand tremor and bradykinesia we introduce an ambulatory measurement system suitable for long-term monitoring. The measured motion parameters are then compared to one of the above described clinical scales UPDRS Experiment setup Ten Parkinsonian patients 5 male and 5 female, age: The clinical protocol was approved by the ethics committee of the Universities of Lausanne and Geneva. It consisted of several steps featuring activities like walking, sitting, standing, eating, speaking, writing, brushing teeth, and combing the hair. Typically, each measurement took 25 to 40 minutes, depending on the performance of the patients. During the measurement, the activities of the patients were recorded using a portable video-camera. The same protocol was used to run a series of measurements on ten normal subjects 5 male and 5 female, age: Measurement system The measurement system consisted of two sensors Fig. Sensors where attached to the skin, just above the wrist, using bands with self-adhesive ends and a layer of silicon on the side facing the skin to avoid slipping. Each sensor measured the wrist angular velocity in roll, yaw and pitch direction. A marker device, was used as another input to the data-logger to mark start and end of each step of the protocol to ease later synchronization of events with the video observations. Two separate algorithms were used to quantify tremor and bradykinesia. Mobility of hand Mh and mean range of the rotation of Hand Rh. An algorithm with following steps was used to calculate these parameters: I Filtering the gyroscope signal angular velocity with a low-pass FIR filter with a cut-off frequency of 3Hz to remove possible effect of tremor. Detection of movements based on thresholding the signal above 10 degreekecond value selected to avoid noise. Integration of the signal for each movement to find angle of rotation of the hand. Finding the range of the rotation max angle - min angle for each movement. Taking the median value more stable than mean of the range of rotation to find mean range of the rotation of hand, Rh. To see how Mh and Rh differentiate between PD patients and controls, a nonparametric hypothesis test was made. Rank-sum test was used to compare PD patients and controls, and Wilcoxon test was to make paired tests when evaluating effect of the stimulation. The algorithm had the following steps: Segmentation of the signal into 3 seconds segments. Finding the nearest pole of AR model to the unit circle in z-plane. Marking the segment as tremor if corresponding frequency of this pole was between 3. Later, reviewing all segments to find those that were marked as tremor but all near neighbors were tremor free. Such segments were considered as false positive and their state were set back to no-tremor. Specificity of the algorithm was calculated based on the results of tremor detection on control subjects. The hypothesis was that controls did not show tremor during the protocol at all and all tremor reported by the algorithm were false negative. The video was reviewed and using a simple program, the observer logged start and end of each visible tremor period. An all-ais output was also calculated. For each segment, the segment was marked as tremor if the result of algorithm for any of the 3 axis of the sensor was positive. Amplitude of the tremor was calculated in these steps: Those segments of the signal that

were marked as tremor were selected. For each selected segment, signal was filtered using a band-pass filter to filter out frequencies below 3. High and low peaks of the filtered signal were found and the average value of all consecutive peak to peak differences was recorded as the amplitude of the tremor. Bradykinesia Table I shows the results of the hypothesis tests for each axis of the sensor and Table I1 shows the mean value of each parameter for each axis of the sensor for each group. Roll axis by itself shows a significant difference between the 3 groups. C P Angular velocity of hand, Mh Pitch The algorithm also provided a profile of the amplitude of the tremor during the measurement Fig. Tremor detection algorithm provides a profile of the amplitude of the tremor. Here the first 45 seconds of the signal of the roll axis of left hand of a PD patient featuring sever tremor is shown. The algorithm detects the tremor and quantifies its amplitude. These results were obtained in a protocol that only included daily life activities suggesting the suitability of these parameters for long-term monitoring. In the case of specificity, most of the miss-classification errors false-positive were during the "brushing the teeth" activity that produced rhythmic oscillations in wrist with 37 characteristics very similar to tremor. The duration of tremor detected by algorithm in its all-axis was constantly more than the observation. As the protocol included many different activities, it was not always possible to have a close-up view of the hands in video, which can explain why the algorithm showed more sensitivity than the observation. Although this range was too high for tremor detection, good sensitivity and specificity were obtained. However, sensitivity could be limited if the tremor had very low amplitude. Although in recorded video such tremor could not be observed, but its trace in the gyroscope signals could be seen. Using a sensor with smaller range or using an AD converter with higher resolution can overcome this limitation. On the other had, such a high range was needed to avoid saturation of the sensor in very high speed movements of hand. Together, these two algorithms bradykinesia and tremor cover most of the information one gets from those parts of UPDRS score related to the movements of upper limbs in a quantitative way. In this study we used 3D sensors. However, based on the obtained results, we could see that most of the information was accumulated in Roll axis of the sensor. With the presented method, a single gyroscope attached on hand and aliened in Roll axis can quantify bradykinesia successfully. However, the sensitivity of such a system in detection of tremor would not be satisfactory. Tremor could be detected with high sensitivity and specificity. Significant differences in bradykinesia quantifying parameters Mh and Rh were found between the two states of the stimulation, and between patients and controls in either state of stimulation. Gramiger for engineering aspects of the design of the sensors and the data-logger device. Parkinson, An essay on the shaking palsy. Sherwood Neely and Jones, New York Marcel Dekker Inc. Florhan Park, New Jersay: Mc Millan Health Care Infomation, , pp. Oflcial Journal of the Movement Disorder Society, vol. Proceedings of the First Joint, Purdue Sch. Dichgans, "Long-term measurement of tremor," Movement Disorders: Clinical assessment of akinesia," Nippon Rinsho. Japanese Journal of Clinical Medicine, vol. Katayama, "Actigraph analysis of diumal motor fluctuations during dopamine agonist therapy," European Neurology, vol.

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Chapter 5 : ITAB : 10th IEEE International Conference on Information Technology and Applications

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Chapter 8 : 10th IEEE International Conference on Information Technology and Applications in Biomedicin

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