DOCTORATS INDUSTRIALS

EL PLA DE DOCTORATS INDUSTRIALS

PROJECTE DE DOCTORAT INDUSTRIAL EXPEDIENT 2014 DI 013

DADES DE L'EMPRESA I DE L'ENTORN ACADÈMIC

Títol del projecte

Development of a system for monitoring the responses to nociceptive stimuli during anesthesia based on neurophysiological signals.

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BREU DESCRIPCIÓ DEL PROJECTE DE RECERCA

The aggression that occurs on patients undergoing surgery triggers a series of responses in the body and in the tissue that may have implications on the outcome of the surgical process. To mitigate the intensity of these responses, a certain level of protection or "anesthetic state" must be achieved. The anesthetic state may be defined as the combination of pharmacological effects that minimize the impact of surgical aggression in the patient. Various methods have been developed for the noninvasive assessment of the level of consciousness during general anesthesia. Measuring depth of anesthesia is not specifically designed for the measurement of nociception, however measuring the depth of anesthesia is related somewhat nociception. Nevertheless, the solutions proposed to date have not proven to be clinically useful methods. It has not been possible to develop a system capable of quantifying analgesia with high reliability and consequently with a high market penetration.

The analgesic component called "Anesthetic State" cannot be measured directly from the physiological signals of the patient. Different attempts to measure anesthetic state have been done by estimating hemodynamic responses, analysis of electrocardiographic waveforms variability, degree of respiratory sinus arrhythmia, plethysmographic responses, pulse wave, skin conductance, heart rate variability or opioid estimated concentrations. Moreover, since the main action of anesthetic agents occurs in the brain, a reasonable choice is to monitor and analyze the electroencephalographic signal (EEG). Added difficulties in this detection procedures are afforded by the response of the autonomic nervous system (ANS) and the sensitivity of the physiological measures to other disturbances, such as changes in blood pressure or heart rate due to patient's

baseline condition (hypertension, arrhythmias of diverse etiology), sympathomimetic drug delivery or unpredictable situations such as perioperative bleeding.

The measurement of the inherent complexity in the rhythms of different physiological signals monitored during a surgery might permit to obtained those indexes or combinations of them "candidate indexes" with a greater predictive capacity of response to nociceptive stimulation.

Base on all these foregoing, the aim of this project is to achieve an indicator that ensures that the patient does not feel pain during surgery, reduces the stay in post-operative unit, contributes for an accurate dosage of analgesia and improves the outcomes of the surgery.

The main tasks contained in the thesis are next described:

Bibliography. Literature review of issues and problems exposed in the field of biomedical engineering in the treatment of EEG signals containing characterization of depth of anesthesia and nociceptive pain; preprocessing and filtering of EEG; methods based on the characterization of the nonlinear dynamics of the EEG signals; methods developed for non-biomedical fields that could be introduced to characterize EEG signals.

Recording/Preprocessing. Recording, preprocessing and conditioning of EEG signals of patients under nociceptive stimulation. Development different methods in order to set up the signals by matching the available data with the proposed methodology (length of the studied windows, band separation, normalizations, etc.) and to manage the other information in the database (gold standard, EMG, stimulation signal, pain events, etc.).

Development algorithms/Evaluation. Design and development of a methodology based on nonlinear complexity techniques. Definition of indexes and their evaluation on the EEG signals under different states of DOA during surgery and under nociceptive pain events.

Thesis writing. Development of the research project memory..