Feature fusion for sleep bruxism detection and prevention based on micro motion accelerations from MEMS sensor and EMG, ECG and HRV signals analysis.

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Abstract— **A system of synchronous recording and analysis of both direct motion signals acquired from MEMS accelerometer and physiological EMG, ECG, Heart Rate Variability (HRV) collected from masseter muscle is presented as an on-line tool for early sleep bruxism (SB) episode detection and prevention. A hybrid feature set extracted on-line after time-frequency analysis of multi-sources data is the input for final decision rules classifier. Results regarding sensitivity and specificity of 20 supervised trials of classifying extracted feature fusion, validated the significant meaning of micro-motion accelerations recorded from MEMs sensors, added to the system for SB episodes detection quality improvement.**

I. INTRODUCTION

Sleep bruxism (SB), defined as an oromandibular activity during sleep with teeth grinding and clenching symptoms, causes several problems, affecting about 8% of population [1] in the area of teeth & implants, masticatory muscles and joints. Both our experiences and published research results reveal very complex nature of this phenomena, where the underlying aetological trigger of SB episode is not well understood [2]. Direct measurements of SB, based e.g. on force sensors placed inside bit strips detect all contractions of masticatory muscles including those, which do not correspond to SB episodes. Taking into consideration human nervous system as an original control loop of SB pathology and its triggering and also trying to detect at the same time more direct signals corresponding to teeth grinding symptoms, we propose to extend our previously proposed system based on ECG, EMG and EOG signals analysis [3] and add a MEMS accelerometer sensor for rapid micro motion and accelerations detection to create hybrid set of extracted feature for final classification based on decision rules.

II. METHODOLOGY

Direct measurement of SB symptoms connected with mechanical activities of mastication muscles was carried out
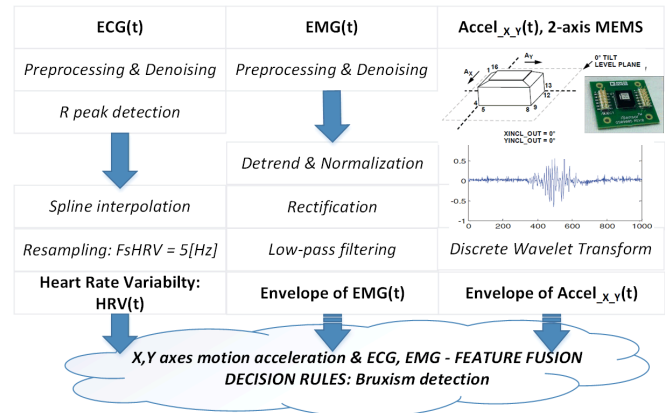

Figure 1. Structure of multisources feature fusion system for SB detection

by ADIS-16209, high accuracy, dual-axis digital accelerometer and inclinometer with 0.244 [mg] resolution. It is a top level integrated sensor with advanced microcontroller and ADC on board. SPI bus electronic communication interface was prepared on embedded FPGA platform, connected with ECG & EMG recorder.

III. RESULTS

To validated the significance of MEMS accelerometer sensor in direct detection of teeth grinding and clenching a series of 20 trials on 10 cases was carried out, where feature set was extracted from DWT analysis of original X,Y axis accelerations. Preliminary results of Sens=86.7% and Spec=89.1% confirmed the usefulness of completing the SB detection system based on ECG&EMG with jaw motion direct detection. MEMS accelerometers should be also more comfortable for patients in comparison to e.g. bit force strips fixed inside dental splint.

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