High density surface electromyography imaging

During muscle contraction, electrical signals are generated by the muscle cells. The analysis of those signals is called electromyography (EMG). While needle EMG (nEMG) is the commonly used method to obtain information on individual neuromuscular properties, the traditional surface EMG (sEMG) gives indirect information because it is influenced by many physiological factors simultaneously. However, by increasing the number of surface electrodes (multichannel sEMG, high-density HD-SEMG), information similar to that of the nEMG can also be obtained using spatio-temporal signal processing. The HD-SEMG technique is a bioelectrical imaging modality.

Our group has worked with basic research in novel processing techniques, including MU synchronization, spatial filtering, conduction velocity estimation, MU decomposition, and differential activation estimation. In addition, our methods have been used in clinical research e.g., in oncology, sport sciences and endurance analysis. In particular, our group has demonstrated that patients with fibromyalgia has different patterns of activity variation in the trapezius muscle, and that the temporal dynamics of this pattern can be quantified using an index which in turn was shown to be highly correlated with the patients experienced pain.

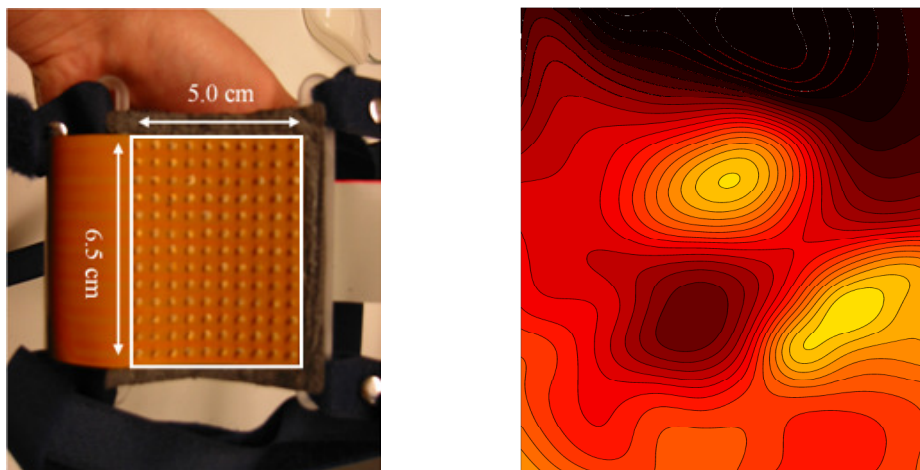Research is based on a modified Active-One system (Biosemi), with 130 monopolar electrodes.

Figure: *Left image is electrode-matrix-probe which is placed on the skin above the investigated muscle of a subject. Right image illustrates a typical image of the electric potential field recorded by the 13 x 10 electrodes on the skin's surface. Sampling at 2 kHz an image sequence reveals the location and propagation trace of individual motor unit action potentials (leading peak is yellow in image).*