IV. Discussion

In Figure 4 it is noticeable that the pressure distribution during the STP arises in an irregular rhythm on the paretic leg (all signals rise simultaneously from the HC moment). Segments in which the pressures are equal to 0 represent the SWP and it can be noticed that their duration differs on the paretic and nonparetic leg: the SWP is shorter on the nonparetic leg, because the subject tends to rely on the nonparetic leg as soon as possible. These differences in signals on both sides indicates to irregular and asymmetrical gait.

In Figure 4 significant difference in EMG activity between nonparetic and paretic leg can be noticed: mean envelope on nonparetic side has relatively repetitive pattern with local maxima at HC moment, while on paretic side EMG envelopes have irregular pattern and noticeably lover amplitude. This difference reflects to EMG maps (Figure 4 top and bottom). Beside lower intensity, EMG maps on paretic side don't have clearly defined high intensity regions, and activity spreads all over the EMG map. This can be explained as patients attempt to make a movement by compensatory mechanism, due to poor innervation of targeted muscle. The EMG maps and histograms in Figure 5 illustrate this scattering of EMG activity. Histogram of nonparetic EMG map wights to uniform distribution because the pixels of the EMG map have various intensities. On the other hand, histogram of the EMG map from paretic side is concentrated around one peak, because the majority of the pixels have same intensity (color).

These differences in intensity distribution are clearly quantified by calculating entropies. The values shown in Table I: 5.12 for nonparetic and 3.46 for paretic leg before the therapy. The greater entropy is the histogram is closer to uniform distribution, which means more different colors in EMG map. After the therapy, difference between entropies are lower, which indicates patient's improvement and greater selectivity in muscle recruitment. The EMG map entropy ratio shown in Figure 6 represents the symmetry of patient's activities on paretic and nonparetic leg and level of selectivity for muscle recruitment. Due to equation (5), in ideal case this ratio would be 0 which would mean that both legs have the same selectivity (entropies are equal on both legs).

Global improvement can be noticed in gait parameters in Table I: patient walks faster (GCD is greater and GC and SC are shorter), but also symmetry is improved (difference between duration of SWP and STP on paretic and nonparetic leg are lower; Figure 6 left panel).

V. Conclusion

The proposed method, which combines the use of pressure sensors with EMG array electrodes and portable amplifiers, provides a good base for gait analysis. The formed set of parameters, based on gait mechanics, and spatio-temporal images of muscle activity during gait (both as a visual assessment and quantified), gives the possibility to assess the patient's condition before and after therapy.

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