NON-LINEAR STATISTICS (ELASTIC MAP) IMPLEMENTATION TO DETECT PARKINSON'S DISEASE vs. ESSENTIAL TREMOR

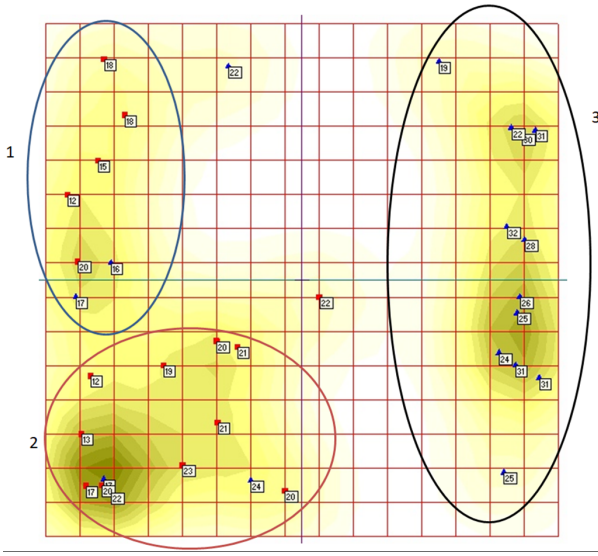*A. Khoroshavina* and *K. Tutsenko,* KrasGMU, 660022 Russia, Krasnoyarsk, Part. Zheleznyaka str., 1.

Figure 1: Clusters of people with BP and ET

Goal: Parkinson's disease (PD) and essential tremor (ET) are hardly differentiated, at the early stage of a disease. This differentiation is of great value for practical medicine. Both nosologies manifest in tremor and olfactory dysfunction. We aimed to find the minimal set of tremor parameters and olfactory characteristics to differentiate the patients with the nosologies reliably.

Methods: Since linear statistics techniques failed to differentiate the patients with different nosologies, we implemented elastic map method. This method consists in approximation of multidimensional data with two-dimension manifold.

Results: A combination of tremor indicators and olfactory function data of the patients with PD and ET yields clear and unambiguous clustering on elastic map. The clusters comprise the patients with PD and ET, mainly. Few patients were observed in "alien" clusters, but their number is low enough. Clustering provided over the data on tremor, or olfactory function, individually, fails to yield the pattern with good separation of the patients. Since the dimension of tremor data significantly exceeds that latter for olfactory function, we reduced the tremor data dimension. To do that we checked the histograms of all tremor data and then eliminated the variables of tremor with the histogram looking far from a normal distribution. Finally, we combined the chosen tremor data and olfactory indicators to develop good elastic maps; Fig. 1 shows the map. The clusters obtained with the elastic map were examined for distinguishability with standard (linear) criteria (Shapiro-Wilk test, t-test, Mann-Whitney test).

Conclusion: Standard (linear) criteria distinguish the patients with different nosology rather poorly. The patients from clusters exhibit better distinguishability. Statistically significant differences were found between the first cluster and the third cluster; also, this difference was observed between the second and the third clusters. Note, that we analyzed the distinguishability in terms of tremor and in smell. The reliable distinguishability in tremor data has been observed for angle of limb deviation in the kinetic test; Fig. 2 shows the pattern. A low distinguishability of the patients gathered into the first and the second clusters may result from the high prevalence of the patients with the same nosology (PD) in the clusters. The third cluster differs significantly from the first and the second ones; probably, it results
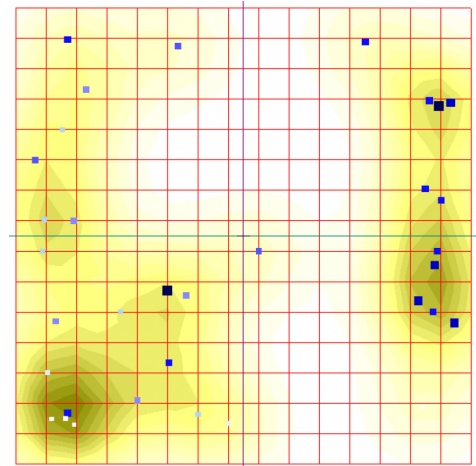

Figure 2: Tremor level among PD and ET patients; darker coloring corresponds to greater tremor.

from the great prevalence of ET patients in the third cluster. Comparison of these two maps supports the hypothesis on the inverse correlation between tremor and olfactory function level.