뇌신경재활

발표일시 및 장소: 10 월 18 일(금) 15:35-15:45 Room B(5F)

OP2-2-9

Prediction of arm impairment by machine learning algorithm from kinematic measures in stroke

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Objective

To predict hemiparetic upper-limb impairment by machine learning algorithm from kinematic measures in a 2-dimensional planar device in stroke patients.

Methods

In the multi-center observational study, 63 subacute and chronic stroke patients with hemiparetic arm of Brunnstrom stage 3, 4, or 5 were enrolled. Hemiparetic arm function was evaluated and trained with 3 kinds of tasks (free exploration, point-to-point reaching, and round shape drawing) using the RAPAEL Smart BoardTM (Neofect, Korea) (Figure 1). The device has 2-dimensional planar board and position sensors.

Results

Among 63 subjects, the ratio of patients of Brunnstrom stage 3 was 61%, whereas stage 4 was 17%, and stage 5 was 22%. Among the kinematic variables, zero crossings in acceleration, mean arrest period rate (Figure 2), hand path ratio, and duration time in point-to-point reaching task had significant correlation with Fugl-Meyer assessment scale. Those variables showed higher correlation in right hemiparesis than in left. In the patients who showed much improvement in the Fugl-Meyer scale, zero crossings in acceleration and duration time decreased in point-to-point reaching task. Zero crossings in acceleration, reaction time, and duration time revealed correlation with box and block test as well as pegboard test. Bias in X-axis (Figure 3) had negatively correlated with Fugl-Meyer scale in round shape drawing task. From these features, the mean absolute error for prediction of Fugl-Meyer scale using 5-fold cross validation in artificial neural network was 14.25 points per 66 (cross-validated R2=0.51).

Conclusion

Upper-limb impairment in stroke patients can be predicted by machine learning algorithm from main kinematic variables in a 2-dimensional planar device. Various kinematic measures were correlated with clinical parameters. An accurate machine learning algorithm needs to be drawn with big data.

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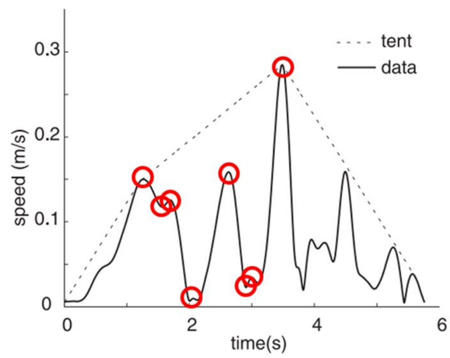
Free exploration

Point-to-point reaching

Round-shape drawing

Figure1 Three tasks in a 2-dimensional planar device

Zero Crossings in Acceleration



Mean Arrest Period Rate

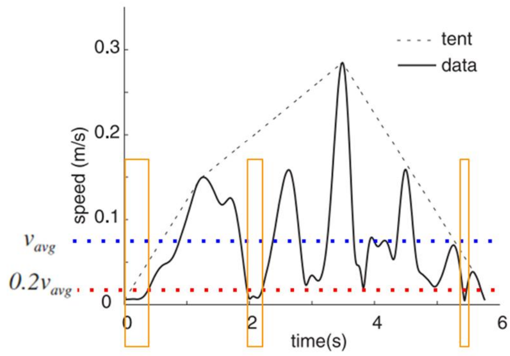


Figure2. Kinematic measures for movement smoothness

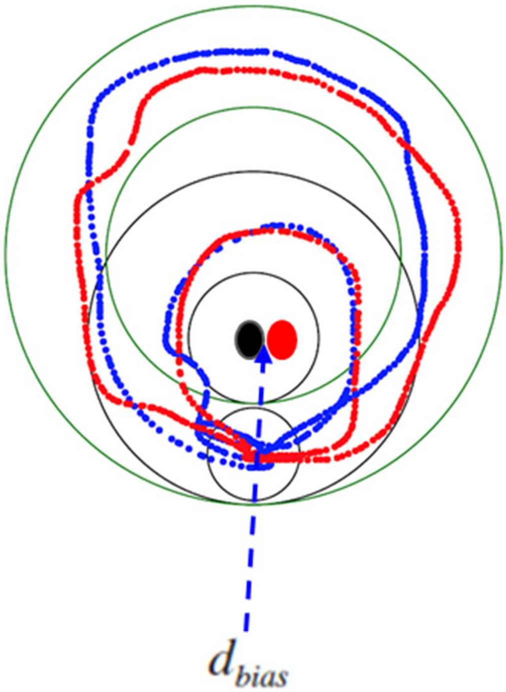


Figure 3. Bias for accuracy assessment