

Article

Supervised Myoelectrical Hand Gesture Recognition in Post-Acute Stroke Patients with Upper Limb Paresis on Affected and Non-Affected Sides

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Supplementary Materials:

Affected and non-affected side feature vector contribution for NP19 and P19 datasets.

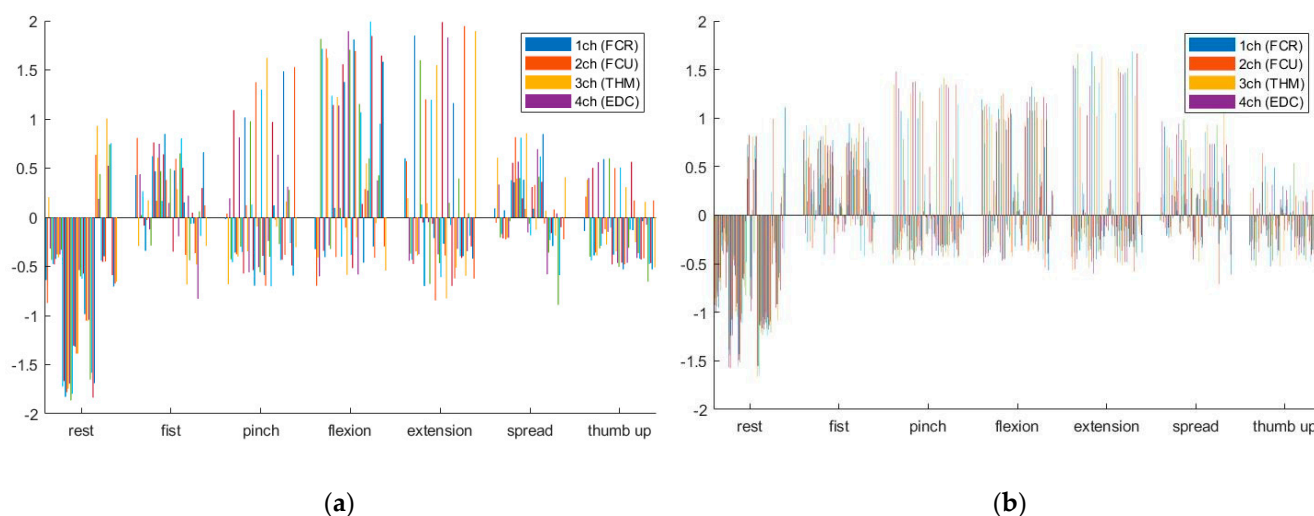


Figure S1. This is the vector feature-per-channel contribution for NP19 (a) and P19 (b) acute stroke data using ASF-14NP feature set for non-affected side, and ASF-24P for the affected side.

Confusion matrix charts of possible random gesture combinations in NP19 using SVM.

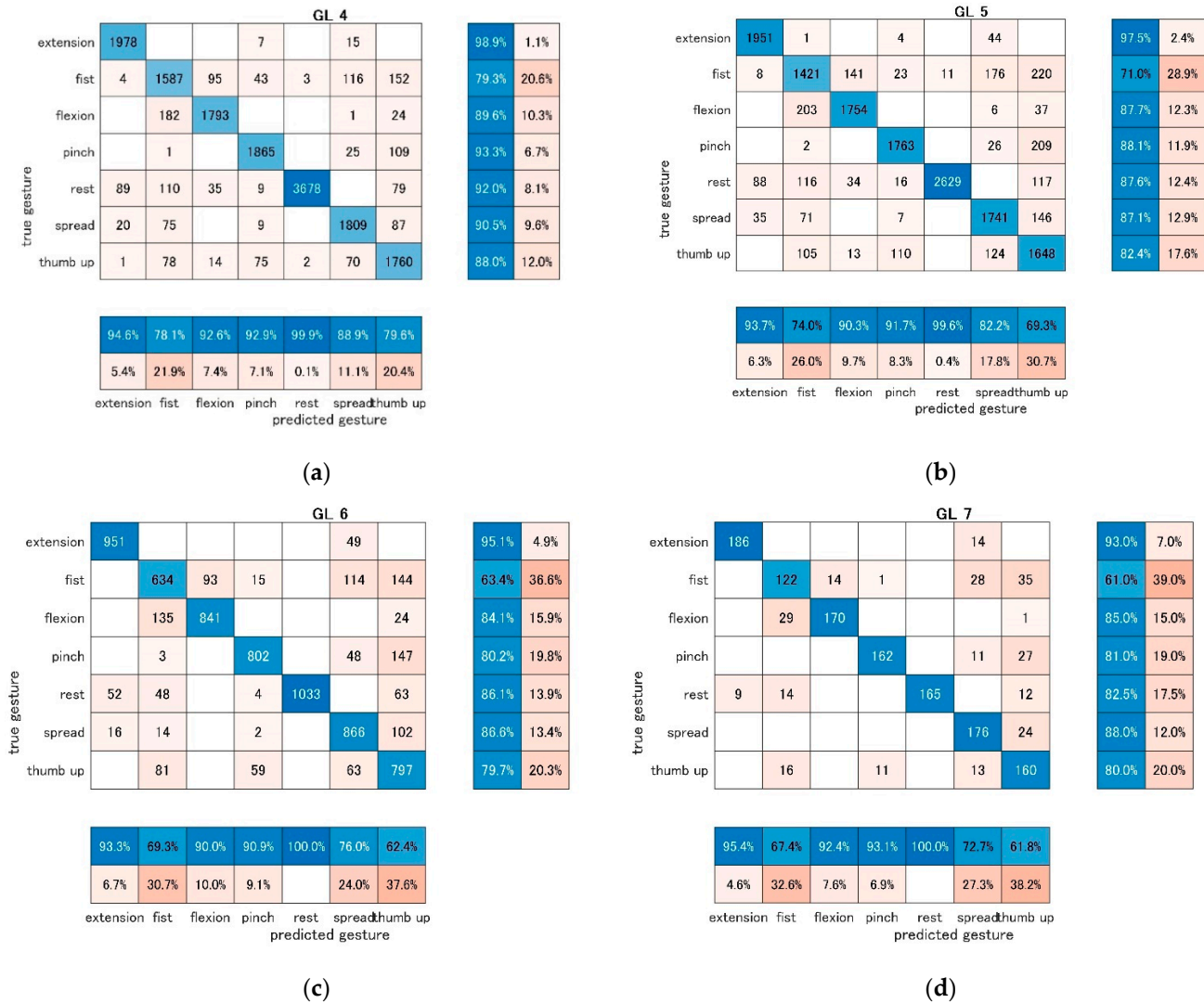


Figure S2. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using SVM on the non-affected side: **(a)** all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 95.18%; **(b)** all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 94.41%; **(c)** all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 94.28%; **(d)** one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 94.73%. PCA has not been applied for ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in NP19 using LDA.

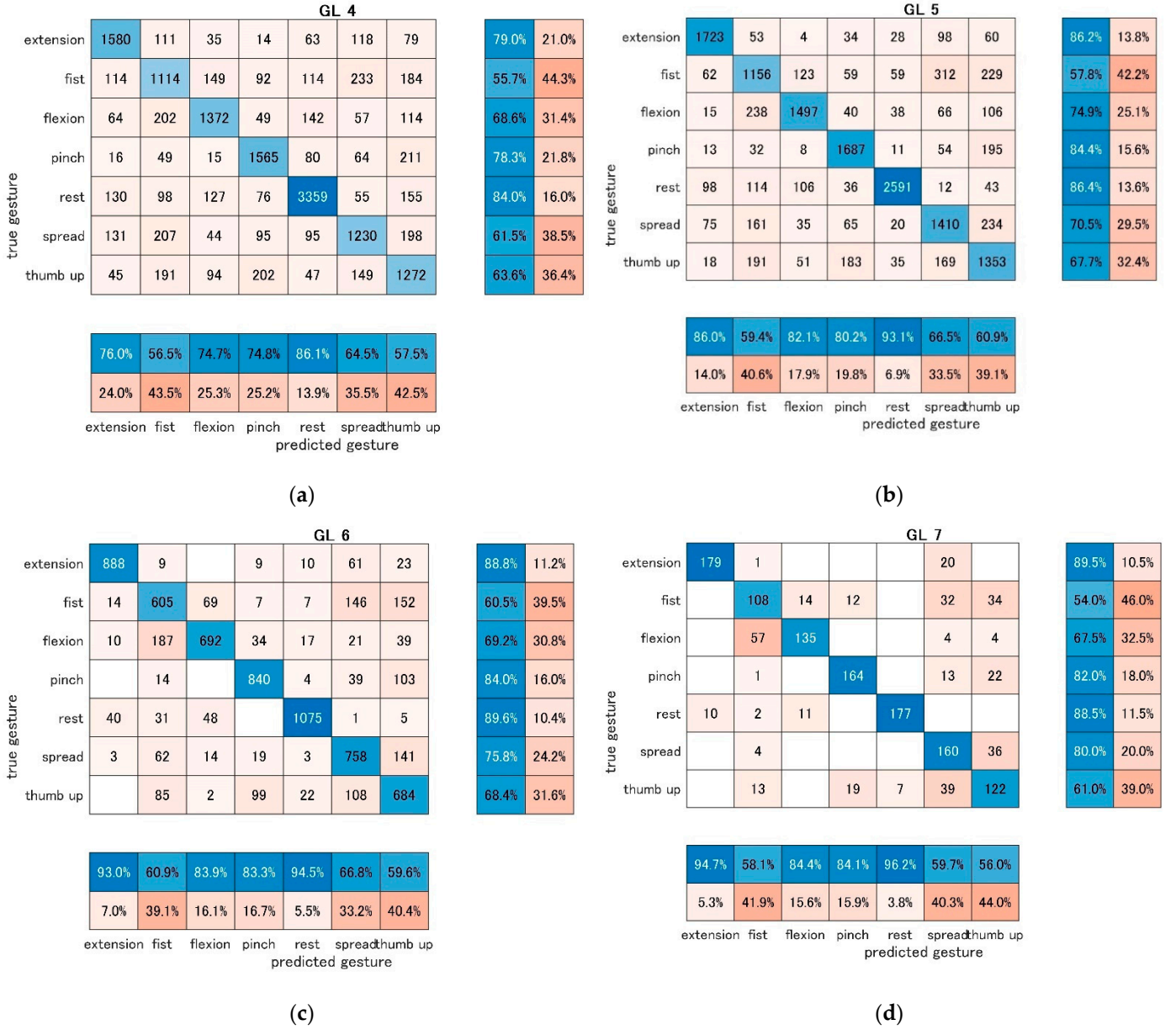


Figure S3. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using LDA on the non-affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 88.40%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 91.30%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 92.49%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 93.27%. PCA has not been applied for ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in NP19 using k-NN.

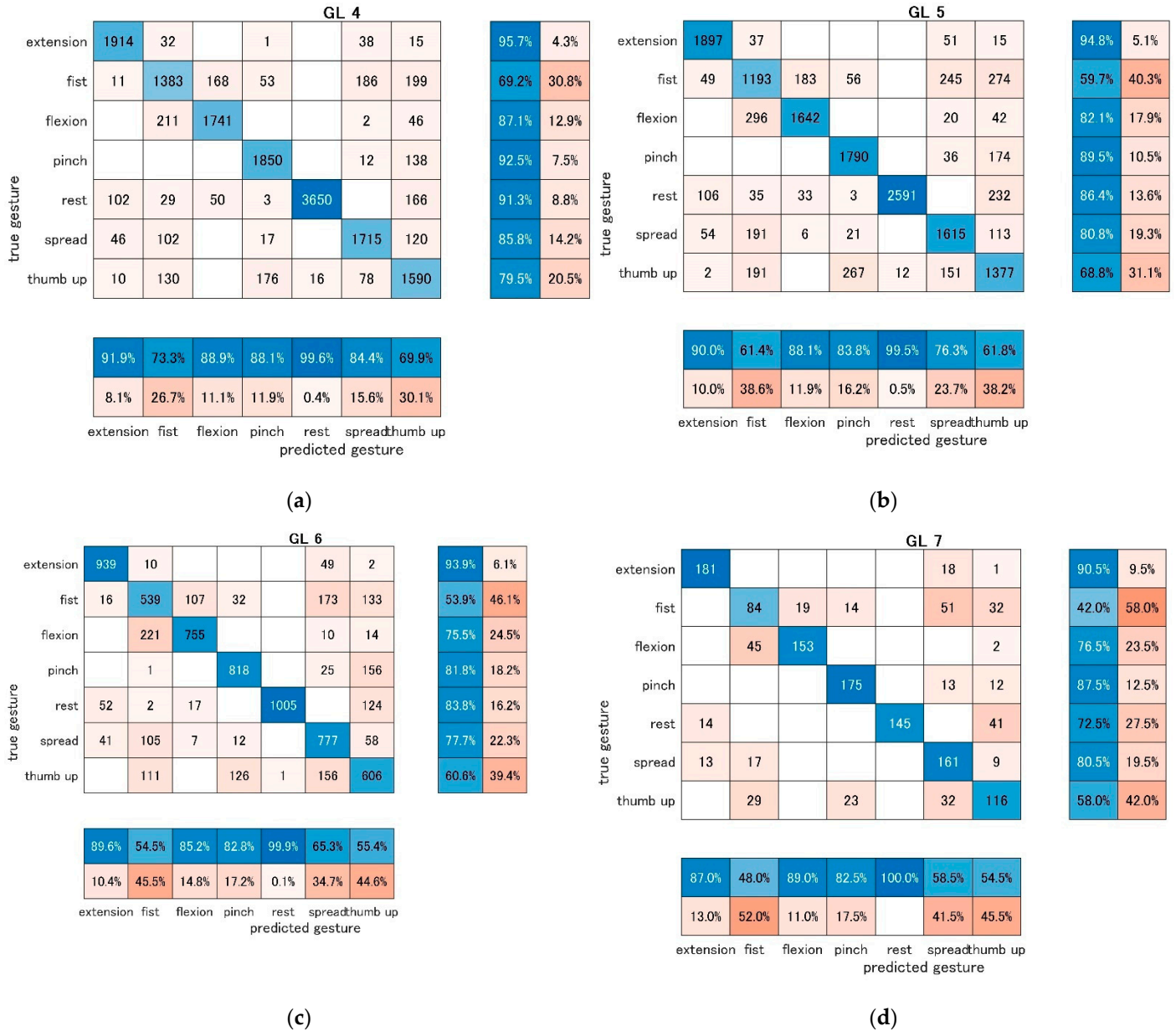


Figure S4. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using k-NN on the non-affected side: **(a)** all possible combinations (20) with 4 gesture labels (GL4) with the total mean accuracy rate of 93.42%; **(b)** all possible combinations (15) with 5 gesture labels (GL5) with the total mean accuracy rate of 92.34%; **(c)** all possible combinations (6) with 6 gesture labels (GL6) with the total mean accuracy rate of 91.85%; **(d)** one possible combination with 7 gesture labels (GL7) with the total mean accuracy rate of 91.71%. PCA has not been applied for ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in P19 using SVM.

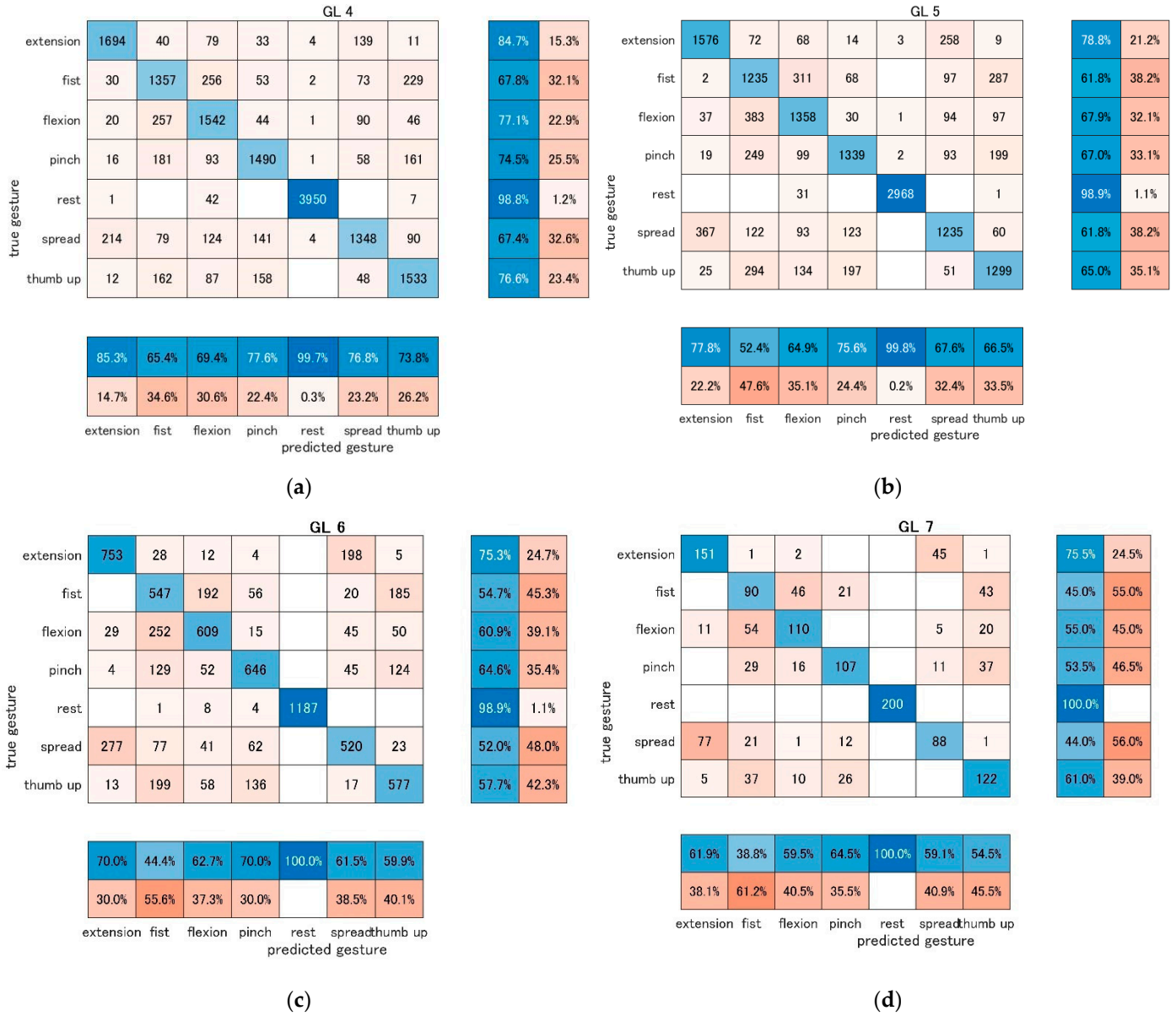


Figure S5. This is paritic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using SVM on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 90.07%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 89.24%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 88.91%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 89.75%. PCA has not been applied for ASF-24P feature set.

Confusion matrix charts of possible random gesture combinations in P19 using LDA.

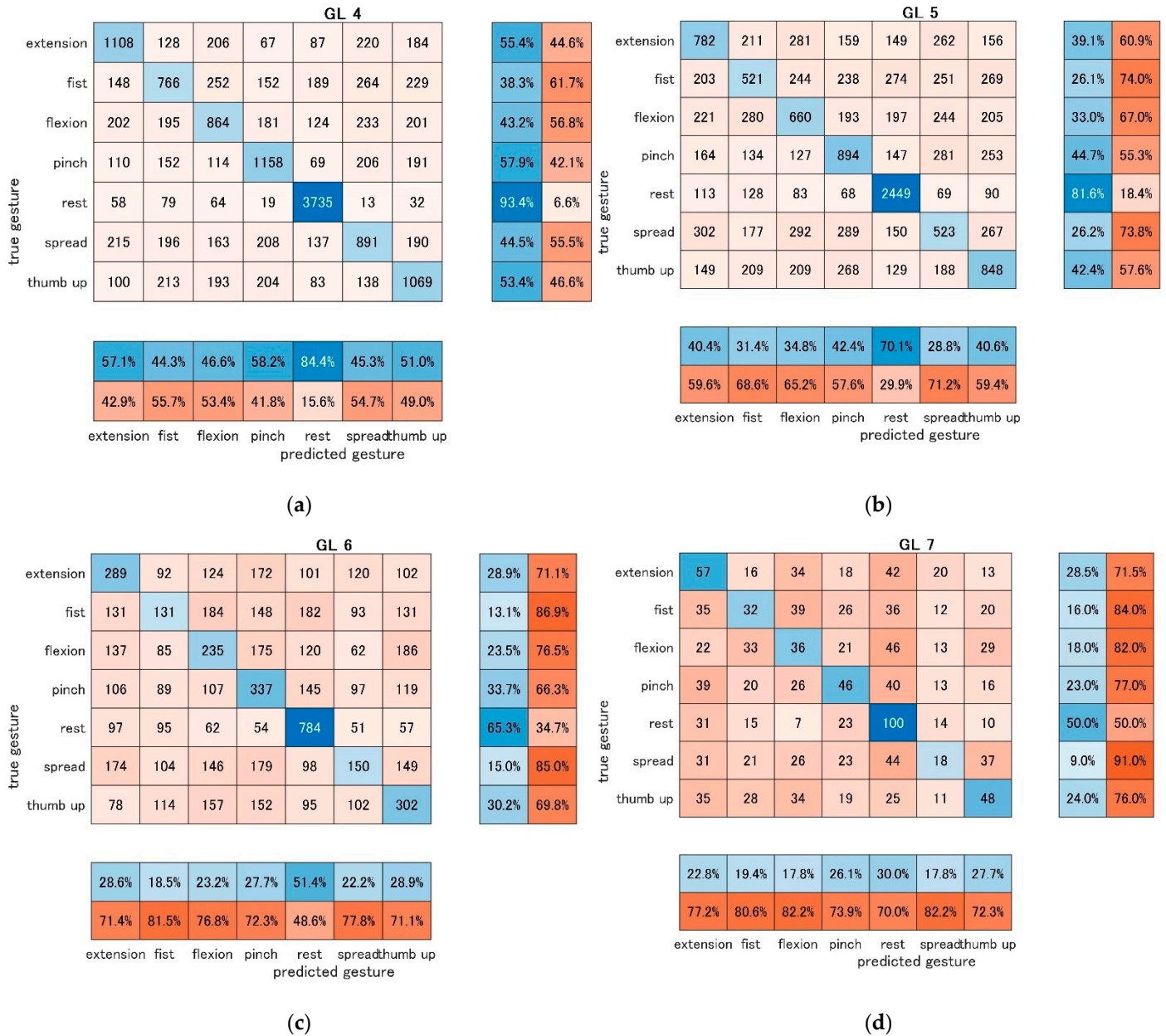


Figure S6. This is parietic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using LDA on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 80.17%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 77.89%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 77.60%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 77.42%. PCA has not been applied for ASF-24P feature set.

Confusion matrix charts of possible random gesture combinations in P19 using k-NN.



Figure S7. This is parietic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using k-NN on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 88.56%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 88.08%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 87.10%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 87.30%. PCA has not been applied for ASF-24P feature set.

Confusion matrix charts of possible random gesture combinations in NP19 using SVM with the dimensional reduction using PCA.

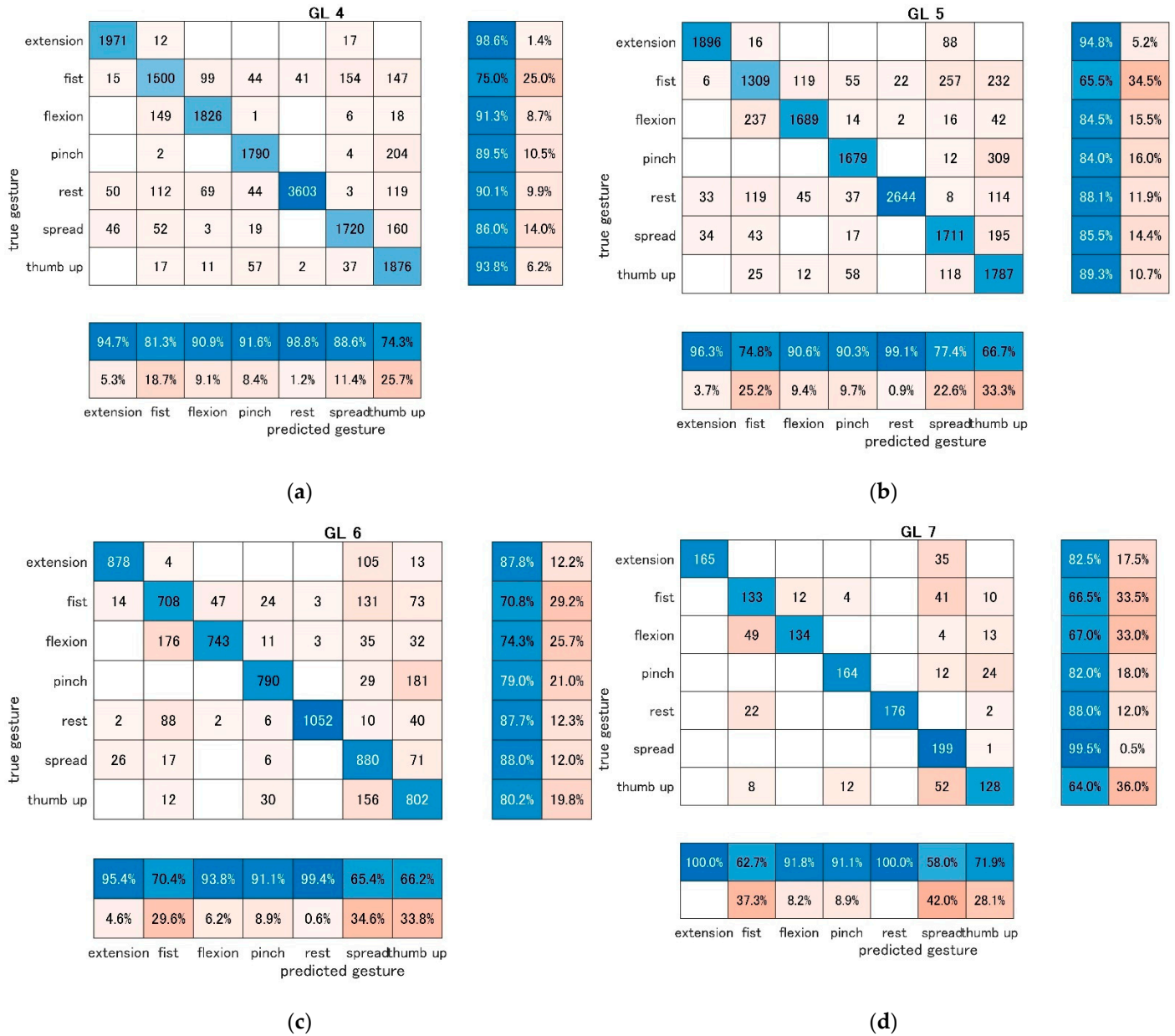


Figure S8. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using SVM on the non-affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 94.81%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 94.00%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 93.82%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 93.53%. PCA set to 23 at the ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in NP19 using LDA with the dimensional reduction using PCA.

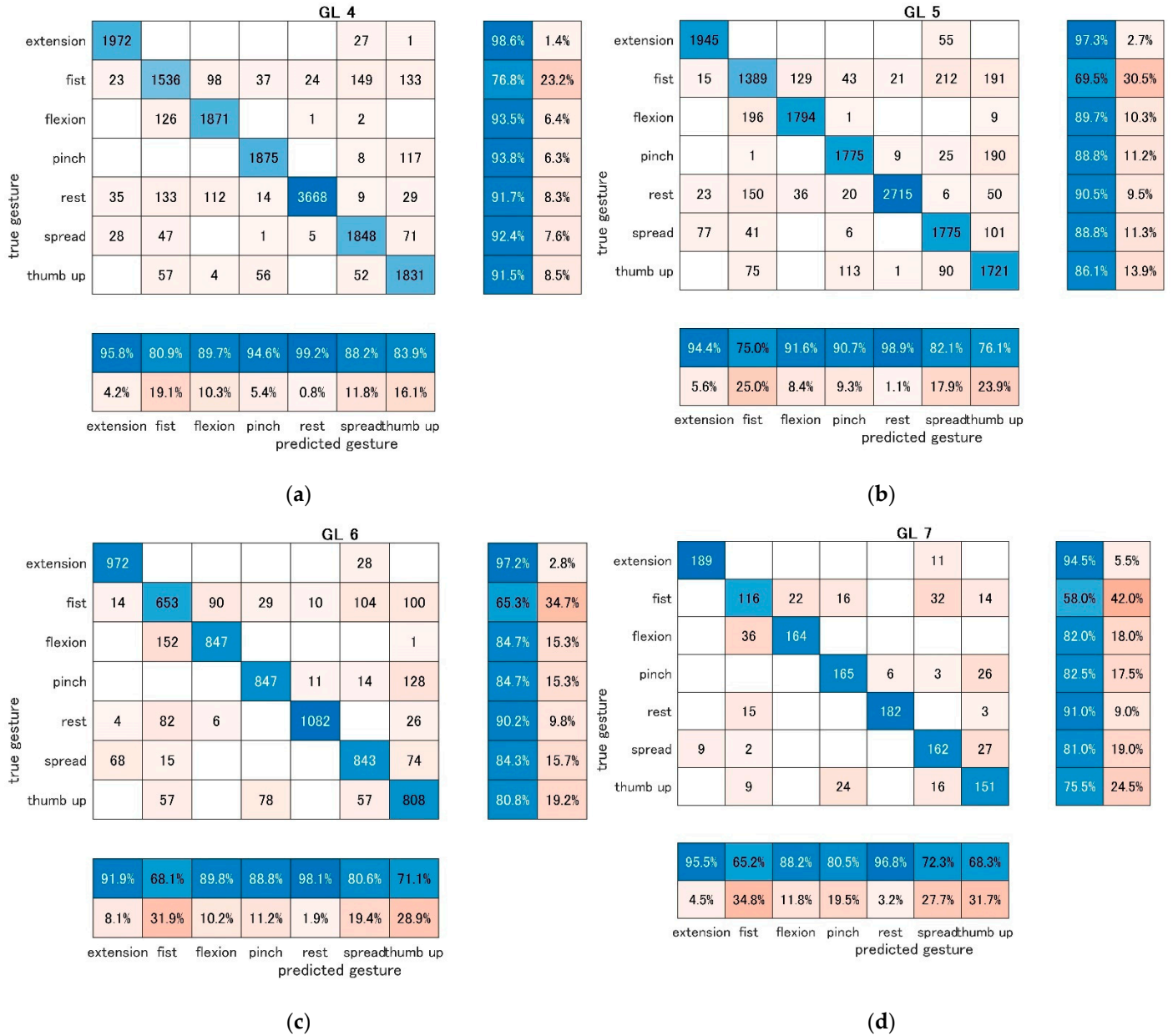


Figure S9. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using LDA on the non-affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 95.42%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 95.30%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 94.81%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 94.36%. PCA set to 19 at the ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in NP19 using k-NN with the dimensional reduction using PCA.

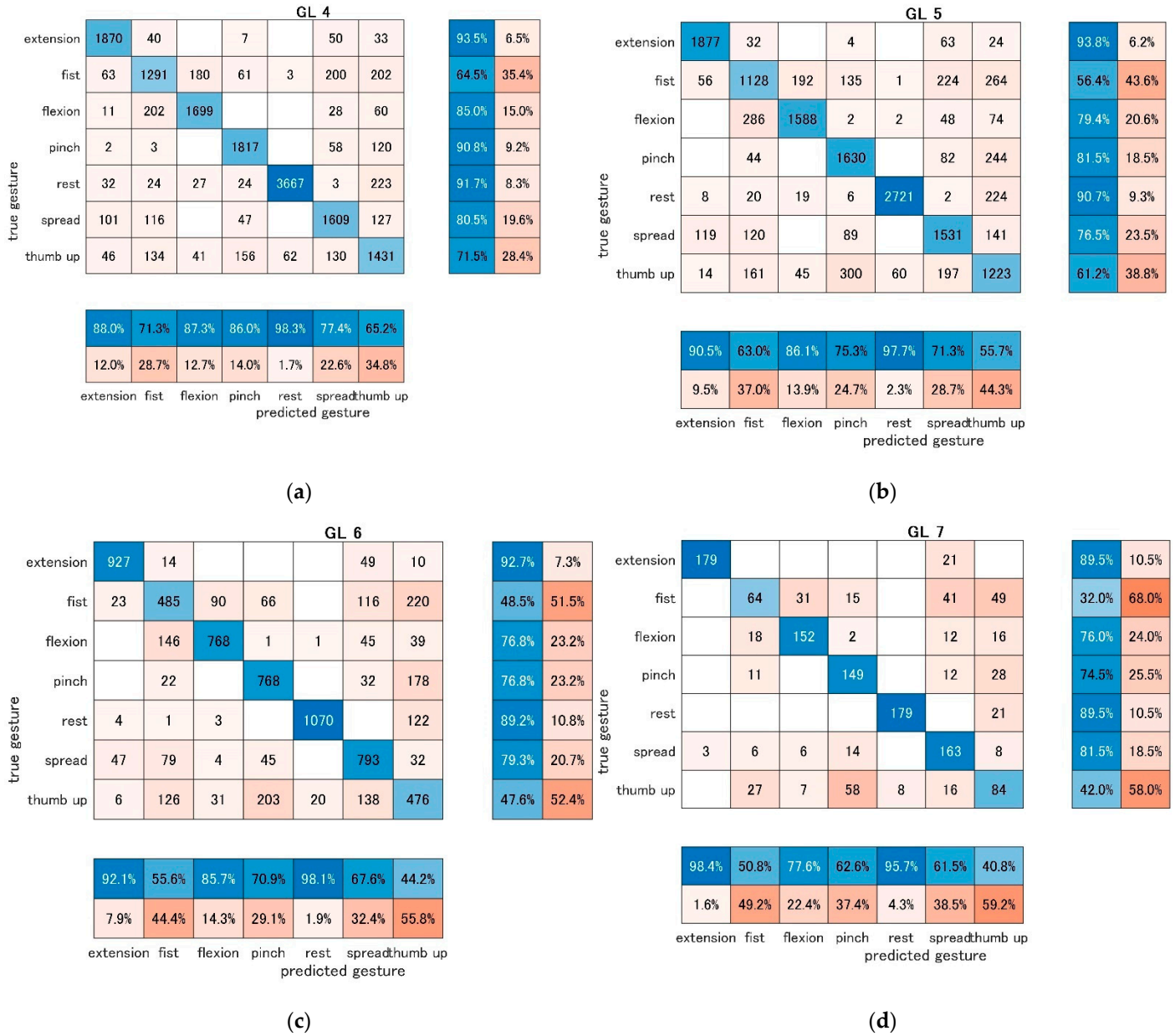


Figure S10. This is non-paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using k-NN on the non-affected side: **(a)** all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 92.15%; **(b)** all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 91.63%; **(c)** all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 91.63%; **(d)** one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 90.83%. PCA set to 8 at the ASF-14NP feature set.

Confusion matrix charts of possible random gesture combinations in P19 using SVM with the dimensional reduction using PCA.

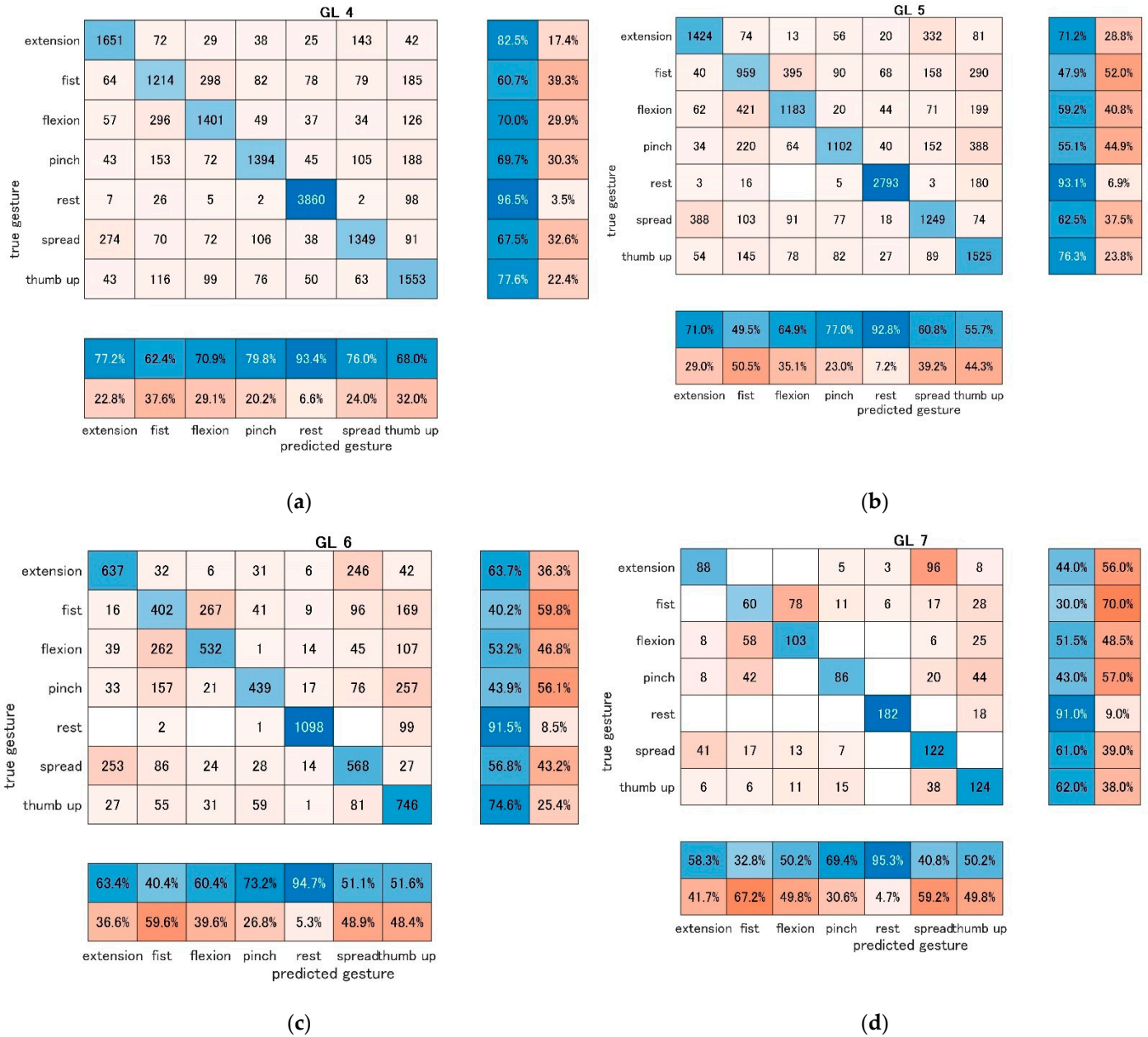


Figure S11. This is parietic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using SVM on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 88.67%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 87.45%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 87.13%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 87.30%. PCA set to 35 at the ASF-24P feature set.

Confusion matrix charts of possible random gesture combinations in P19 using LDA with the dimensional reduction using PCA.

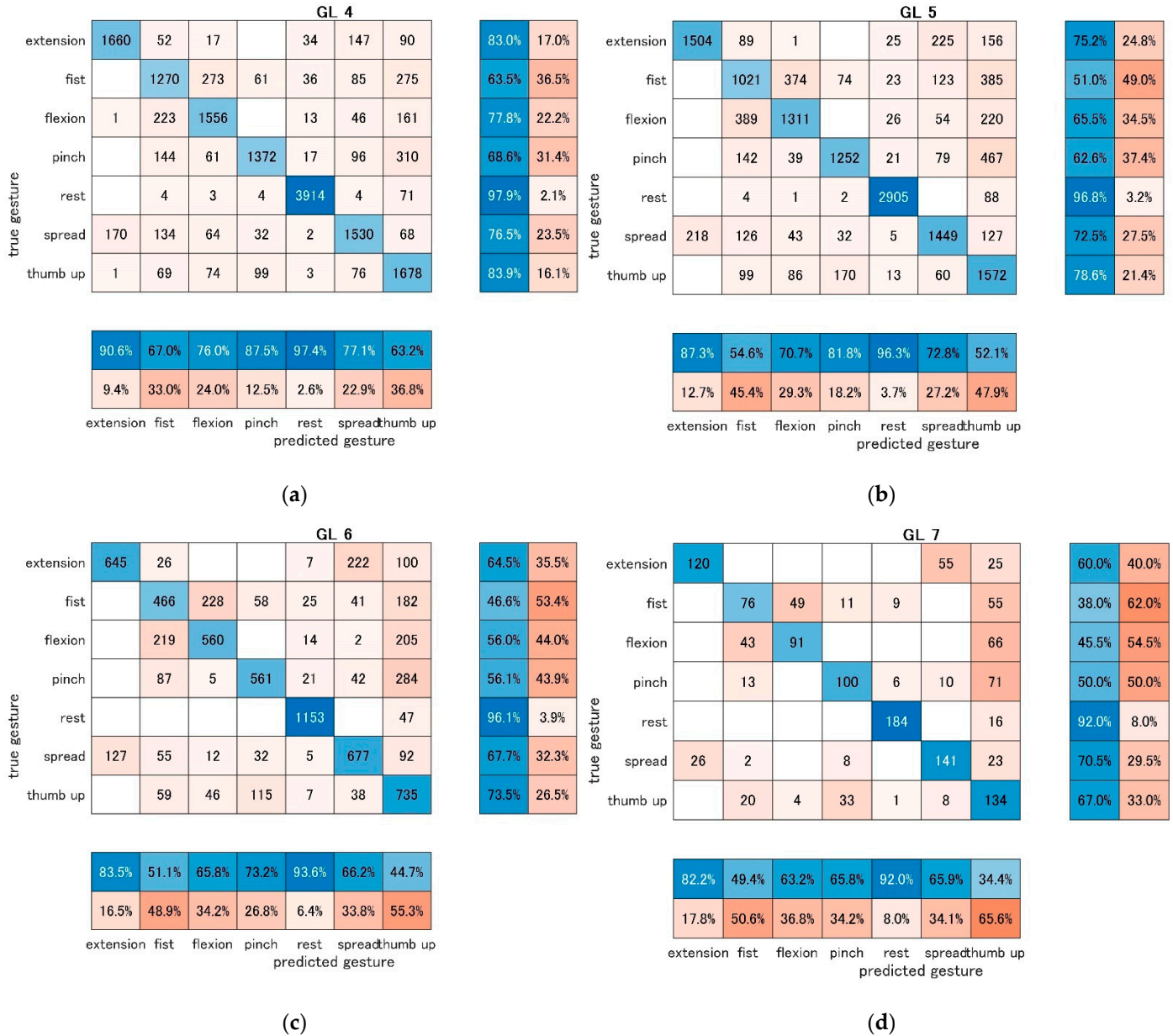


Figure S12. This is parietic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using LDA on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 90.20%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 89.57%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 89.32%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 89.27%. PCA set to 5 at the ASF-24P feature set.

Confusion matrix charts of possible random gesture combinations in P19 using k-NN with the dimensional reduction using PCA.

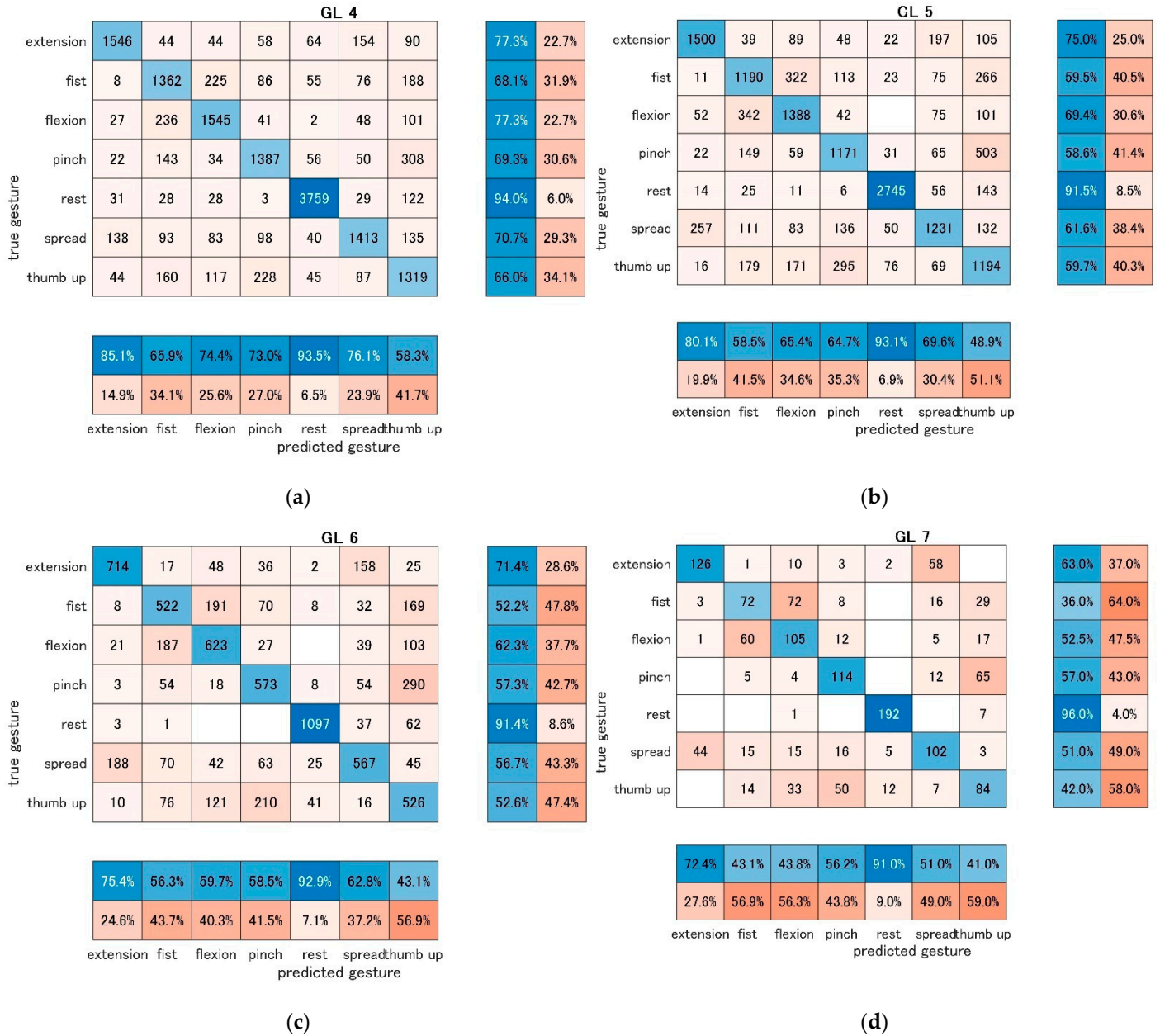


Figure S13. This is paretic cross-validation confusion matrix charts with predicted on x-axis and true gesture labels on y-axis which return accuracy rate value using k-NN on the affected side: (a) all possible combinations (20) withing 4 gesture labels (GL4) with the total mean accuracy rate of 88.55%; (b) all possible combinations (15) withing 5 gesture labels (GL5) with the total mean accuracy rate of 87.98%; (c) all possible combinations (6) withing 6 gesture labels (GL6) with the total mean accuracy rate of 87.35%; (d) one possible combination withing 7 gesture labels (GL7) with the total mean accuracy rate of 88.88%. PCA set to 5 at the ASF-24P feature set.

Table S1. Statistical verification of max of mean accuracy obtained by SVM, LDA, and k-NN with and without the use of PCA.

Number of Gesture Labels	No PCA	PCA Dim. 5	PCA Dim. 8	PCA Dim. 19	PCA Dim. 23	PCA Dim 35
GL4 (P)	SVM *	LDA*	LDA*	LDA*	LDA*	LDA
GL4 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL5 (P)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL5 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL6 (P)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL6 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL7 (P)	SVM	LDA	LDA	LDA	LDA	LDA
GL7 (NP)	SVM	LDA*	LDA*	LDA	LDA	LDA

* Asterisk indicates statistical significance based on the paired *t*-test ($p < 0.05$).

Table S2. Statistical verification of max F_1 -score performance metrics obtained by SVM, LDA, and k-NN with and without the use of PCA.

Number of Gesture Labels	No PCA	PCA Dim. 5	PCA Dim. 8	PCA Dim. 19	PCA Dim. 23	PCA Dim 35
GL4 (P)	SVM *	LDA*	LDA*	LDA*	LDA*	LDA
GL4 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL5 (P)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL5 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL6 (P)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL6 (NP)	SVM*	LDA*	LDA*	LDA*	LDA*	LDA*
GL7 (P)	SVM	LDA*	LDA	LDA	LDA	LDA
GL7 (NP)	SVM	LDA*	LDA*	LDA	LDA	LDA

* Asterisk indicates statistical significance based on the paired *t*-test ($p < 0.05$).