

APPENDIX

A. Comparison with the BCI Competition IV dataset 2a winning version of FBCSP

Table II and Figure 4 present the same results as Table I and Figure 3, along with an additional model: **OVR FBCSP+MIBIF4**, which corresponds to the FBCSP version that was described in [9] and that won the BCI Competition IV dataset 2a [14]. In particular, it differs from our version in the sense that our version uses an intrinsic multi-class CSP [10] without feature selection, whereas the competition version uses a one-vs-rest strategy with a feature selection based on mutual information in each of the 4 pipelines.

We observe in the table that our pipeline obtained slightly better results than the competition version when using all the calibration trials (+1.5%). In the figure, we observe that our version performed better than the competition version when using more than 4 calibration trials per class, while it performed worse when using less than 4.

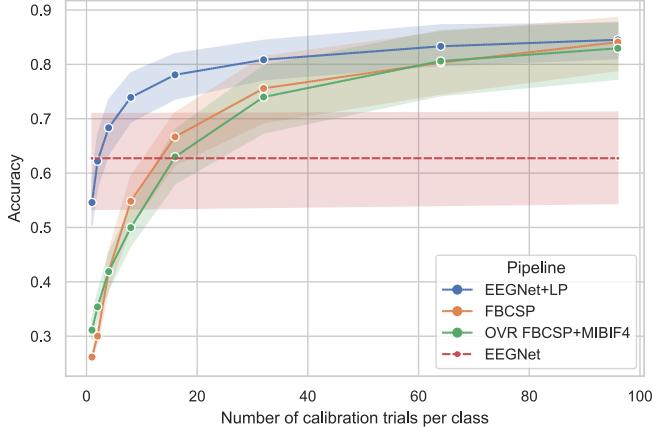


Fig. 4. Development of the classification accuracy for an increasing number of training trials per class to calibrate the pipelines (with additional model).

B. Exhaustive 2D projection of the embedding vectors

Figures 5 to 18 provide the same type of projected views of the embedding vectors as Figure 2 except that they each present the embedding function learned in one of the folds of the leave-one-subject-out cross-validation procedure and that they contain all the subjects.

TABLE II
CLASSIFICATION ACCURACIES ON THE DIFFERENT SUBJECTS (WITH ADDITIONAL MODEL).

Pipeline	Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	mean	std
EEGNet		0.863	0.734	0.612	0.452	0.741	0.806	0.764	0.308	0.514	0.532	0.414	0.736	0.517	0.790	0.627	0.171
EEGNet+LP		0.931	0.858	0.872	0.908	0.886	0.867	0.881	0.883	0.775	0.796	0.747	0.950	0.816	0.886	0.861	0.058
FBCSP		0.894	0.800	0.947	0.953	0.907	0.930	0.733	0.912	0.743	0.845	0.808	0.918	0.796	0.948	0.867	0.078
OVR FBCSP+MIBIF4		0.900	0.759	0.959	0.952	0.880	0.935	0.705	0.899	0.728	0.888	0.710	0.880	0.805	0.924	0.852	0.092

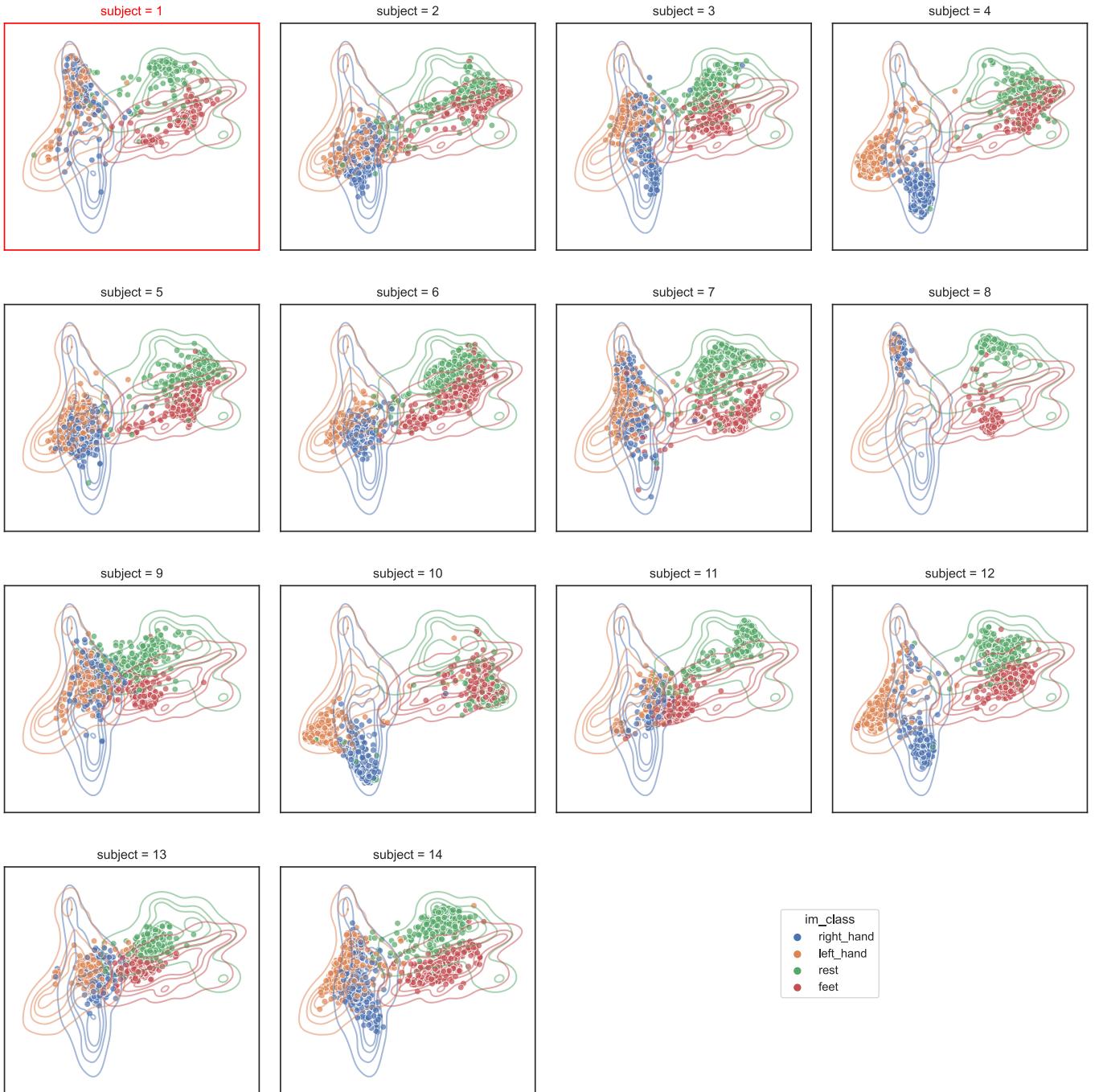


Fig. 5. Similar to Figure 2 except that it uses the embedding learned without subject 1 and that all the train subjects are represented.

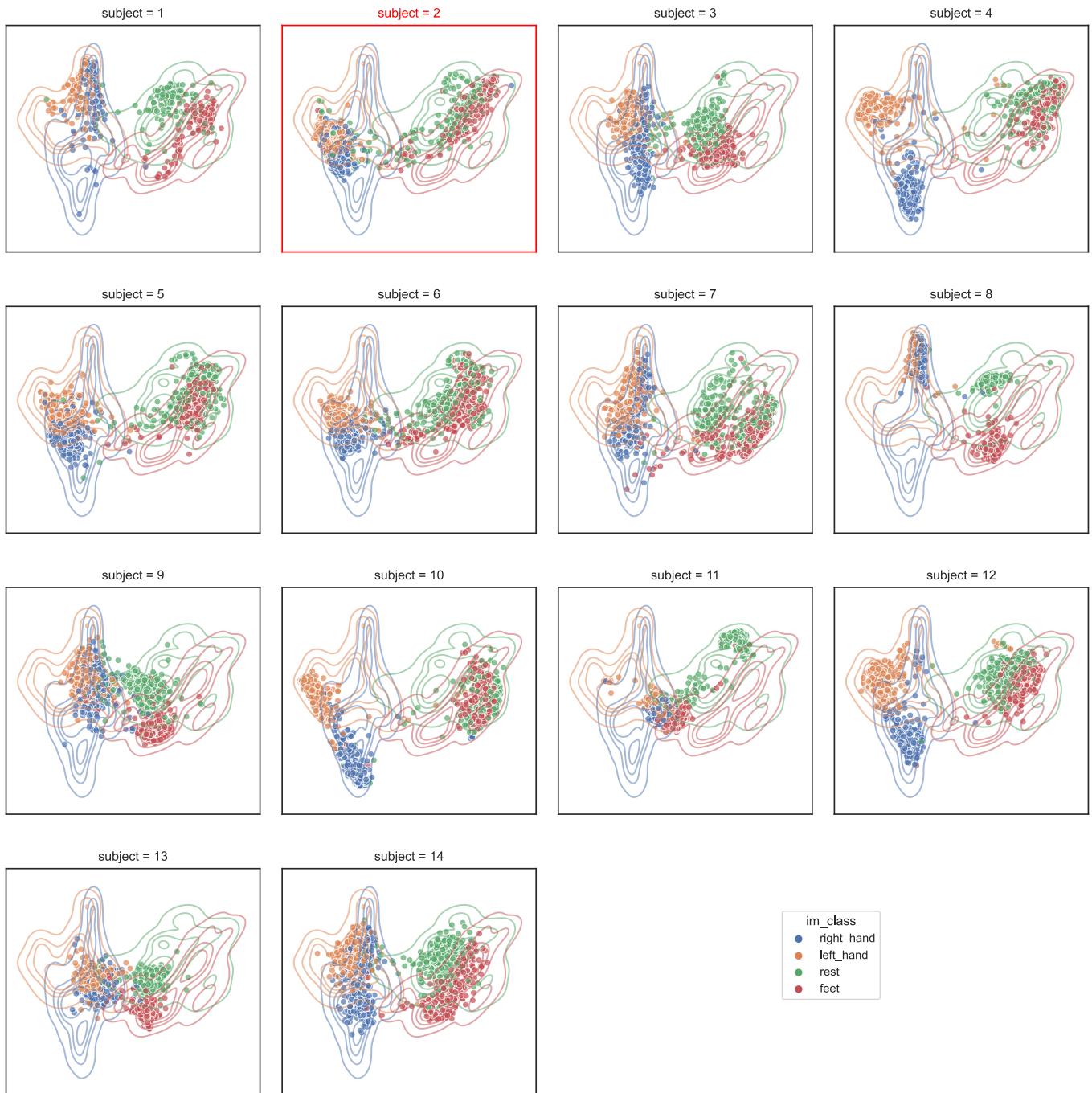


Fig. 6. Similar to Figure 2 except that it uses the embedding learned without subject 2 and that all the train subjects are represented.

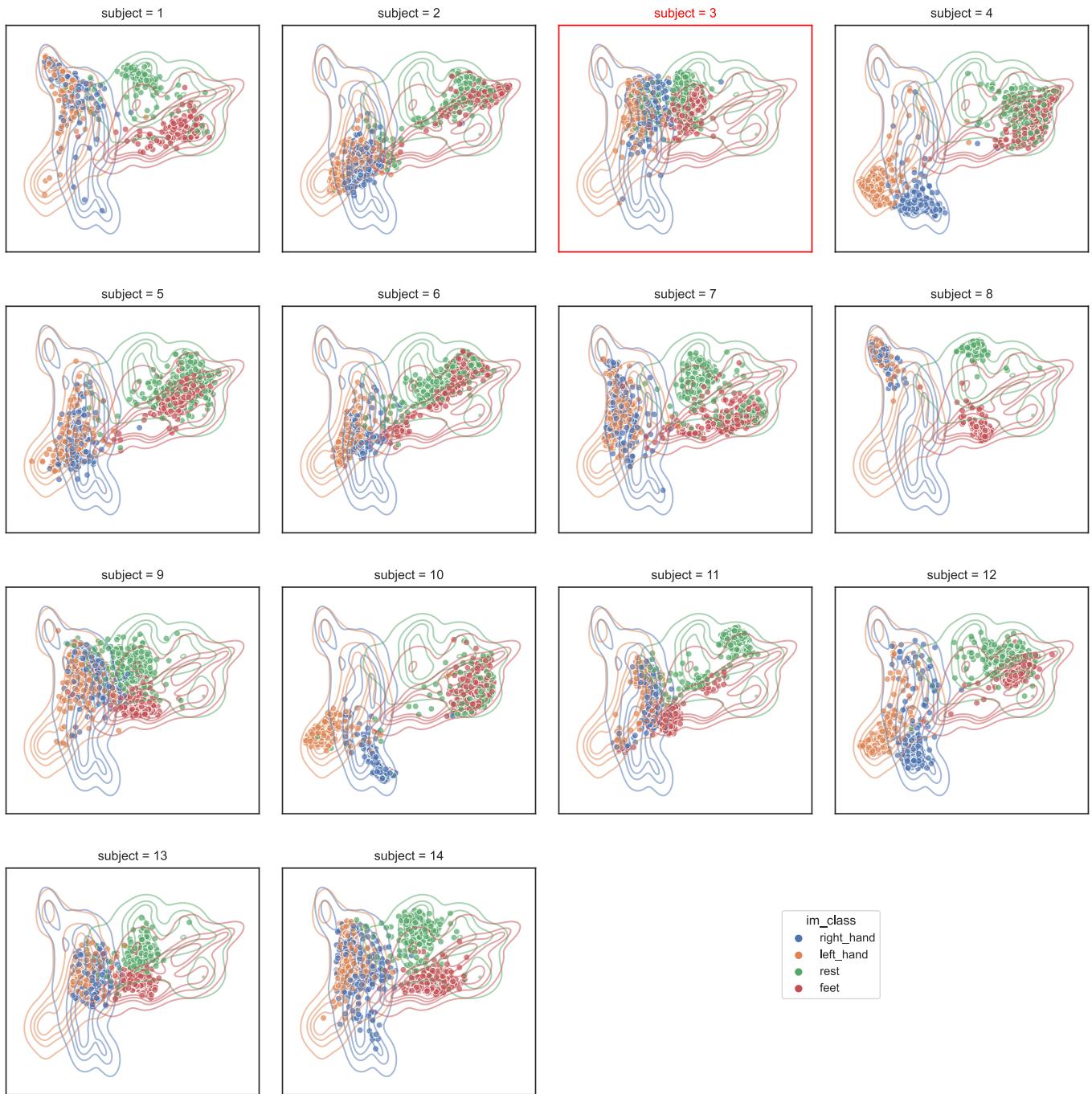


Fig. 7. Similar to Figure 2 except that it uses the embedding learned without subject 3 and that all the train subjects are represented.



Fig. 8. Similar to Figure 2 except that it uses the embedding learned without subject 4 and that all the train subjects are represented.



Fig. 9. Similar to Figure 2 except that it uses the embedding learned without subject 5 and that all the train subjects are represented.

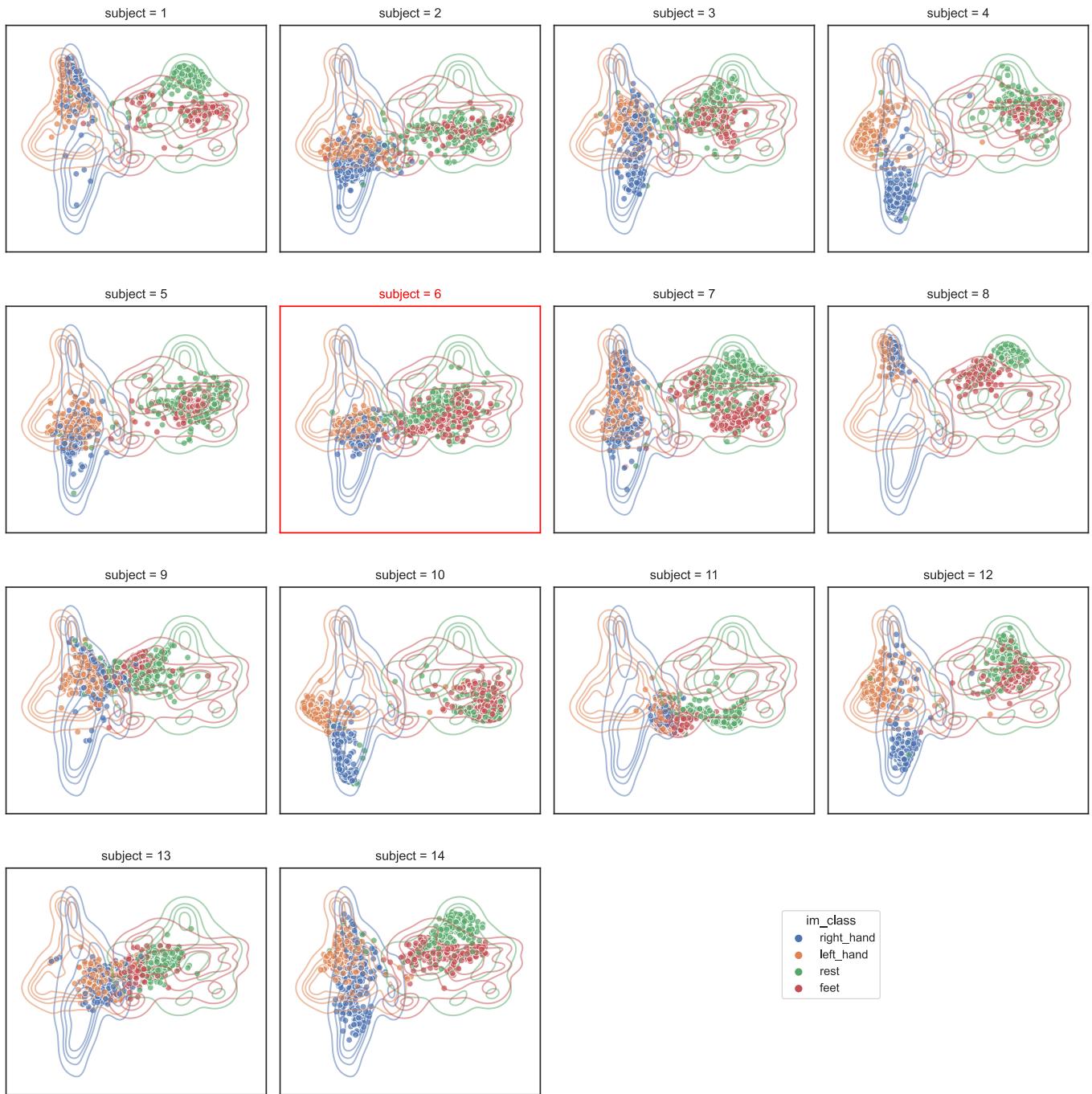


Fig. 10. Similar to Figure 2 except that it uses the embedding learned without subject 6 and that all the train subjects are represented.

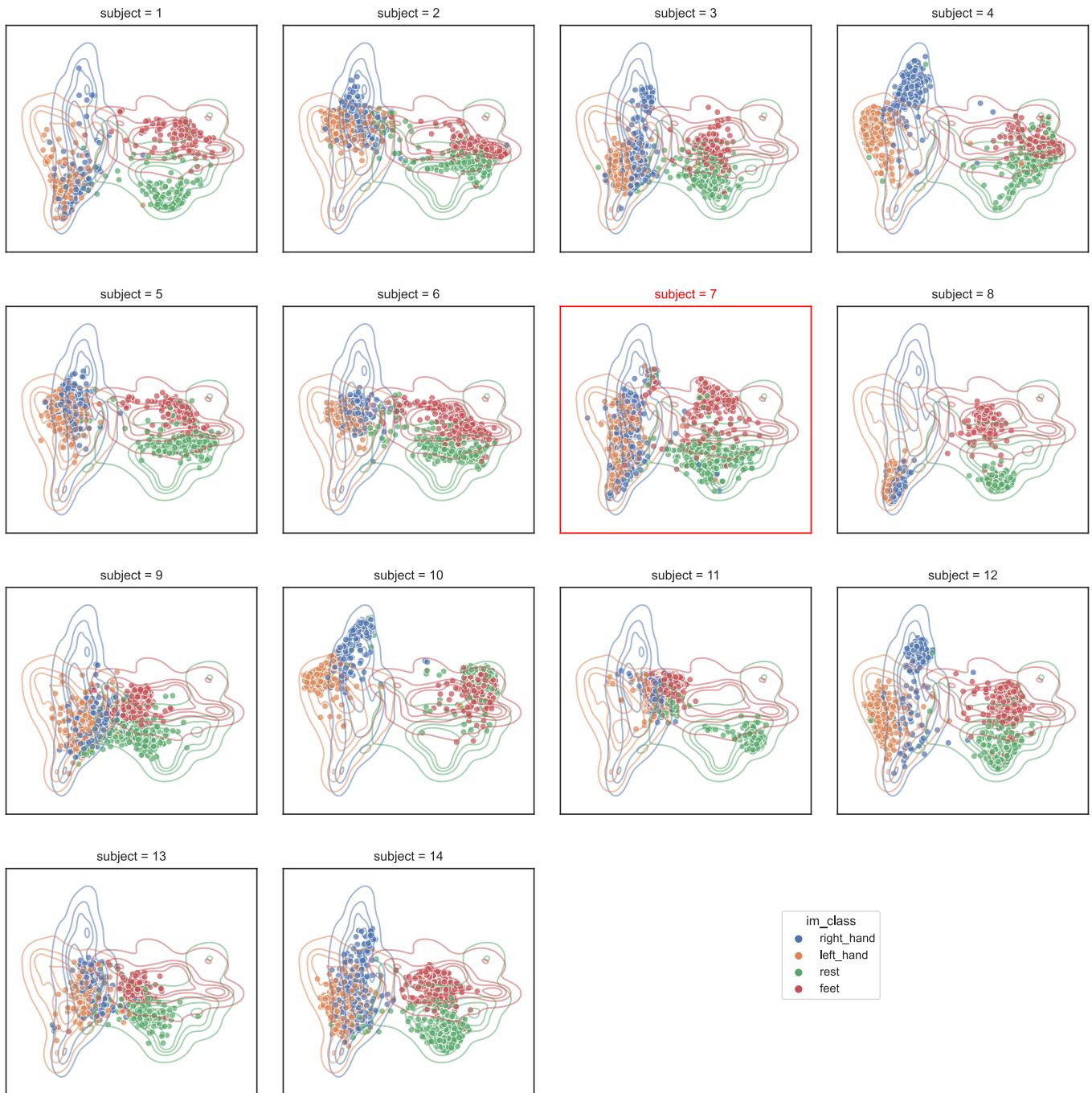


Fig. 11. Similar to Figure 2 except that it uses the embedding learned without subject 7 and that all the train subjects are represented.

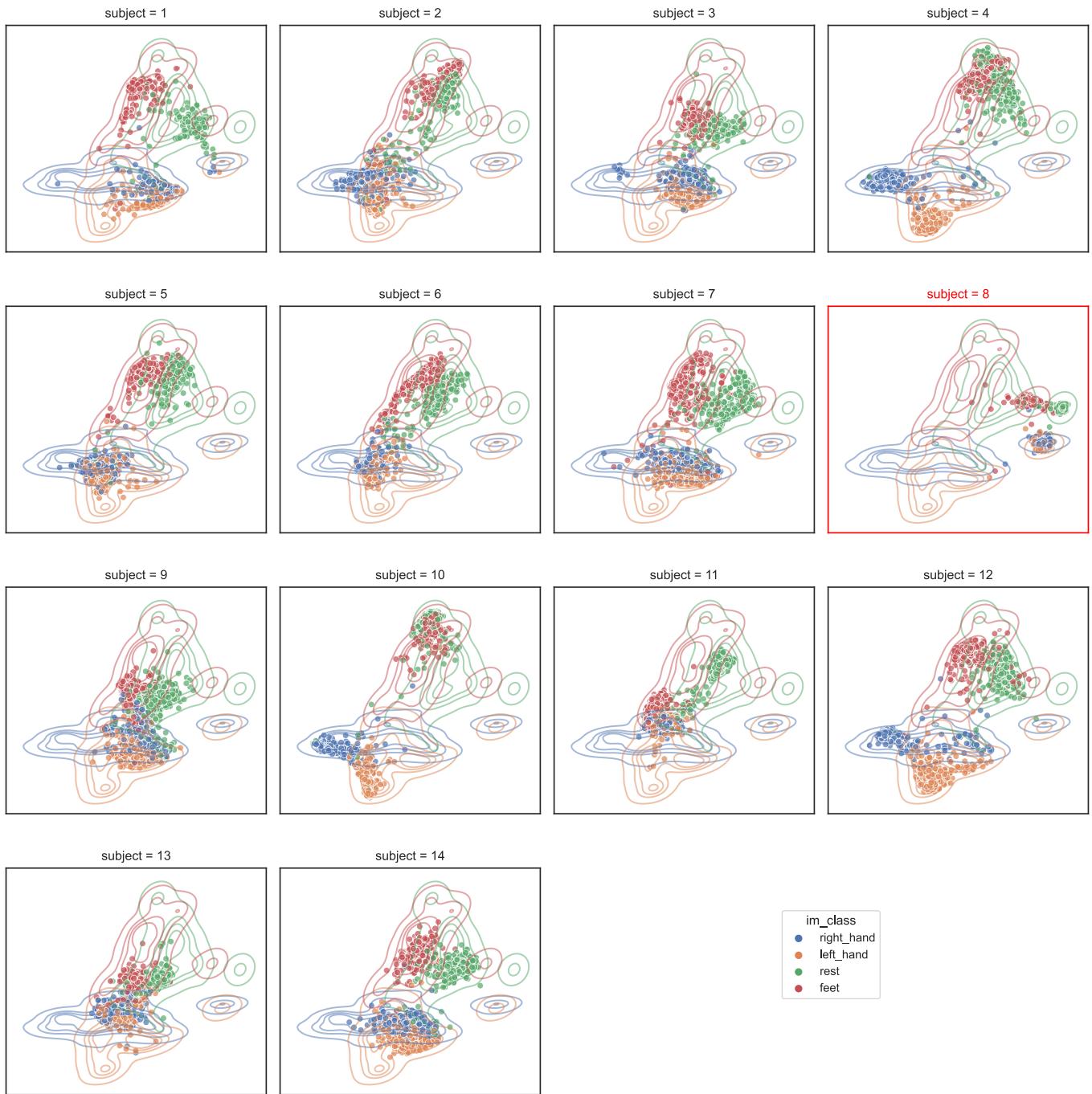


Fig. 12. Similar to Figure 2 except that it uses the embedding learned without subject 8 and that all the train subjects are represented.



Fig. 13. Similar to Figure 2 except that it uses the embedding learned without subject 9 and that all the train subjects are represented.

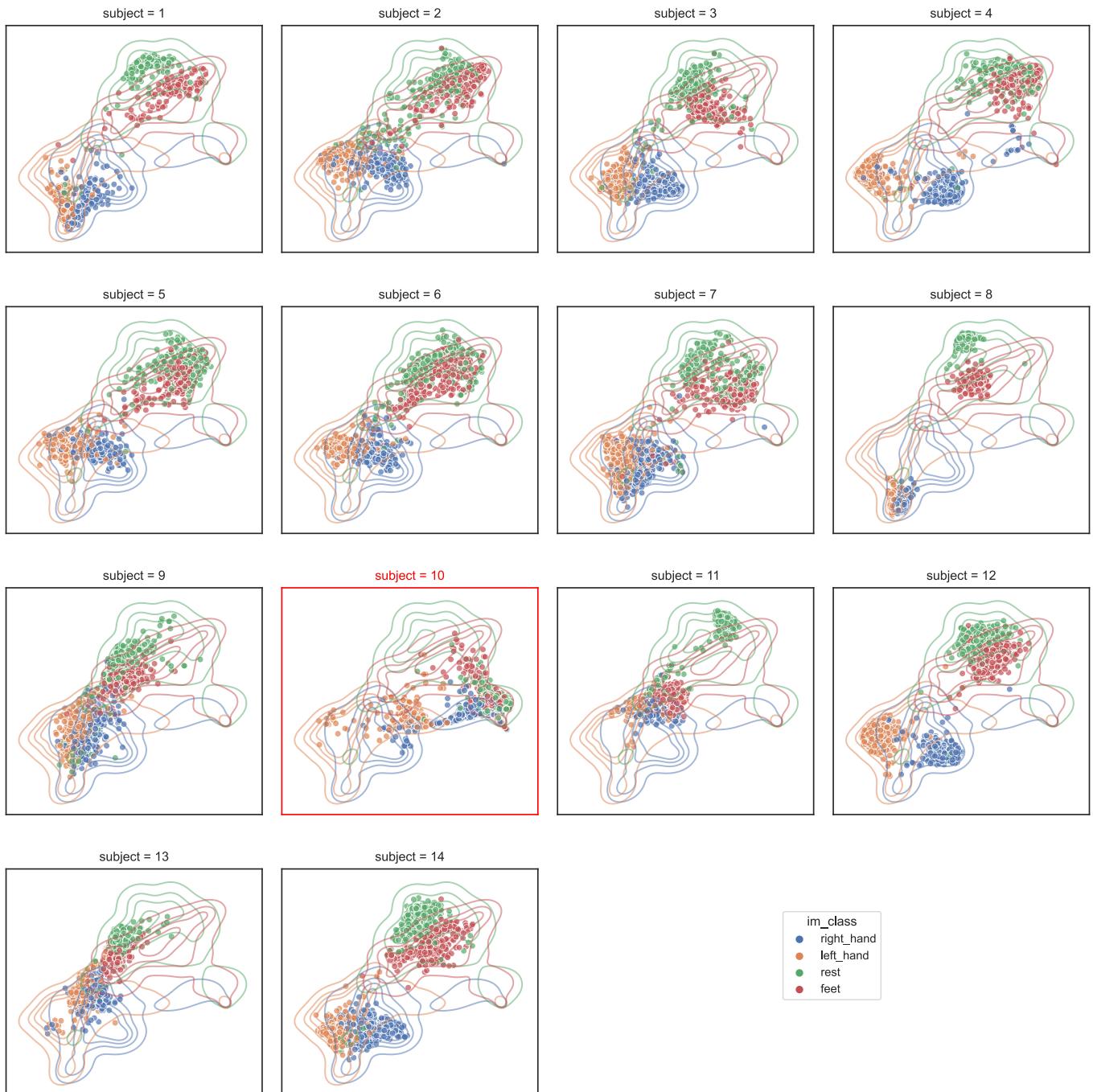


Fig. 14. Similar to Figure 2 except that it uses the embedding learned without subject 10 and that all the train subjects are represented.



Fig. 15. Similar to Figure 2 except that it uses the embedding learned without subject 11 and that all the train subjects are represented.

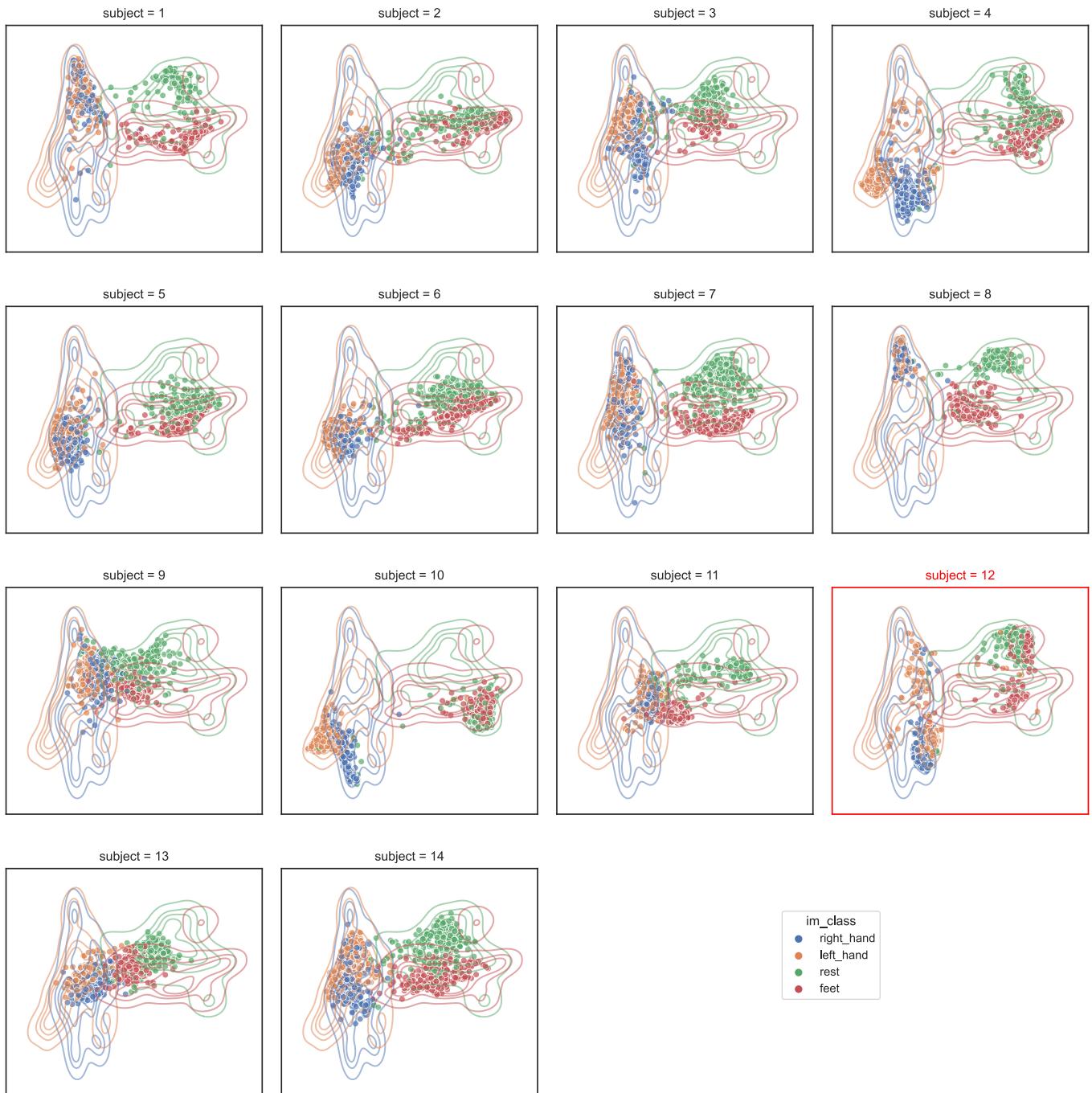


Fig. 16. Similar to Figure 2 except that it uses the embedding learned without subject 12 and that all the train subjects are represented.



Fig. 17. Similar to Figure 2 except that it uses the embedding learned without subject 13 and that all the train subjects are represented.



Fig. 18. Similar to Figure 2 except that it uses the embedding learned without subject 14 and that all the train subjects are represented.