

The table below displays results of different modality combinations. The results were obtained by training a Random Forest Classifier with 10 estimators (~2min time to train).

Features were extracted by using 50% of each class (subject) data to train the model and the rest was turned into embeddings. When using RF for classification we used a train_test_split of 80:20.

To improve results we can try out other models (XGB) and dimensionality reduction on embeddings (top 10 features by PCA) and redo.

Modality	Accuracy	F1	Model
Face	0.225	0.206	RF
Iris	0.738	0.703	RF
Fingerprint	0.688	0.665	RF
Face+Iris	0.996	0.957	RF
Face+Fingerprint	0.883	0.872	RF
Iris + Fingerprint	0.974	0.972	RF
All	0.979	0.978	RF

We see huge improvements when using combinations.

The combinations were made by taking 2 modalities and oversampling the one with less samples and then concatenating them.

The following table displays scores achieved on embeddings reduced to 100 components with RF with 50 estimators. Face kept 99% explained variance, iris 88 and fingerprints 89.

Modality	Accuracy	F1	Model
Face	0.361	0.316	RF
Iris	0.893	0.873	RF
Fingerprint	0.842	0.825	RF
Face+Iris	0.995	0.994	RF
Face+Fingerprint	0.951	0.942	RF
Iris + Fingerprint	0.995	0.993	RF
All	0.997	0.997	RF

To further test the robustness of this approach we could rerun the experiments with subsampled data, since the oversampling introduces some degree of overfitting.

The following table displays scores of subsampled original embeddings, again RF with 10 estimators.

Modality	Accuracy	F1	Model
Face	0.225	0.206	RF
Iris	0.738	0.703	RF
Fingerprint	0.688	0.665	RF
Face+Iris	0.810	0.768	RF
Face+Fingerprint	0.823	0.796	RF
Iris + Fingerprint	0.861	0.840	RF
All	0.865	0.834	RF

In this case the improvements are less extreme but still obvious, as every combination performs better than a single modality by a margin of about 10%.

The last table shows results of subsampling + PCA with 50 estimators:

Modality	Accuracy	F1	Model
Face	0.361	0.316	RF
Iris	0.893	0.873	RF
Fingerprint	0.842	0.825	RF
Face+Iris	0.950	0.937	RF
Face+Fingerprint	0.926	0.912	RF
Iris + Fingerprint	0.949	0.940	RF
All	0.975	0.968	RF