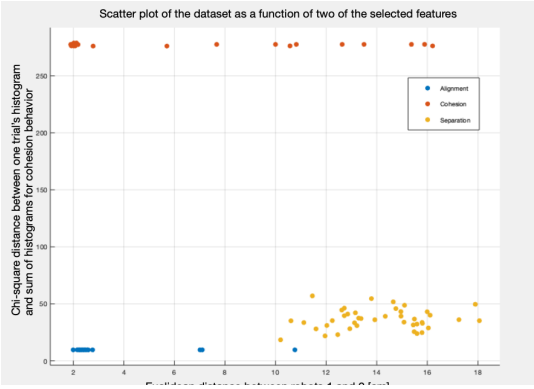
Spring Semester 2021 Research Project: Cellulo

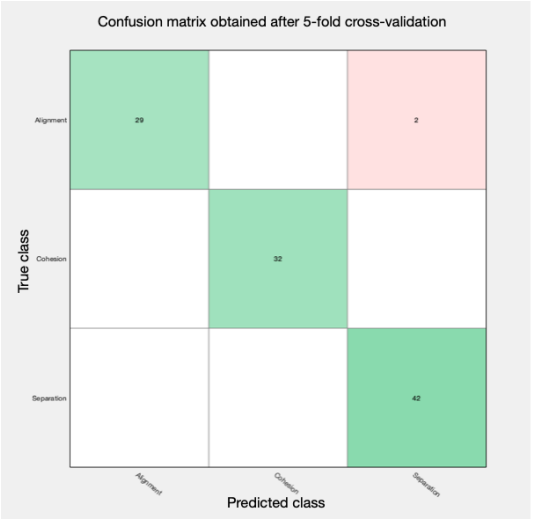
Teach Cellulos interaction rules

Lisa Mareschal
Supervisor: Hala Khodr, Barbara Bruno

MOTIVATION

The question motivating this project is: “Is it possible to tell the rules a robot is following by the way it moves?”. If yes, in the case that robot, rather than autonomous, is controlled by a human, this would mean that we are able to tell the types of rules (and thus have a glimpse on the type of mindset) that the person is following.





METHODS

To this end, 3 swarm behaviours were investigated: alignment, cohesion and separation. Their trajectories were investigated in order to identify and extract highly discriminant features and test their effectiveness towards classification.

Qualitative, statistical analysis and clustering techniques were used to explore the features’ relevance. Then, cross-validation was performed on 70\% of data and used both for tuning parameters and feature selection. Lastly, the model was tested on a random behaviour and on combinations of the three main rules.

RESULTS

Among the 32 extracted features, 10 were kept to achieve maximum accuracy with minimal computational cost. The feasibility and accuracy of such a framework was validated with an accuracy of 98.1% for cross validation and 100% when testing.

Composite behaviours were mostly classified as instances of the rules they are composed but random behaviour was not classified as unknown.

Retained features are: Euclidean, DTW, Frechet, mean velocity in x, STD of differences of acceleration, STD of acceleration in x, chisquare distance between trial and cohesion and separation’s reference histograms.

Link to the code repo and report:
https://c4science.ch/diffusion/11268/cellulo-interaction-trajectories-analysis.git