TORCS Racing –
Computational Intelligence

Agenda

- What Controllers were used?
- How we measured their Accuracy?
- What Fitness Function was used?
- What we did to improve performance?
- What is the final outcome?

Controllers

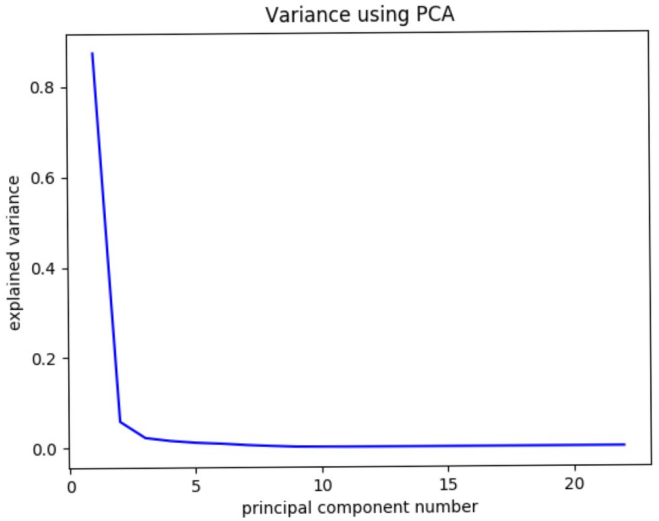
- Neural Networks
  - Recurrent Neural Network (Pyrenn) using RTRL
  - Echo State Network (Pyesn)
- Evolutionary Computing
  - NEAT and HyperNEAT
- Swarm Behaviour
  - Emergent Collective Behaviour

Accuracy Measure

- Neural Networks
  - 80% training and 20% spliting, measure of MSE after 100 generations
- Evolutionary Computing
  - Evolved a Recurrent NN from scratch
  - Fitness function = Maximum Distance Travelled
  - Constrain = Car should stay within track edge
  - Tested the network on 20% of test data to visualize the output
- Swarm Behaviour
  - No measure on accuracy, but only created an Emergent collective behaviour

Performance Improvement

- Feature Extraction
  - PCA
  - New features from Sensor 8,9 and 10



- Activation Functions
  - Tanh, Sigmoid, clamped and Sin
  - Sin performed the best for our network

Performance Improvement

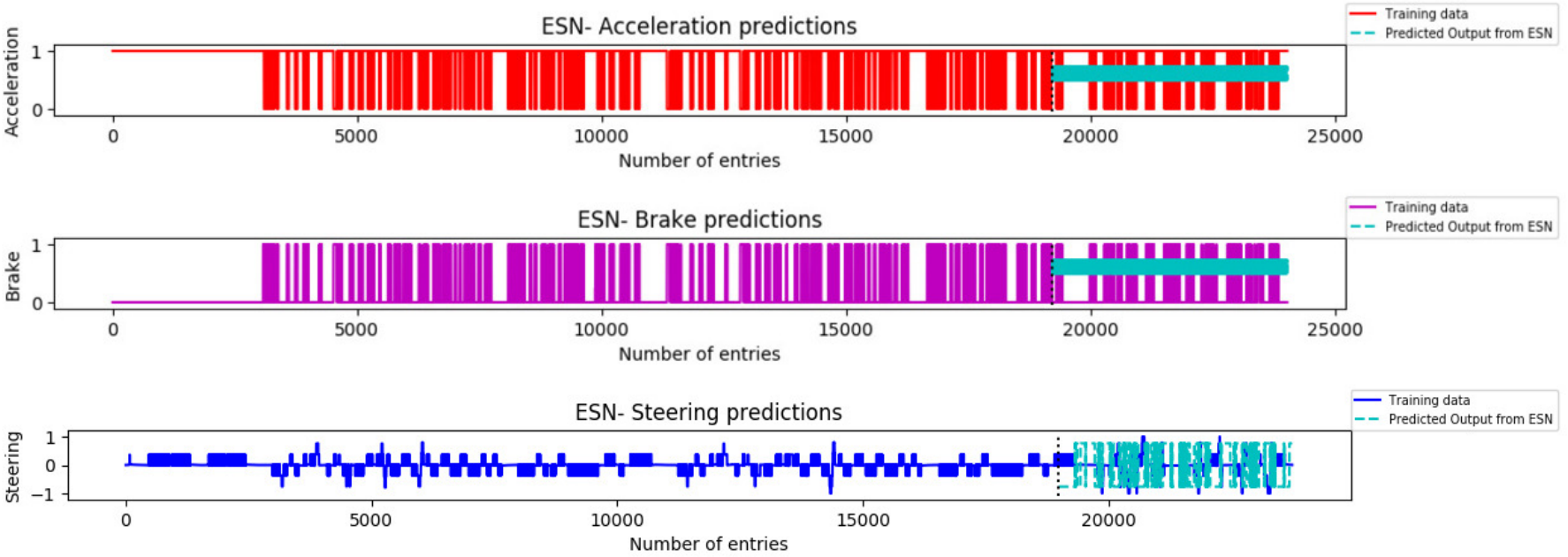
- Normalization of Inputs
  - Angle = Angle / ∏
  - Speed = (max(0, min(Speed, 200)) / 100) -1
  - D_center = max(min(D_center / 2, 1), -1)
  - D_Edge= ((D_Edge + 1)/100.5)-1

Fitness Function

- Constraint Opmimization problem
- Maximize the fitness function
  - Fitness = Distance travelled in a lap
  - Constrain = Stay within the track edges

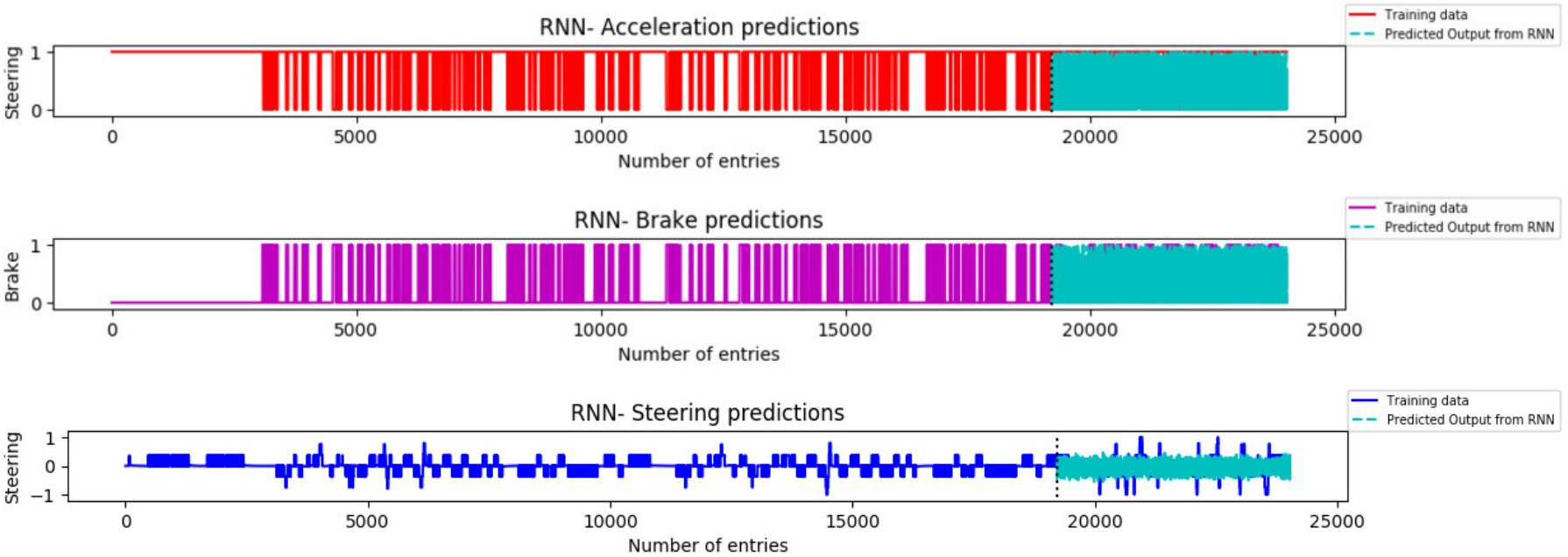
Results

- Predictions of ESN



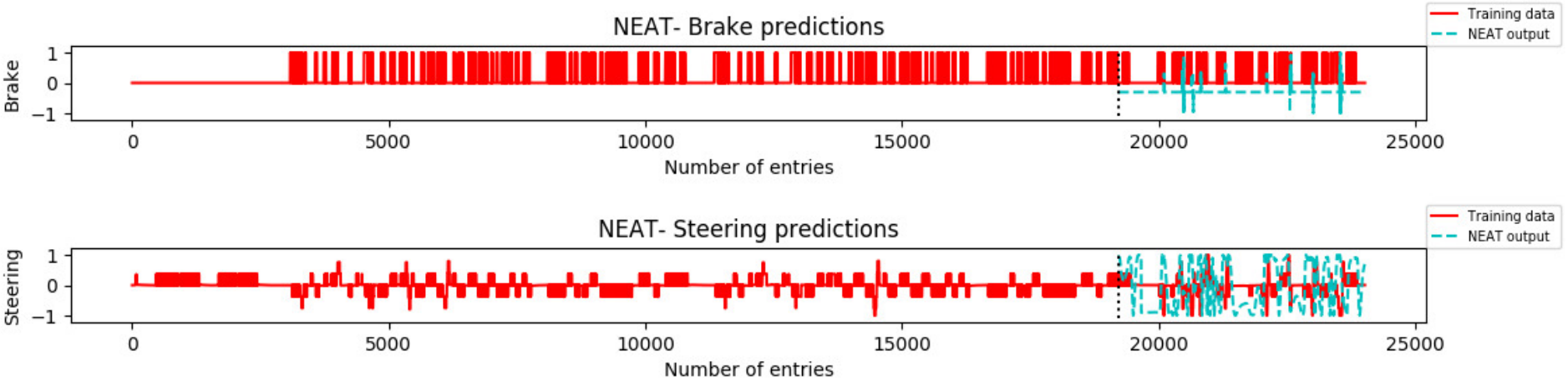
Results

- Predictions of RNN



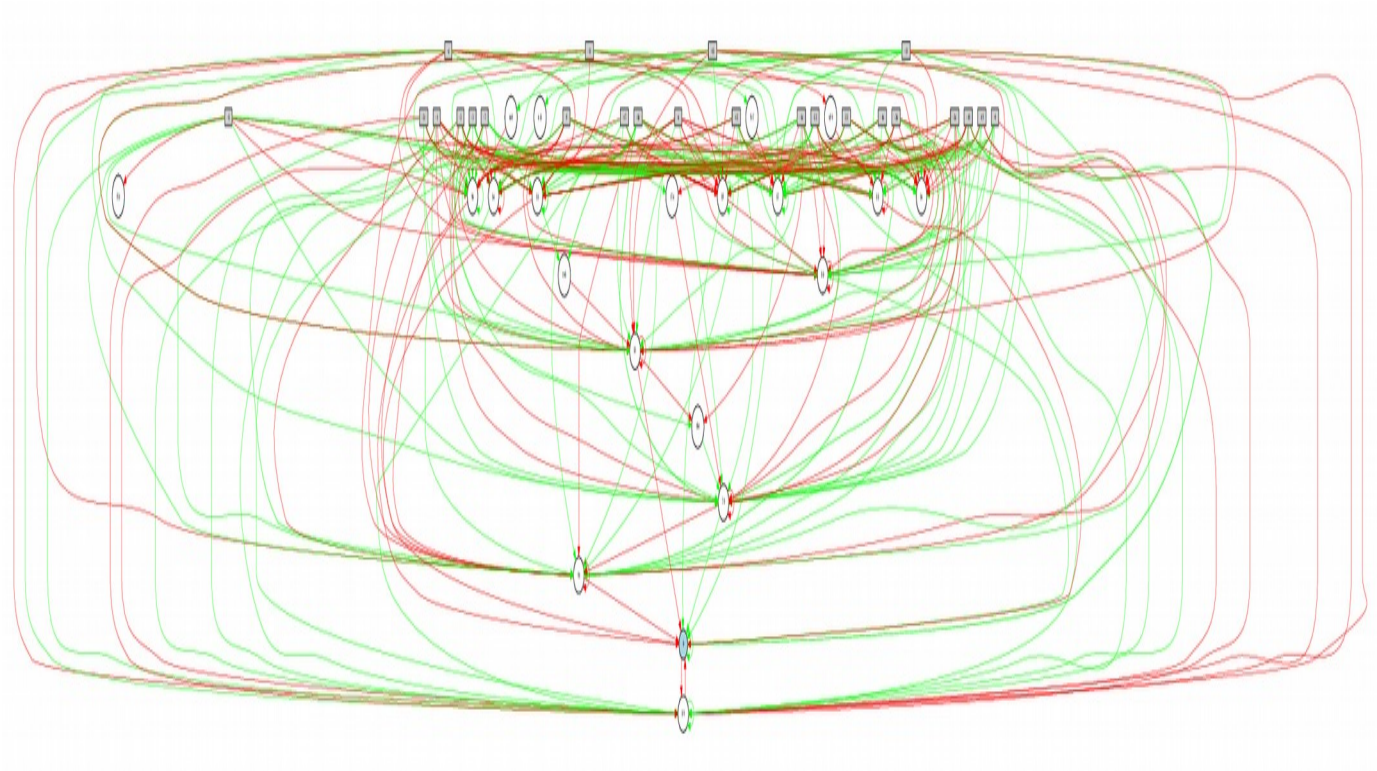
Results

- Predictions from NEAT



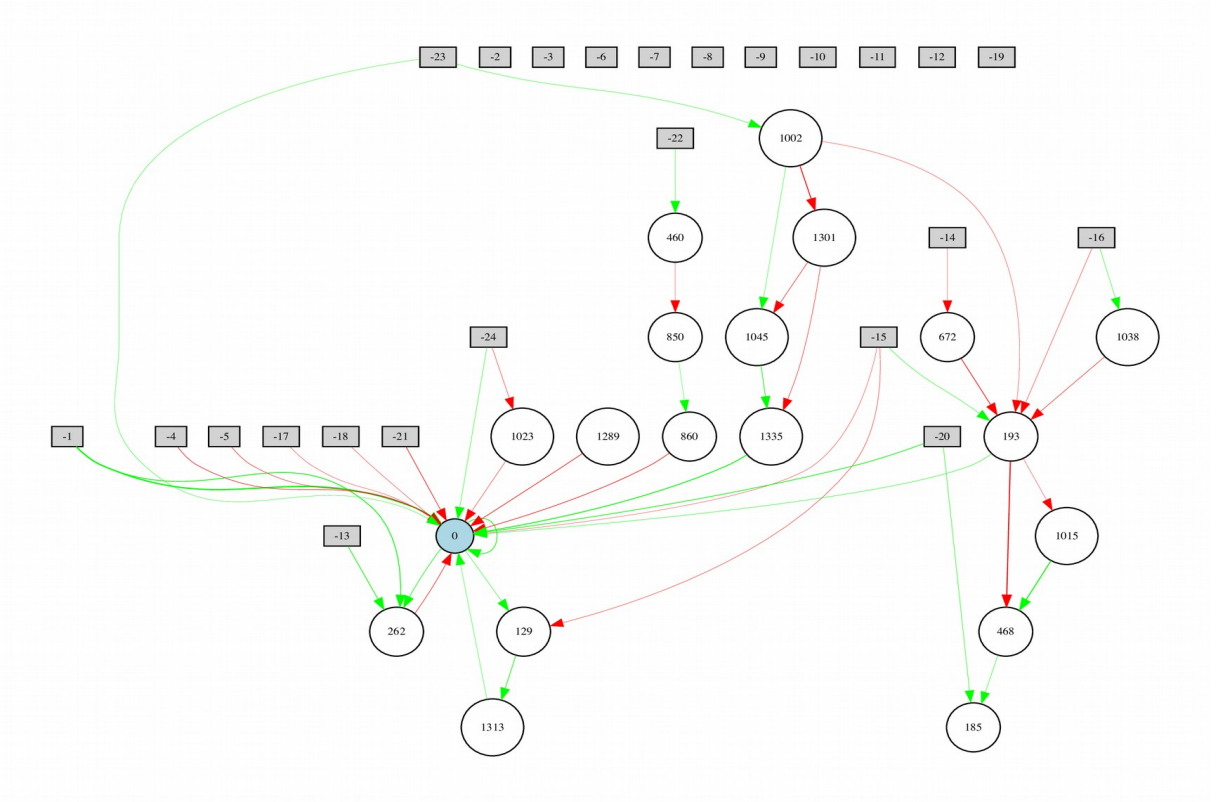
Results

- NEAT- Steering Topology



Results

- NEAT- Brake Topology



Results

Emergent Collective Behaviour