Neural Networks for Self Localisation

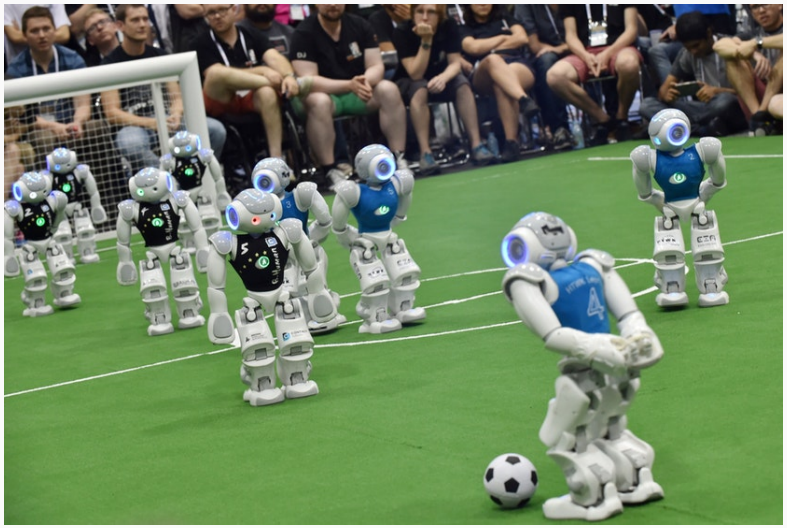
James Monks and Nathan Villalobos

Supervisor: Oliver Obst
Western Sydney University: 200045 Quantitative Project

RoboCup

History and Goals

- RoboCup is an international competition held yarly which simulates a match of football (soccer) using programmed robots
- Started in 1997 with the goal of propelling AI and robotics research forward
- To achieve this, the goal to beat the 2050 world cup football champions with robots was set
- Modelled on similar successful endevours, such as IBM beating the chess world champion

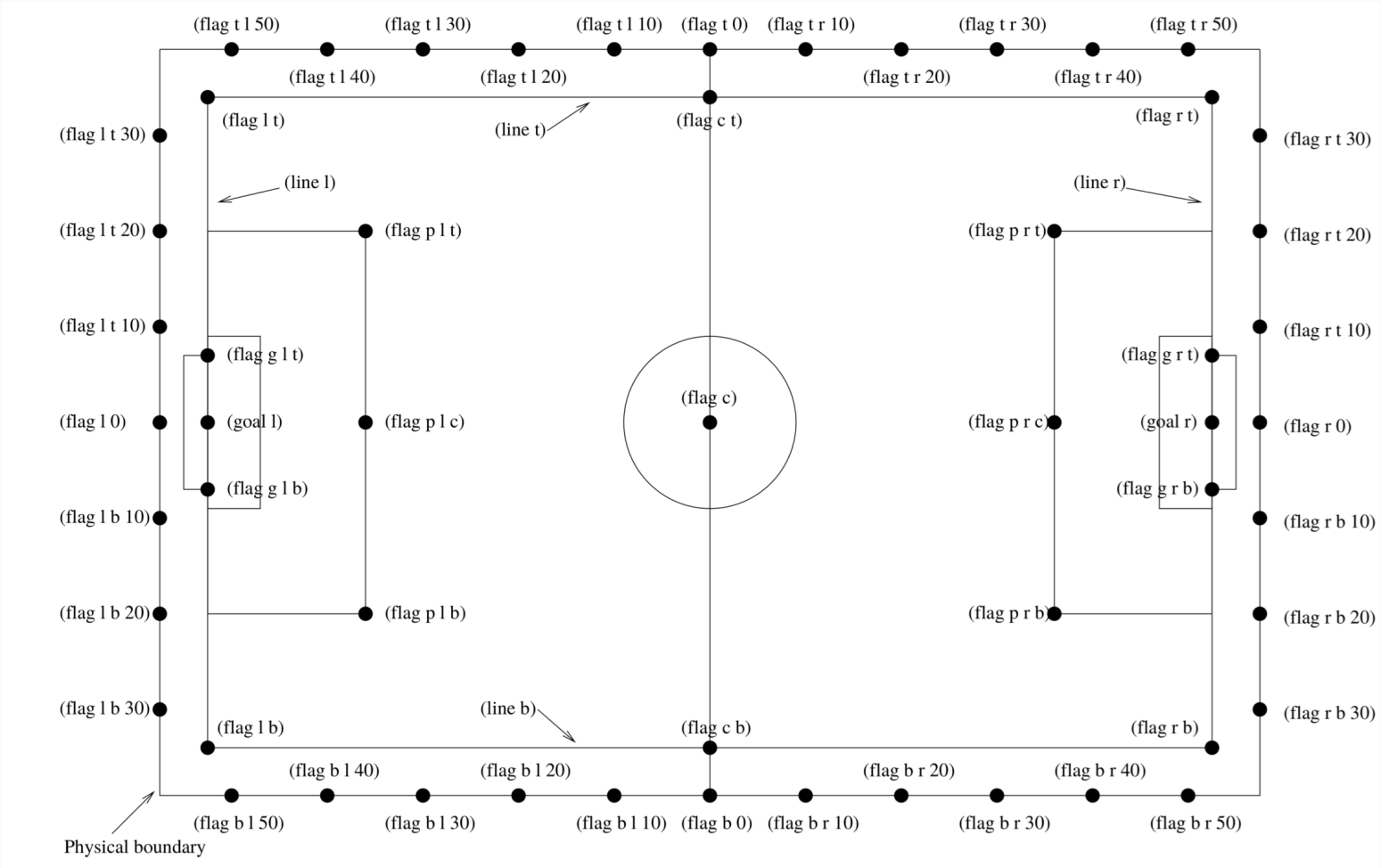


Leagues

- Robots
  - Humanoid
  - Standard Platform
  - Middle Size
  - Small Size

- Simulation
  - 2D
  - 3D

Simulation League



Data

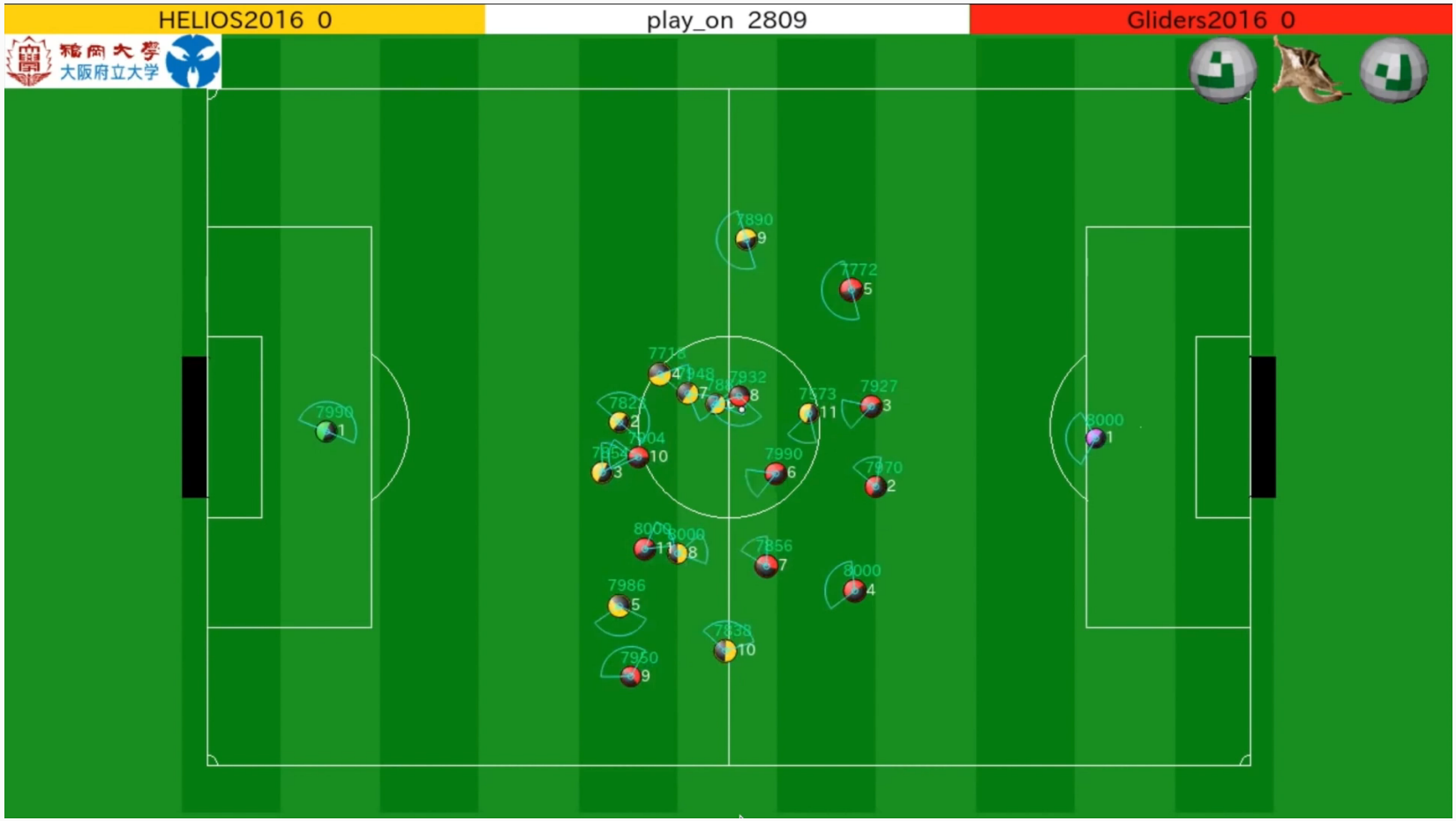
HELIOS Player 3 Landmarks

number_time	f_b_0_dist	f_b_0_angle	f_b_0_ddist	f_b_0_dangle	f_b_l_10_dist
2	50.4	-51	NaN	NaN	55.7
4	49.9	-49	NaN	NaN	55.1
6	48.9	-50	NaN	NaN	54.6
8	48.4	-52	NaN	NaN	53.5
10	47.9	-52	NaN	NaN	53.0
11	NaN	NaN	NaN	NaN	NaN
12	NaN	NaN	NaN	NaN	NaN
13	NaN	NaN	NaN	NaN	NaN
14	NaN	NaN	NaN	NaN	NaN
15	NaN	NaN	NaN	NaN	NaN

The Problem

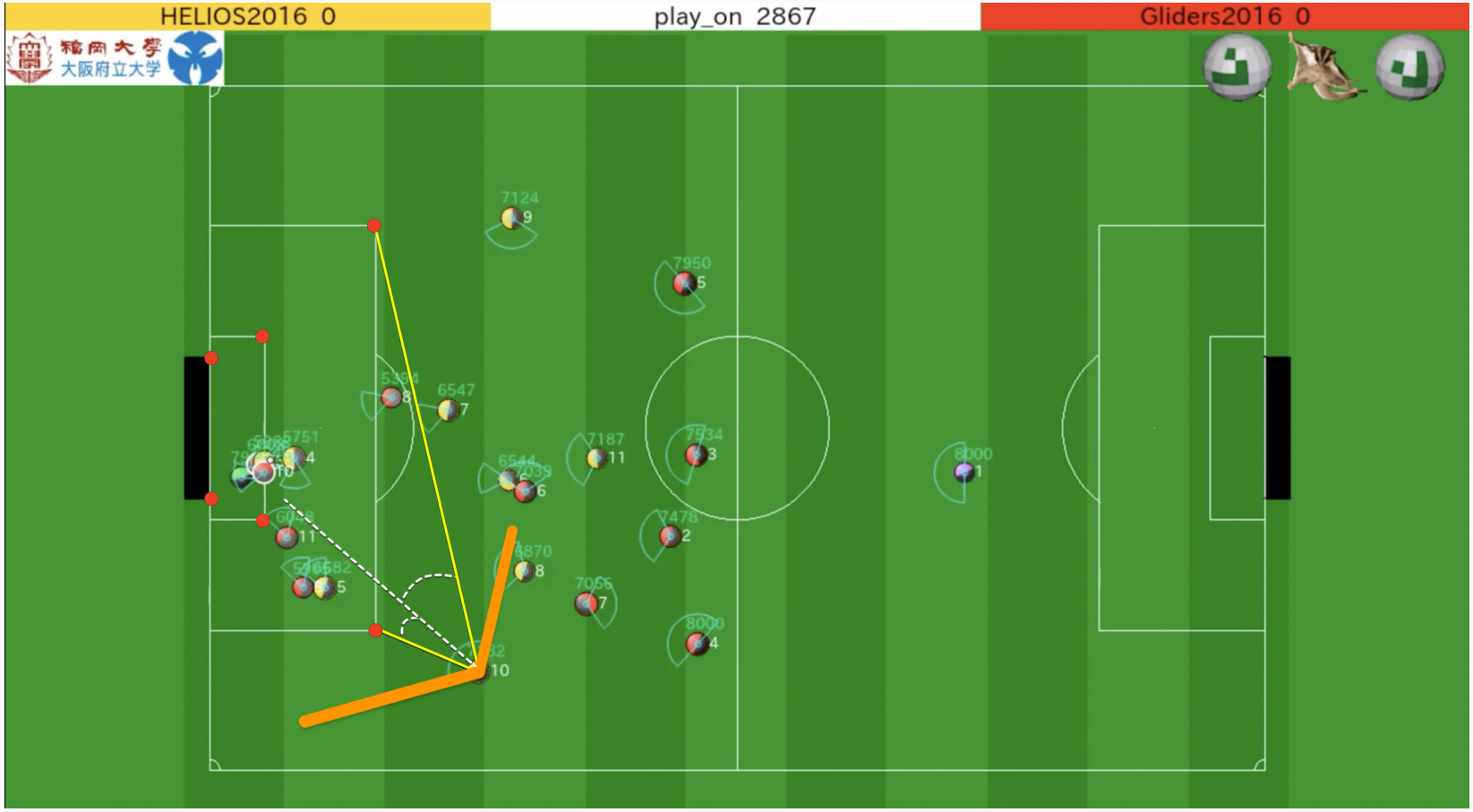
Self Localisation

Where are we?



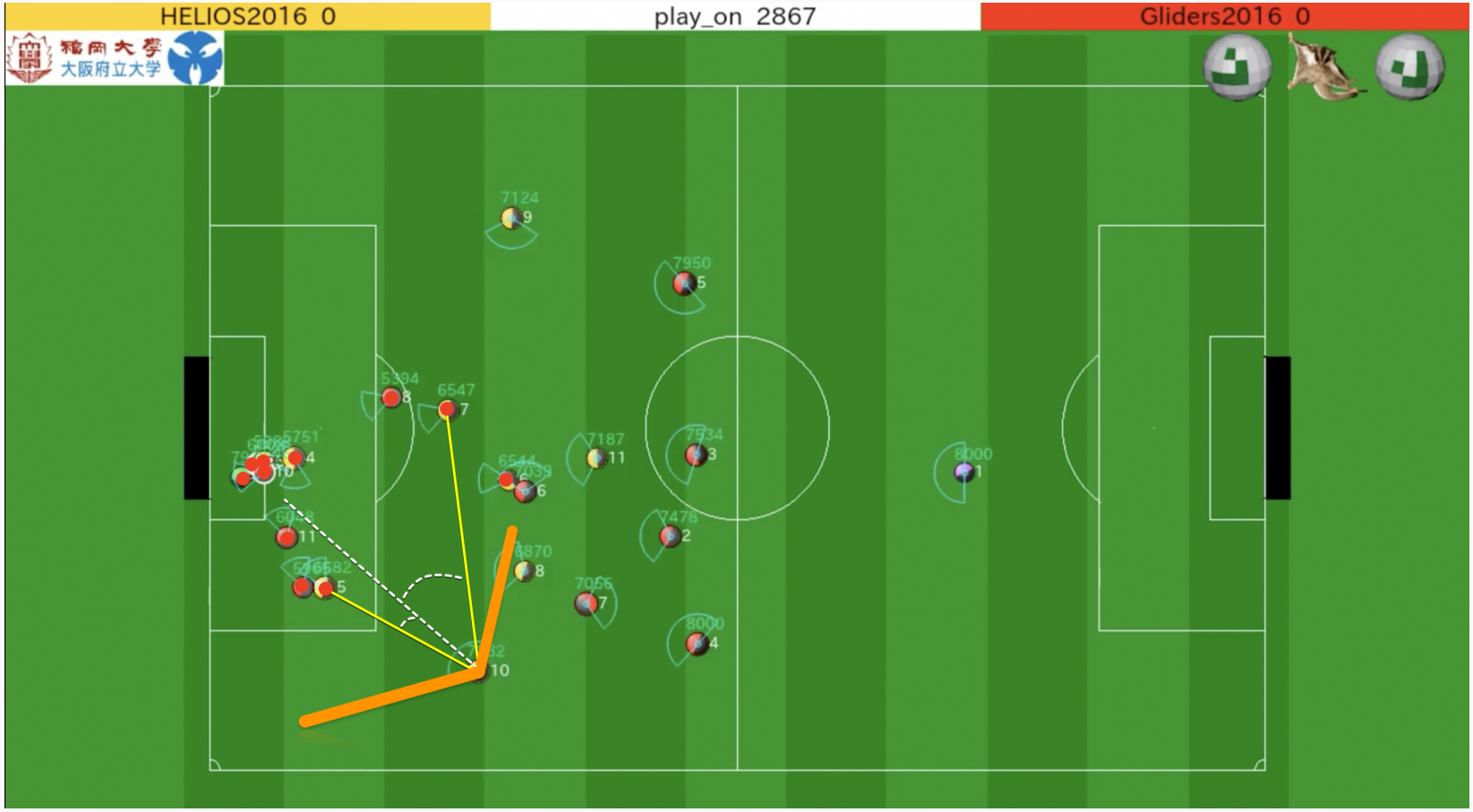
Self Localisation

Where are we?



Position of Other Players

Where is everyone else?



Mathematical Localisation

Mathematical Localisation

Trigonometry

If we have the distances between the player and the landmarks, along with the angles between the landmarks relative to the player, **Sine Rule** and **Cosine Rule** can be used to get all of the dimensions of triangle formed.

Vector algebra

Using the rotation matrix:

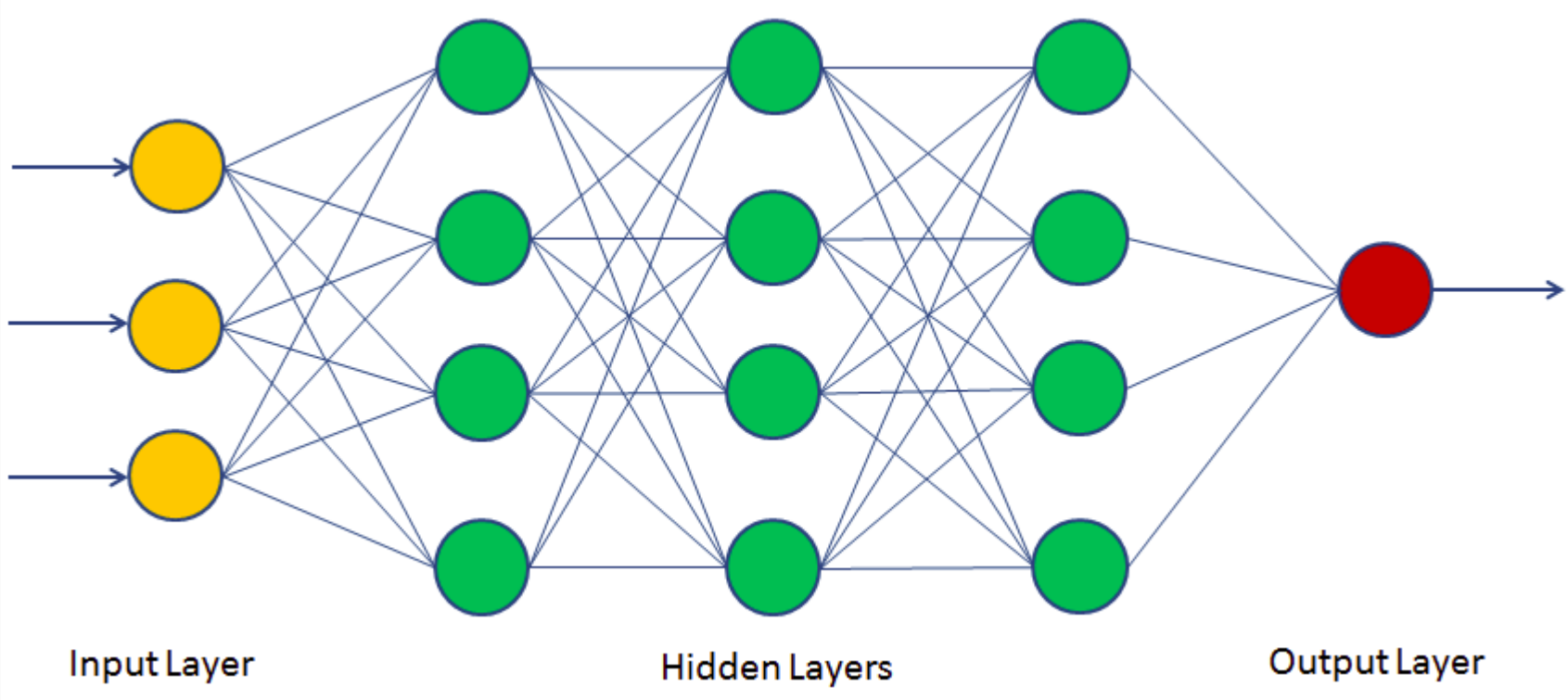
$$M = \begin{pmatrix} cos(\theta) & -sin(\theta) \\ sin(\theta) & cos(\theta) \end{pmatrix}$$

The bearing of the player from a flag can be found.

Mathematical Localisation

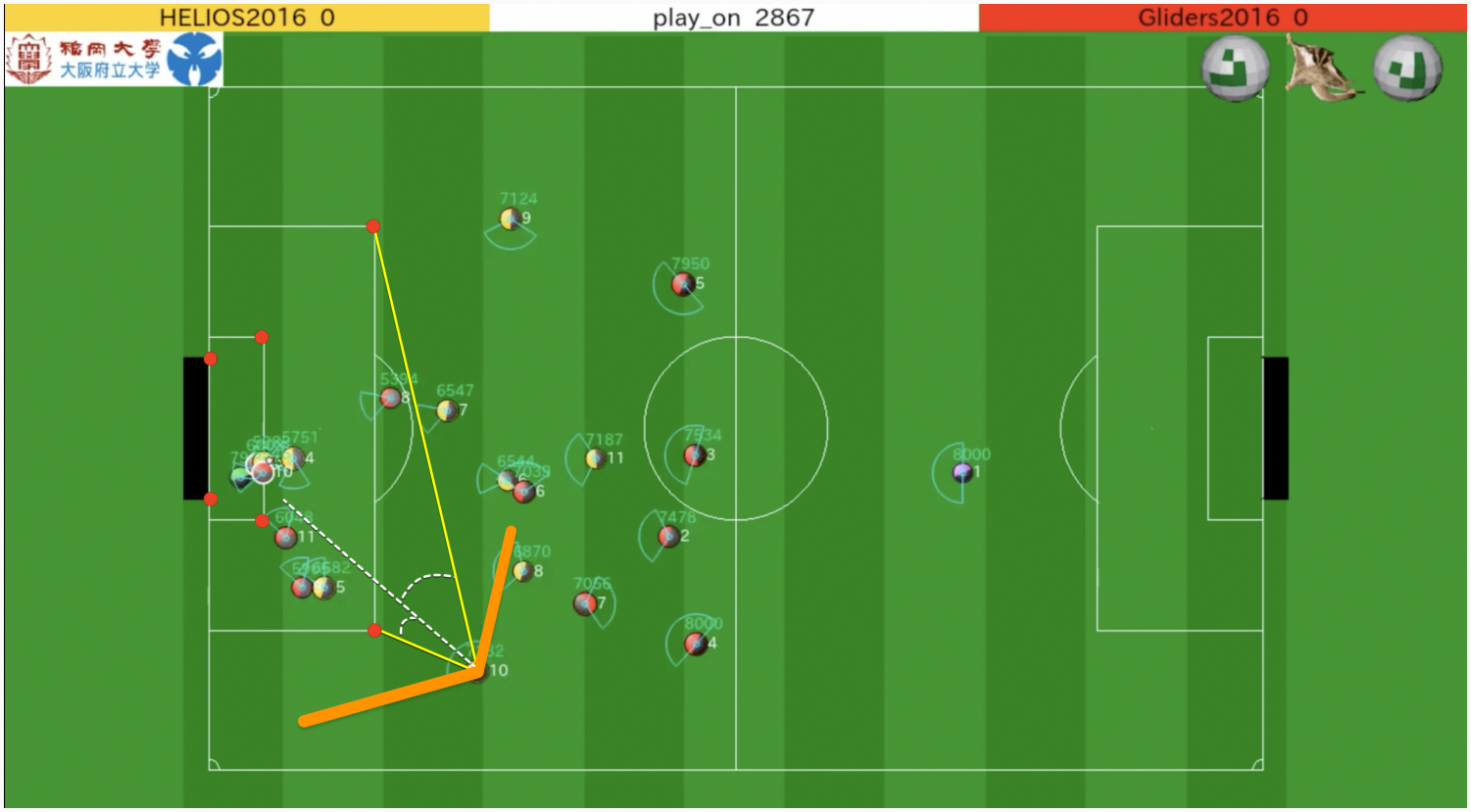
Neural Network Approaches

Neural Networks



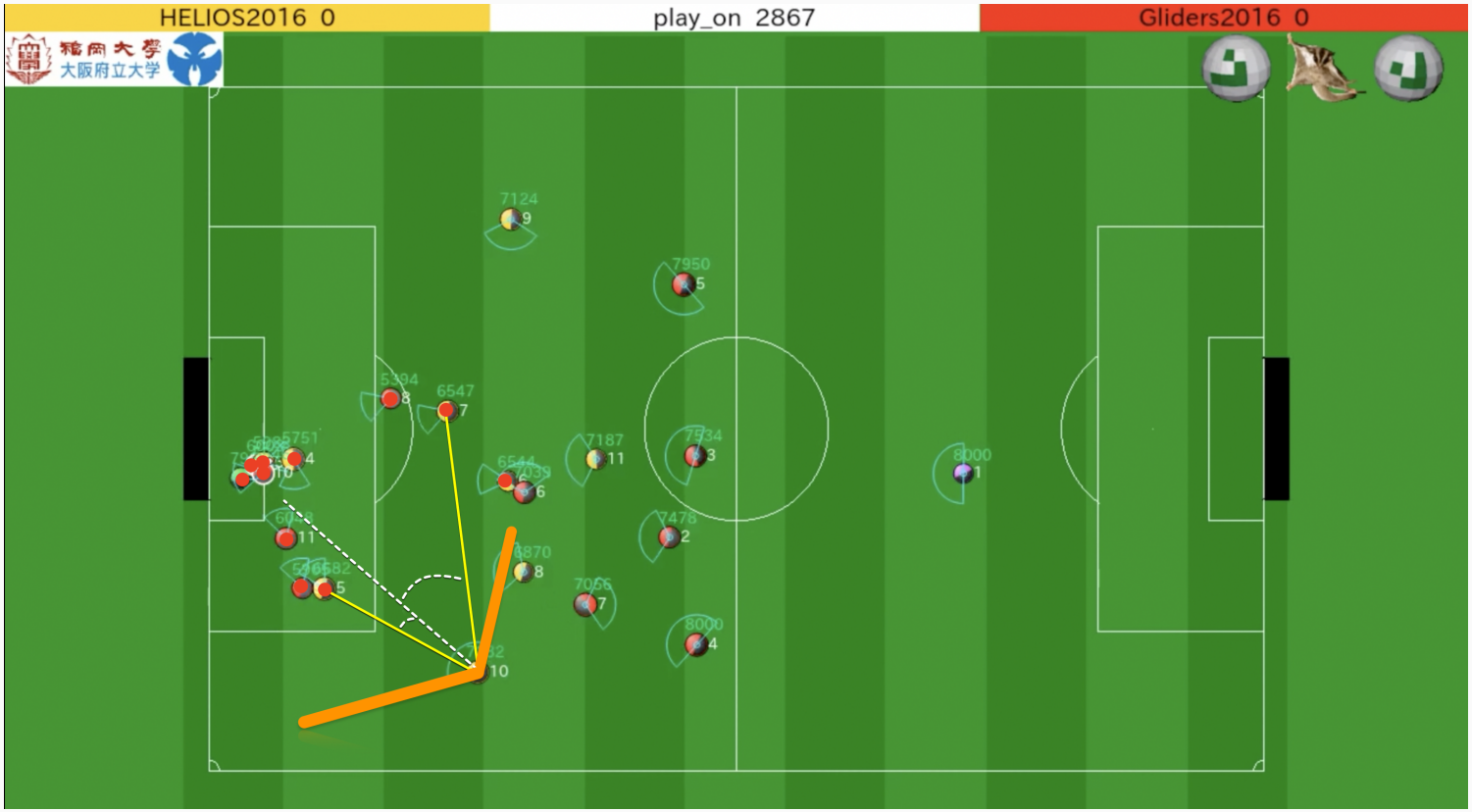
Neural Networks for Localisation

- Decrease error through taking into account error differences
- Taking into account previous values in order to predict the current value



Neural Networks for Positioning

- Track player movement and learn programmed patterns
- Predict for un-observed players



Questions?