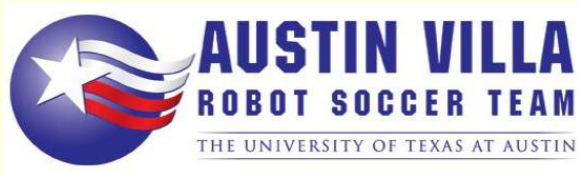


# UT Austin Villa: A Machine Learning Approach for Kicking and Passing

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## Topics

- How to approach and kick the ball to different targets
- Where to kick the ball
- When to kick the ball
- How to have teammates move to receive a pass

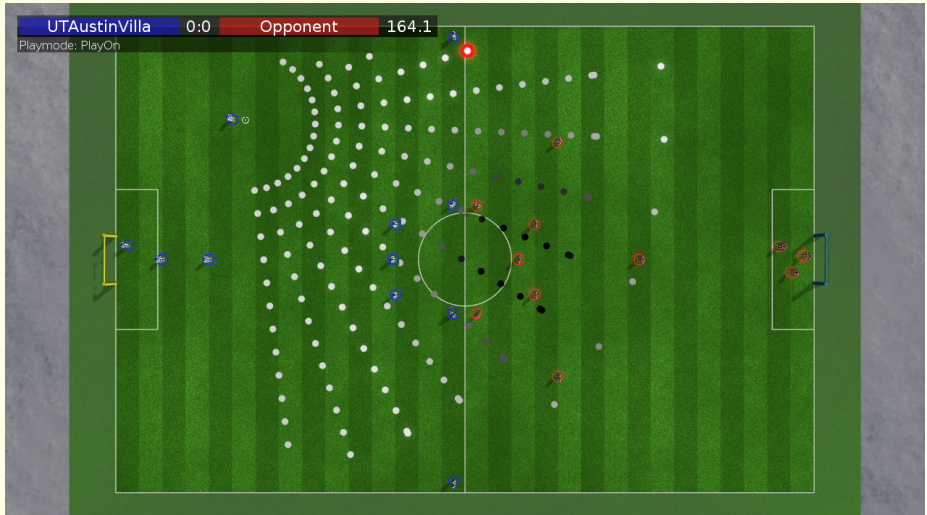
## How to approach and kick the ball to different targets



# Video

- **Optimize** parameters using **CMA-ES**
- **Independently learn** walk for approaching/stopping next to ball and for kicking the ball from a fixed position
- Relearn a subset or **overlap** of parameters for the walk approach and kick skills through an **overlapping layered learning** approach to combine them
- Learn kicks for **different distances**

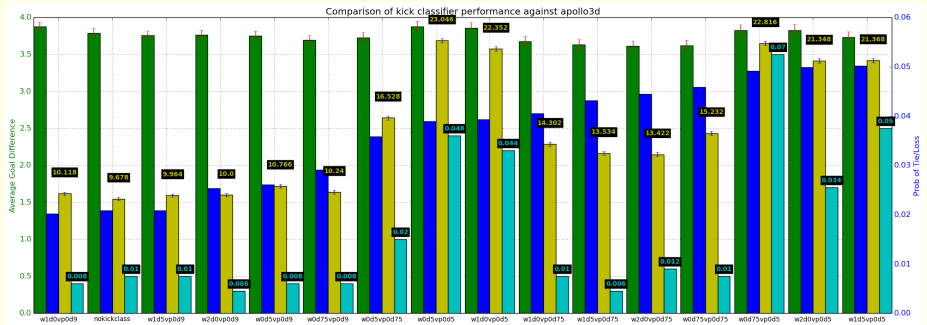
# Where to kick the ball



Kick locations with lighter circles having a higher score. Selected location shown in red.

- Evaluate possible kick locations and select highest value location
  - ▶ - opponents close
  - ▶ + teammates close
  - ▶ + moves ball closer to opponent's goal

# When to kick the ball



- Train logistic regression classifier to predict probability of success
- Use 35 different features including:
  - ▶ Angle and distance to ball
  - ▶ Nearest opponents' angles, distances, orientations, and velocities relative to ball
- Sample probability thresholds and play 100s of games to evaluate
  - ▶ Average goal differential
  - ▶ Number of kicks
  - ▶ Goals against
  - ▶ Probability of tie/loss

How to have teammates move to receive a pass



# Video

purple path of ball, magenta avoid path, light blue anticipated positions

- **Kick anticipation** where players move to projected destination of the ball after the kick
- **SCRAM role assignment** selects players to move to receive pass
- Teammates **avoid path of ball** right before it is kicked



# Video

Keepaway team in yellow maintains possession for over two minutes against 2014 champion UT Austin Villa released binary in orange

## Related Publications

- P. MacAlpine, M. Depinet, and P. Stone. "UT Austin Villa 2014: RoboCup 3D Simulation League Champion via Overlapping Layered Learning," in Proceedings of the Twenty-Ninth AAAI Conference on Artificial Intelligence (AAAI), January 2015.
  
- P. MacAlpine, E. Price, and P. Stone. "SCRAM: Scaleable Collision-avoiding Role Assignment with Minimal-makespan for Formational Positioning," in Proceedings of the Twenty-Ninth AAAI Conference on Artificial Intelligence (AAAI), January 2015.