Understanding and Applying the Offside Rule: An Empirical Modelling Approach

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Abstract

This paper will discuss the use of Empirical Modelling in demonstrating and explaining the offside rule within the game of football. A model is created using a modelling approach based on the principles behind Empirical Modelling and related software and tools. This model will be used to help summarise and explain the offside rule as well as helping to teach people when the rule applies and when it does not. The model will provide a means of investigating the different outcomes given different rules and situations. The experimental approach this model uses offers the option that it could be used within the area of Educational Technology, as it helps the user build up an understanding of the offside rule by explaining each sub-rule, building up to complete understanding of the rule. The paper goes onto evaluate the model and the overall approach, as well as assessing the suitability of current Empirical Modelling tools for the topic.

1 Introduction

For many years the offside rule has caused discussion, controversy, arguments and even heartbreak in the game of football. Every football fan has witnessed their favourite team being given a decision they have felt is wrong and spent many hours arguing why they think they are right, often through the use of condiment containers. However often people don't fully understand the offside rule, and in some cases don't even understand the basic sections of the rule.

The offside rule is one of the shortest of the 17 football laws, but is perceived to be one of the most complicated and controversial.[1] This is due to a number of different factors having to be considered all at once, where a change in one player on the pitch can change the whole status of the game.

The rule is divided up into various subsections. Each subsection plays a large part in the decision of penalising an offside offence. Using the idea of dependencies within Empirical Modelling a model was created that allowed the many different factors of the offside rule be linked together to enable a correct decision to be made. The model also allows the rules to be explained visually enabling people to better understand the rule as they can see how each player is affected by another players movements.

2 The Offside Rule

The offside rule is made up of three main subsections; a player's position related to other players, a player's position related to the ball and whether a player is active or passive. All of these different subsections must be monitored to decide if a player is offside or onside.

2.1 Player's position

A player is considered to be in an offside position if he is closer to the opponents goal than the second last opponent. However this is only true if the player is in the opponent's half. A

[1] FIFA 2010, Laws of the Game

player cannot be in an offside position if he is within his own half, even if he is closer to the opponent's goal than the second last opponent.

2.2 Ball's position

A player cannot be considered in an offside position if he is level or behind the ball, even if he is in violation of the first subsection of the rule. A player cannot be considered offside if the ball is off the pitch for a throw-in or corner kick, and neither can a player be offside from a goal kick.

2.3 Active player

If a player violates the two previous subsections they are only considered offside if they are active in the current play. A player is considered active if he gains an advantage from being in an offside position, interferes with the opposition while being in an offside position or interferes with play.[2] If a player is not considered active then they will not be penalised for being offside.

2.4 Suitability for Empirical Modelling

The offside problem would strongly benefit from an Empirical Modelling solution. Empirical Modelling is well suited to modelling changing variables, such as player position, as well as allowing easy human interaction with the model. Empirical Modelling's ability to create observables and dependencies allows the model to be an open-ended exploratory environment, where a change in one variable affects the other variables in the model's world. This is different to conventional programming ideas that have constraints which express persistent relationships in a closed world, where changes to these variables only affect the ones they are related to and not the world as a whole.

Empirical Modelling is based on the idea of construals that are used to describe artefacts that embody the modeller's understanding of the situation.[3] This concept enables the situation to be intuitive to all users who look at it i.e. The fact that the box on the screen is coloured green and has the familiar markings of a football field creates a construal that allows the user to infer that this area represents a football pitch. The use of construals means that the user knows how the world works as they know that objects have properties similar to what they would expect, for example, the user can infer that because the green area is a football pitch the pitch markings aren't going to move around as they are fixed, as in reality.

3 Modelling the Offside Rule

As we have seen in previous sections the offside rule has a number of characteristics that fit the concept of Empirical Modelling well. Through the use of construals, observables and dependencies a user can infer the current state of the play. This allows the user to know exactly what is happening on the pitch when any variable, player position etc., is changed.

3.1 Construals

As mentioned when discussing Empirical Modelling suitability for modelling the offside rule, construals help a user infer the state of the environment and the different objects within this environment.

Construals enable the user to understand how different elements of the environment behave, for example, the attacking players are coloured red and start positioned nearer the half way line. This allows the user to infer that

[2] FIFA 2010, Law 11: Offside

[3] Beynon 2006, A Glossary for Empirical Modelling

these players are not on the same team as the defending players who are coloured blue. This use of construals means that the user can automatically associate properties that they know are true for this environment and the objects within the environment, for example, they understand that a player will not suddenly explode if they are moved.

3.2 Observables & Dependencies

An observable is a feature of the situation or domain that we are modelling to which we can attach an identity.[4] The environment is made up of many observables, playing an important part in creating the environment construal, each being assigned a certain value or status. Relationships are created between various observables within the model, known as dependencies. These dependencies mean that changes to certain observables can cause other observables to change, for example, moving the second last defender will result in the offside line changing position. By introducing these dependencies into the model the whole environment can react appropriately to any change in one observable, unlike conventional programming constraints. An example of this is if a player moves into an offside position, a number of different observables must change. Firstly a offside flag appears to show where the offense occurred and the message is changed on the screen to explain the reason the player is offside.

3.3 Agents

Another concept within Empirical Modelling is that of agents. Agents are perceived to be entities that are capable of initiating state change. In the offside model there are three groups of agents; attacking players without the ball, the ball carrier and the defending players. Each of these agents can initiate a state change by being moved to a different location on the pitch. The notion of agency within the model evolved with the construal, with the initial model only the attacking players were modelled with a fixed offside line.

3.4 Using the model

The model is used by clicking various players on the pitch and clicking again elsewhere to reposition them. If the new positioning of the players is resulting in a player being in an offside position the model's state has changed and the user will be alerted to this and the reasoning behind the state change explained, i.e. why the player was offside. This makes the model useful when re-watching match footage to determine if a decision was correct or not.

Players can be manoeuvred to mimic that of the match and the changes in the model's observables will determine if the current state is offside or onside. This enables snapshots of games to be carefully modelled and decisions to be accurately verified; a luxury that is unfortunately not possible during the fast paced game of football.

3.5 Potential use as a teaching tool

As discussed in previous sections this model also has applications in helping people understand the offside rule and its various sub-rules. By describing the reason for a player being given offside, based on the current values on observables, a user can understand why the decision has been made. This model could be further extended as a teaching tool and these extensions are discussed in section 5.3.

3.6 Assumptions within the model

Some assumptions were made when creating the model. The first is that at the time an offside decision is made the ball carrier is about

[4] Beynon 2006, A Glossary for Empirical Modelling

to kick the ball, as a player can only be penalised for being offside if they are involved in the play i.e. the ball is being passed to them. If the ball carrier wasn't passing at this time further player movements may occur and the decision may therefore be incorrect.

The second assumption that was made is that the linesman is always correct. This model correctly determines offside decisions using player co-ordinates, which is not the same as real linesmen. Real linesmen have to deal with obstructions by other players etc. so this model should be considered as a tool to confirm decisions or educate people on the offside rule.

4 Limitations

4.1 Model Limitations

The model does not completely cover all aspects of the offside rule; it does not take into account fully whether a player is passive or active. As discussed previously it is assumed that the players without the ball are always active within the play however in reality this may not be the case.

Currently the model does not take into account a player may be in an offside position but have nothing to do with the play, thus not resulting in an offside decision being made. The reason that this was not considered in the model was adding this feature would require a large increase in computation which was not feasible to design in the given timescale. Humans currently struggle to make this decision correctly, so for a model to accurately decide it would need a much greater number of observables and dependencies. If more time was available this addition would be of very high priority.

The model also suffers from simplified graphics. With more detailed graphics, such as feet to indicate player direction, the model would be clearer to look at and understand. These improved graphics would also help greatly in implementing the active/passive section of the law.

4.2 Empirical Modelling Limitations

The biggest limitation of using an Empirical Modelling technique is not being able to easily extend the model. Due to the lack of any objects or templates, from which many similar observables could be created, within the EDEN, DoNaLD or SCOUT languages it requires a lot of additional code to simply create another player. To achieve this, a current player's code would have to be copied and adapted to create the new player. This issue could have been solved by using CADENCE, however I felt as this notation is still in the early stages of development with limited documentation it was not appropriate to use in this project.

5 Evaluation

This section will evaluate both the model itself, as well as how suited the Empirical Model approach is to modelling the offside rule as opposed to conventional programming techniques. Finally we will look at some possible extensions to the model that could be added to increase functionality.

5.1 Evaluation of Model

The model that has been built is sound and is a useful tool in helping to enforce the offside rule. It also provides a good way to learn about the offside rule and all the different factors within it. The main criticism of the model is that it over-simplifies the problem, i.e. the players are just coloured squares with no real human features. However for any noticeable benefit in functionality the model would have to be much

more complex which the time frame allotted did not allow, however this could be developed on in the future with the current model as a solid foundation to build upon.

5.2 Evaluation of Empirical Modelling

An Empirical Modelling approach to this problem proved to be an interesting alternative to more mainstream computer science methods. One main benefit was the concept of dependencies. The idea that one change to an observable may affect the entire environment was a very powerful tool when modelling the offside rule where the decision is made based on a number of different factors.

An area where Empirical Modelling fell down however was when it came to obtaining scalability. More conventional approaches like Object Oriented Programming offer ways to modularise code which can be helpful when producing a lot of similar items i.e. players. Due to these issues with scalability EM is limited more too simple models unless a lot of time is available to write the necessary code.

However Empirical Modelling proved to be a very good approach for creating a simple model of a situation that requires a number of items to rely on one another to decide the state of the environment, in a relatively short time frame.

5.3 Possible Extensions to Model

Some possible ideas on how to extend the current model to increase functionality are:

- Adding a way of determining if a player is active or passive in the current play
- Improving the graphics of the model to help represent the situation more realistically
- Take into account position of the linesman when making offside decisions

6 Conclusion

Although I have spent my coding life modelling problems using more conventional Object Orientated techniques I have found that Empirical Modelling is a powerful tool for modelling real world scenarios such as the offside rule. Although Empirical Modelling has its weaknesses, the use of dependencies within a model make observables much easier to manage with the coder not having to worry about keeping consistency amongst them. In conclusion although Empirical Modelling is not an appropriate solution for all problems, it was certainly able to create an accurate model of the offside rule.

References

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