ABSTRACT

Modelling Football Penalty Kicks

Jeffrey Kevin Leela

In modern football the penalty kick is considered a golden opportunity for the kicker to register a goal. The kicker is virtually unchallenged by any opposing player except the goalkeeper who stands on the goal-line 12 yards away. Therefore, the kicker has an overwhelming advantage. Maximising on this advantage is of paramount importance since penalties in many instances, determine the outcome of games.

This thesis analyses the variables involved in a penalty kick and attempts to devise the best method to kick a penalty to ensure a very high success rate. The two fundamental components of a penalty shot are the angle at which the shot is kicked and the velocity of the shot. A feasible range of angles is established using right angled triangles and trigonometric ratios. Also, the sides of these triangles are

calculated using Pythagoras theorem. Velocities are calculated using simple projectiles motion equations.

Numerical methods are employed to find the range of velocities for the respective angles. The penalty kicks modelled in this thesis are high velocity shots placed in areas of the goal that are difficult for goal-keepers to reach. These results inform coaches about the techniques used to kick a penalty with the required trajectory. Players can practise these techniques to develop mastery.

It is also important to mention the educational impact this project can have on the teaching of calculus to undergraduates. Interest is generated with the use of real world examples that appeal to students who like sports and provides a foundation for research in Applied Mathematics. This can be described as a simple and stimulating introduction to the technique of Mathematical Modelling.

Keywords: Jeffrey Kevin Leela; penalty kick; kicker; goalkeeper; angle; velocity; trajectory; range; real world; football; modelling.