Efficiency Parameter for Coach and Player Influences in Soccer Using Soft Computing Techniques

J. Vijay Fidelis , E. Karthikeyan

Abstract—Football has inclination of human liking towards the game making it the most watched game, in previous decade and before has witnessed pivotal change the way the game has been presumed at different levels. Professionalism has bought in plenty of opportunity for sports enthusiasts in form of players and coaches too. Evolutionary algorithms are influential to optimize and help in decision making, hence making it likely to influence the concepts in optimizing the concepts and decision making in how coaches and players influence each other for optimal output in terms of resultsfor the matches to be played in soccer.

Index Terms: Optimization, Heuristics, Gravitational Search Algorithm, Soccer, Evolutionary Algorithm.

I. INTRODUCTION (LEAGUE FORMAT)

A. Overview of Soccer

Soccer rolls back in synonym to Football almost 200 decades before from where Englishmen who bought in impediments towards soccer into the game as what it is absorbed today. Any game requires a set of rules or guidelines which need to be institutionalized and Englishmen are the ones who will take this credit who regulated and imposed basic rules needed to be amended for the same, which included forbidding tumbling the opponents, to hold or touch the ball with hands when game at play[4].Transition is a needed scenario which cannot be erased and hence soccer too required more rules which were to be implemented. The Federation International Football Association (FIFA)which is a member of the International Football Association Board instituted in the year 1913. Referees had been administered the hardened rule of maintaining the decorum of the game played with caution cards including yellow card for red card for dangerous play. The changes were not really

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alarming and significantly do not have too major impacts on how a game was perceived earlier. Offside rules were more minutely looked into as it had lot of repercussion on awarding goals to teams which had made away with [4].These reformation shad not made any type of concerns especially on all the type of stakeholders involved and the viewership of the game;it in fact boosted the popularity and momentum towards the game.

Over 250 million players spanning over 200 countries and various continents depend on soccer as their mode of earning, making it as the top sport played and viewed. [6] Recently continents who had not thought about soccer have made huge and radical changes in how young and teenagers follow on with this beautiful game. And for the reasons above soccer has its impact in most of the continents. Main reason for soccer being most viewed and impactful game throughout the globeis due to the fact that rules have been simple to be adapted by a common man. Field dimensions on which the game is played is of 100 meters in length and 60 meters in width which can vary from one club to another depending upon various aspects such as land details and other pre-requisites available. In most of the situations, the club has more flexible guidelines in setting up world class requirements on the same and make thorough of the available productivity in terms of all the aspects in making soccer more available to all stake holders than to that compared with a government run institution deploying of the same strategies [5]. When a ground needs to be built it has to satisfy all the proforma requirements mentioned in FIFA guidelines to conduct matches of international levels and bring in improvements in abundance to have world class infrastructure for training, game, seating, viewing, parking and other requirements well in for all other stakeholders.

One of the main reasons why a club or country gains or gained popularity is due to two major reasons, 1. Players who were roped into for the current season to play for a club 2. Coaches who are really effective during their course of stay in a club or country in bringing out major reforms and improvements as stated by the management members to

harness the best at the interest of country and that of the club to improve on the stake holder ship at various levels.
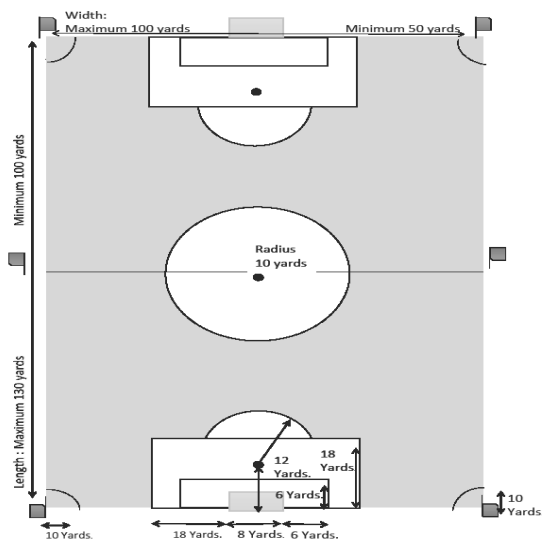

Fig 1.1: Dimension of Soccer Field.

Any level of Soccer has generated interest only in league format, because of the fact that, any professional team requires at least 10 months of game to be played as that is the minimum amount of time required to settle down as a team and to consolidate further in a tournament. This version applies any sport said for the above specified reason. Participating teams in the league tends to play each other twice one on their home turf and the other on reverse fixture at opponents turf, hence testing the competency and optimal level of players performance. The main objective of league games which are played in Soccer, Basketball, Hockey, Cricket, Kabaddi and other team sport which has always improvised on many ideologiesinto harnessing huge interest and lot of sport management strategies in generating revenues and enhance their fan base.

B. Role of Coach/ Mangaer

The role of coach/Manager is instrumental in bringing accolades to any team is a laudable note. Coach not only has the professional approach to bring up a team but also should be on a personal note to gel up with players to enhance their performance on field. Coach/Manager has the main responsibility of how to bring out maximum of a given squad in all possible means for an entire season. In addition to this he should have mentorship and administrative qualities to handle demanding situations when in demand. An institutional club invests plenty into bringing greater revenues by potentially competing at global level standards to create a fan base in each and every country. For example when Kabbadi Premier League (KPL) was inaugurated in the year 2014, the fan base for each and every state what was drawn was very dilute as compared to 2018 Season. Hence a larger fan bases the better and effective will it be to push for brand creation of a club. The more credits the Coach/ Manager have in his credentials the more will be the expectations and investments too.

It so happens that when a club starts its season of matches which can be played during the entire year with lot of strategic breaks which can be for players to get back into their better performance and availability. When a club offers a professional contract to any players he/she needs to be

available for the complete season and provide his best for each and every game of which the club represents at prestigious tournaments. Elite clubs give full privileges to Coach/Manager in bringing the best possible players and improve the squad if required and see though a players credentials for crucial matches. The squad decided preseason cannot be changed every point of time. The transfer of players happens before the season commences or through winter window session transfers which usually happen in the month of December.

Picking up a well-balanced squad has always been an important aspect of any Coach/Manager which can bring a win to a club.An Institutional club which invests in millions will ensure the outcome of club matches should be decisive in the retention of Coaches/Managers or players.Various reasons can be included wherein the coach makes errors in decision making to pickthe seasoned players into the squad at that point of time. Discrimination and favoritism can add on to the misery of others players not being included. The ultimate point is that a club which is said to have the best Coach and best players in their squad is not giving the expected outcome will always be a debatable issue. There are instances that the players and coaches get into rifts with each other bringing down the performance of a team. These types of instances have occurred more number of times that the bloated ego between coaches and players get spilled on the field and it is there for everyone to witness the instances at situations. Hence when the Coach tries to pick up a squad, even though the player has enough credentials and is completely fit to play a match the Coach does not allow him, which ignites more misery into a players profile. Such events keep happening at regular intervals without resolving can lead to brand identity discoloration, hence forcing the management to take evasive actions.

II. GRAVITATIONAL SEARCH ALGORITHM

A. Introduction to GSA

Gravitational search algorithm (GSA) having its origins on soft computing techniques, has been conceptualized from Mother Nature evolving from gravitational kinematics and Physics. This model is completely revolving upon motion and objects of masses moving with that of gravity concerned.[3]The relevance of GSA is that group of objects which internallyin communication with each other because of the Newtonian gravity and principles of motion. Performance of each and every object is directly depending on the masses.The density of objects in a particular region acts on the gravity, force and masses of all these objects as they influence the objects and by law of attraction and forces a global movement of all objects toward other objects of heavier masses [4]. Solution to a problem depends on each object positioning.While iterating the position of each and every object is updated and the best value of respective object is stored [12]. The law of Physics state that objects with heavier masses tends to move in a more relaxed or subtle way than the lighter ones. Once the best fitness value is found the looping after specific time will be terminated. In our case how far the player or Coach drifts away from each other signifies the needed change to a global solution.[2]

B. Working of Gravitatinal Search Algorithm

GSAgains its inspiration in its working from nature since has its main focus and its mainstay into features derived from Newton's gravity and law of motion. [13]. Optimization in a contrast to how we attain maximum best results and the algorithms revolving around it has its mainstay on how Animals, Birds, Insects on how they carry out the basic and daily routines and have deployed most of it in the algorithms derived from. Since these algorithms have been very impactful on how we are optimizing the general efficiency of the output what we desire to [9]. Examples being Spider Monkey optimization algorithm, Elephant Herding algorithm, Genetic Algorithm etc. The credibility of GSA is infor his accuracy, effective and providing very high and quality solution.For any such said optimization based problems [18]. Categorically falling into density based method as the number of objects what are involved is high. The main building blocks of GSA is particle which are evaluated with four main parameters such as, passive gravitational force, inertial mass, position and active gravitational mass [12]. Uniqueness of GSA being that it is based upon an algorithm not utilizing any memory but does not compromise on the efficiency as in comparison with memory based algorithms [10]. G, which is gravitational constant computed in iteration t, is computed as follows,

$$G(t) = G_0 e^{-\alpha/T} \qquad (2.1)$$

Where G_0 and α has to beloaded earlier,and their values graduallydecreased during search [11]. T is the total number of iterations. The mass of each and every object will be initialized as per the law of gravity and represented by equation (2.2).
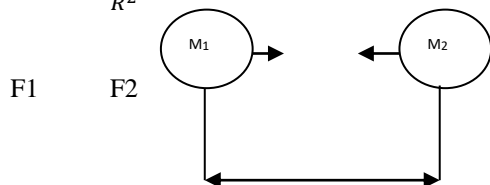
$$F = G \frac{M_1 M_2}{R^2} (2.2)$$

F1   F2

Fig 2.1: Mass M_1 and M_2 acting with respective Force.

Equation 2.2represents F as a magnitude of gravitational force delegated on various objects acting at one point of time. G isgravitational constant. $M_1$and M_2representing respective masses of objects relating to first and second [13]. The distance between M_1 and M_2 is represented using R. The second Newtonian law states that when a force of F is enforced upon a respective object the respective objects tends to maneuver with acceleration 'a' which is in direct proportion with the force applied upon it and the object mass 'M' as described in equation 2.3.

$$A = \frac{F}{M} \qquad (2.3)$$

There are three types of masses, 1. Active gravitational mass Ma. 2. Passive gravitational mass Mp. 3. Inertial mass Mi[16]. The$F_{ij}$is the gravitational force that acts on mass I by mass j and is defined by,

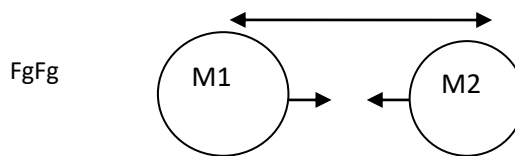$$F_{ij} = \frac{GM_{aj} \times M_{pi}}{R^2} \qquad (2.4)$$

Fig 2.2: Gravitational masses of M1 and M2.
The acceleration of object a, will be calculated as below.

$$a_i = \frac{F_{ij}}{M_{ii}} \qquad (2.5)$$

Where M_{ii} is inertia mass of particlei. While searching the particles update their velocities and positions as below equations [19].

$$V_i(t+1) = rand_i \times V_i(t) + a_i(t) \quad (2.6)$$
$$X_i(t+1) = rand_i \times V_i(t) + a_i(t) \qquad (2.7)$$

III. PROPOSED METHODOLOGY

A. Experimental Setup

This study makes use of GSA model and proposes an efficient way of optimizing the coach and player influences on each other for better efficiency. For these scenarios various attributes were considered such as, CoachExperience (CE), Coach Performance (CP), Coach Attitude (CA), Coach Approach (CAp), Coach Team Selection Criterion (CTS), Coach Feedback (CF), Coach Attendance (CA), Coach Inputs (CI), Player Attitude (PA), Player Performance (PP), Player Attendance (PA), Player Form (PF), Player Input (PI), Player Feedback (PFE), The model helps in how the Coach and player inference is and the kind of influences it creates in either bringing in the best of both or in contrary. The model helps to evaluate whether the coaches and managers in tandem with players have been working hand in hand to bring in the best out of the interest of the clubs future aspects.Another aspect in player and coachevaluation in compromise with ego and other personal or professional fronts on which the decision of coach or player optimizes him/her for the club or country. Hence the procedure is to iterate the parameters through different number of particles and variation so that the results obtained are tabulated after processing.

B. Dataset

The dataset what is taken is for a particular season and for a specific team for which the range of values for each and every attribute have been categorized into. i. CP (Range: 0 to 10), ii. CA (Range: 0 to 10), iii. CTS (Range: 0 to 10),iv. PF (Range: 0 to 10), v. CF (Range: 1 to 10), vi. PFE (Range: 1 to 10). The Dataset captured for a specific season of play is calculated through different values of NOP (Number of Particles) and later will calculate the mass and variations in the number of iterations. Using GSA the data set will be iterated though a process where best mass for different approximations are recorded. The training done on the dataset evaluates to the kind of optimal level with which the Coach or Manager works along with players. The dataset needs to be trained for different set of values for

NOP and iteration, NOP=50 and iteration=400, NOP=100 and iteration=5000, NOP=80 and iteration=1500, for which the best mass values were recorded for further calculations. The proposed GSA model takes into consideration all the variables of the current season as in equation (3.1).

$$G_t = S_a0 + S_a1 * CF + S_a2 * CA + S_a3 * CP + S_a4 * CFE + S_a5 * PFE \qquad (3.1)$$

Where S_a0, S_a1, S_a2, S_a3, S_a4 and S_a5 are the coefficients which need to be evaluated using the algorithm and G_t is the fitness function which decided upon the coach and player optimal performance. To reduce the error between the current performance of coach and players as compared with an earlier model and later counterfeited using fitness function e using the equation (3.2)

$$e = \min(\sum[GS\ Estimation - Actual\ Gs]2_{ni} = 1 \qquad (3.2)$$

Where n represents the experimental data set values.

C. Performance Metrics

To compare with the performance of coach and players before joining a club over the current form of both needs to be evaluated by various attributes what are recorded and computed earlier. Hence the error between the previous and current performances is calculated using i) Mean Absolute Error (MAE) ii) Mean Absolute Percentage Error (MAPE) iii) Mean Square Error which are defined as follows [13].

$$MAE = \Sigma(Xt - Ft)n = \Sigma etn \qquad (3.3)$$

$$MAPE = \Sigma|Xt - FtXt|n(100) = \Sigma|etXt|n(100) \qquad (3.4)$$

$$MSE = \Sigma|Xt - Ft|2n \qquad (3.5)$$

X_t is original data at period t, F_t is the estimation at period t, et is predicted forecast error at period t, while n is the number of observations [14].

IV. EXPERIMENTAL RESULTS

Clubs investing in millions is not for the world to see a tiff between player and coach scenarios erupt and players losing
sometimes everything by ruining their career. Attitude of players towards a coach and coach or manager attitude towards players is evaluated not only on field but goes beyond levels of our understanding. Here we use the iterative method using multiple linear regressions using GSA to find the coefficient for S_a0, S_a1, S_a2, S_a3, S_a4 and $S_a5$which evaluates the current team performance for the

NOP/Iteration	Sa0	Sa1	Sa2	Sa3	Sa4	Sa5
70/ 900	0.140653	-0.22851	0.18529	0.64474	1.07111	-0.1896
100/ 1000	-0.65926	0.037489	0.25852	0.19907	1.27980	-0.2068
70/ 700	0.253006	0.14263	0.00455	0.03421	0.25772	0.3956
20/ 100	-0.12093	0.397929	0.01812	1.50048	0.19721	0.5108
50/ 400	0.729297	-0.37249	0.02214	-0.7272	-0.6975	0.4576

season.

Table 4.1 Parameter Estimation Player Selection data model using GSA

GSA Algorithm uses every particle involved will have its individuality by having its own inertial mass, location, active and passive gravitational masses. These parameters used in evaluating the performance analysis of the team. Here the Algorithm uses evaluation modelby using the number of mass as 50, initial position and velocity are random values between 0 and 1, and gravitationalconstant (G) is 1. Since random values are generated at all the specific and strategic points, the best mass doesn't coincide with its previous one. The obtained results were tested and evaluated using relevant metrics, which are available through parameters in our dataset, estimation from GSA, Fitness function.

The estimation of coefficients in table (4.1) is for different values of NOP and Iterations respectively.
   i.   NOP=50 and iteration=400.
   ii.   NOP=120 and iteration=5000.
   iii.   NOP=80 iteration=1500.
   iv.   NOP=20 iteration=290
   v.   NOP=60 iteration=370.

Applying the coefficients using model equation 3.1, the evaluation of players and coaches performances have been evaluated and estimated for a set of players playing in the season of play, graphs were plotted in relevance to the results obtained and as shown in respective graphs in Fig.4.1, Fig 4.2, Fig 4.3, Fig 4.4, and Fig 4.5. The performances MAE, MAPE, MSE for the validated data of both the models were tabulated.
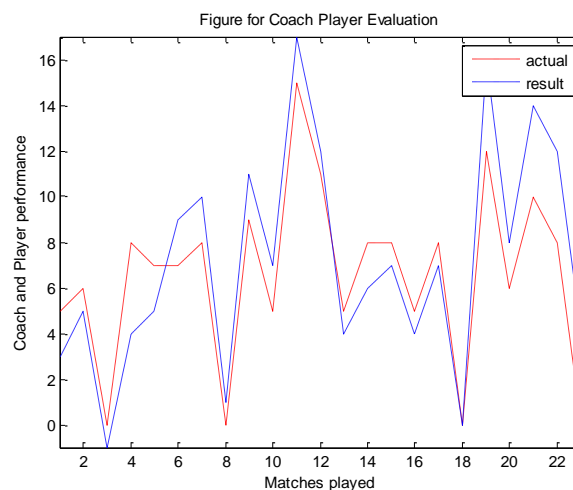

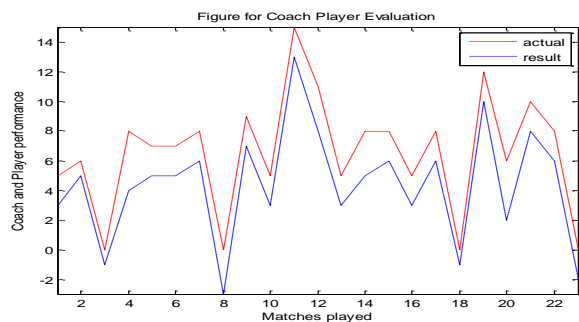Fig 4.1: Goal Scored Estimation for NOP=50 and Iteration=400.

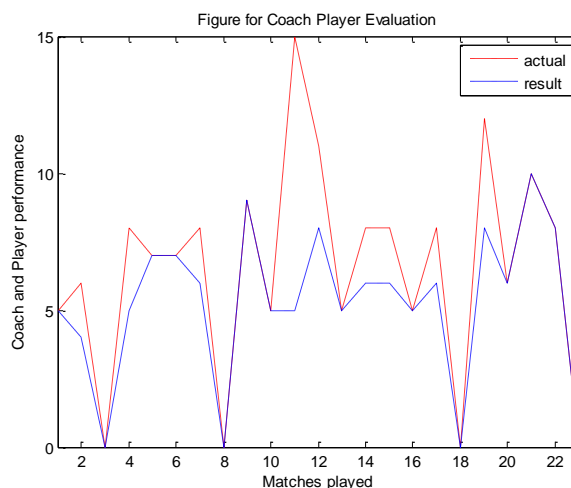Fig 4.2: Goal Scored Estimation for NOP=120 and Iteration=5000.

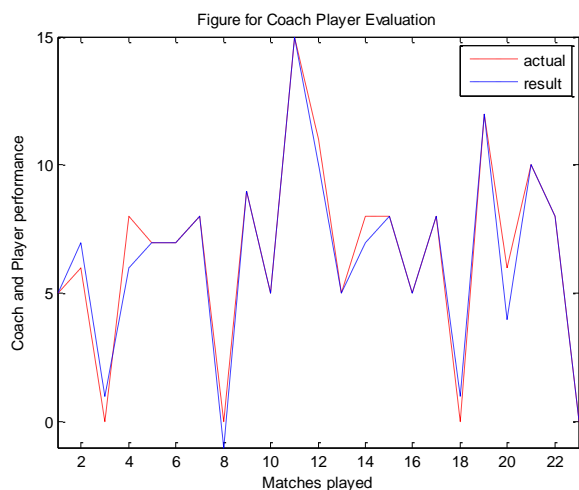

Fig 4.3: Goal Scored Estimation for NOP=80 and Iteration=1500.

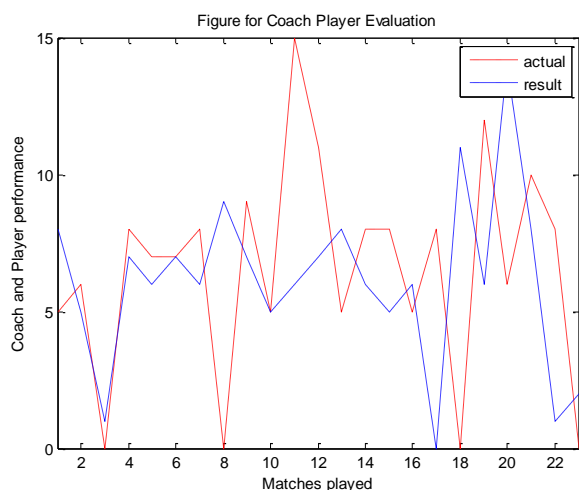Fig 4.4: Goal Scored Estimation for NOP=20 and Iteration=290.

Fig 4.5: Goal Scored Estimation for NOP=60 and Iteration=370.

Graphs plotted against different values of NOP and iterations have varied observations and as described earlier as pertaining with GSA Algorithm maintain the differentiated outputs as with various parameters. Observations from Figures 4.1, 4.2, 4.3have estimations which are really close to the optimal performance and associations with coach player estimation of performance evaluation. The model designed for the process of coach and player evaluation clearly indicates optimal results even with the change in NOP at some instances of input parameters in the dataset have better accuracy was shown in Figure 4.3 hence the efficiency of the player and coach evaluation was evident from the obtained results GSA are tabulated.

V. CONCLUSION AND FUTURE WORK

The proposed model was set to evaluate the estimation of coach and player performances.Evaluated on the models trained and verified the results can be far more improved at radical levels by expanding the data set to more elaborate and precise attributes and other Soft computing techniques for bettered results.

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