# A METHOD TO ANALYZE SOCCER OFFENSIVE SEQUENCES

**Fernando Santana Ziskind, Ana Lorena Marche, Milton Shoiti Misuta, Ricardo Machado Leite Barros, Sergio Augusto Cunha**

**Laboratory of Instrumentation for Biomechanics - College of Physical Education - University of Campinas - Campinas, Brazil.**

**KEYWORDS:** Soccer, attack velocity, offensive sequences.

**INTRODUCTION:** There is a range of possibilities to analyze the soccer game in relation to physical-technical-tactical aspects. The importance of going toward the goal rapidly since the recovery of possession was defended by Grehaigne et al (1996). The main technique to analyze soccer attack speed in literature was presented by Yue et al (2008). The aim of this study was to propose a method to analyze offensive sequences in soccer based on goal progression velocity (GPV) and goal progression indicator (GPI).

**METHODS:** One game from Brazilian first division championship was recorded with four digital cameras (30 Hz). Players' positions during the match were obtained using Dvideo software as in Figueroa et al (2006a, 2006b). Technical actions were also registered using Dvideo as in Moura (2006). Ball position was considered as the position of the player just when the action was executed. All offensive sequences from both teams that ended in shots and with at least two actions were considered into the analysis (n=29). Two of them (which ended in goals) were detailed.

In each attack, for every pair of sequential actions ($i$ and $i+1$), the GPV was calculated by: $\overrightarrow{\mathrm{GPV}} = \left(\overrightarrow{\mathrm{vel}} \cdot \overrightarrow{\mathrm{tar}}\right)\overrightarrow{\mathrm{tar}}/|\mathrm{tar}|^2$, where $\overrightarrow{\mathrm{vel}}$ is a vector with direction defined by vector $\overrightarrow{bt}$ (figure 1) and modulus equal to the ball average velocity between these actions; $\overrightarrow{\mathrm{tar}}$ is the vector defined by the center point between the same actions and the center point of the goal. As a result, $\overrightarrow{\mathrm{GPV}}$ is the projection of $\overrightarrow{\mathrm{vel}}$ over $\overrightarrow{tar}$. The modulus of $\overrightarrow{\mathrm{GPV}}$ represents the velocity and the signal – positive or negative – of scalar multiplication $\overrightarrow{vel} \cdot \overrightarrow{tar}$ indicates progression or digression in relation to the goal. Figure 1 shows an example.

The GPI was calculated for the same actions by: $\overrightarrow{\mathrm{GPI}} = \left(\left(\overrightarrow{\mathrm{bt}}/2 \cdot \overrightarrow{\mathrm{tar}}\right)\overrightarrow{\mathrm{tar}}/|\mathrm{tar}|^2\right)/\overrightarrow{\mathrm{tar}}$, where $\overrightarrow{\mathrm{bt}}$ is the vector defined by actions $i$ and $i+1$. Consequently, $\overrightarrow{\mathrm{GPI}}$ is the projection of $\overrightarrow{\mathrm{bt}}/2$ over $\overrightarrow{tar}$ normalized by $\overrightarrow{tar}$. The signal – positive or negative – is given by the scalar multiplication $\left(\overrightarrow{bt}/2\right) \cdot \overrightarrow{tar}$. Therefore, GPI can exist between -1 and 1, where 1 is the biggest progression to goal possible and -1 is the biggest digression.

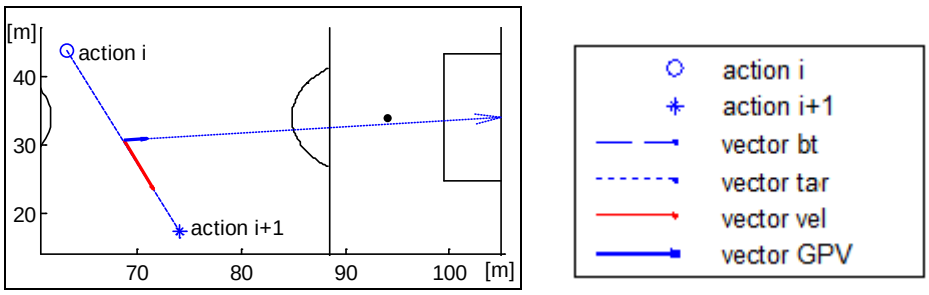


**Figure 1. Examples of $\overrightarrow{GPV}$, $\overrightarrow{vel}$, $\overrightarrow{bt}$ and $\overrightarrow{tar}$. $\overrightarrow{GPV}$ is the projection of $\overrightarrow{vel}$ over $\overrightarrow{tar}$.**

As a result, GPV shows the attack velocity while GPI is a relation among the goal progression and the goal distance. GPV and GPI maximum and minimum values will

presented in average and standard deviation. Results from two sequences ended in goals will be detailed.

**RESULTS:** The average of GPV and GPI minimum values for all offensive sequences ended in shots in both halves were 2.5 m/s (±5.5) and 0.21 (±0.17), respectively. Also, average of maximum values of GPV and GPI were 10.4 m/s (±5.7) and 0.31 (±0.33), respectively. Each GPV and GPI values from two goals on second half are presented in figures 2 and 3. In these cases, GPV and GPI maximum values were 13.2 m/s and 0.49 for goal 1 and 11.3 m/s and 0.41 for goal 2, respectively.

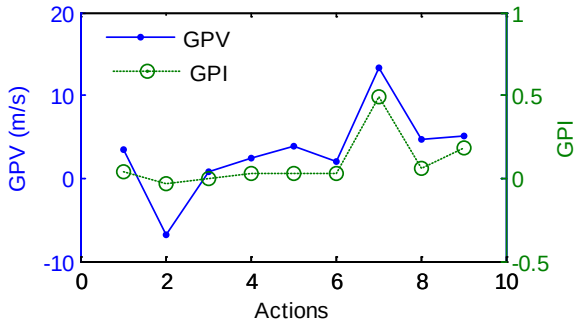


**Figure 2. GPV and GPI from all goal 1 actions.**

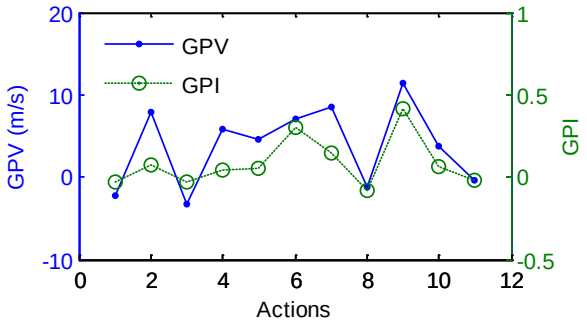


**Figure 3. GPV and GPI from all goal 2 actions.**

**DISCUSSION:** An advantage of the method proposed is that it permits the analyses of the influence of each action to attack velocity and goal progression, and not only the average attack speed. Goal 1, for example, presented higher values of GPV concentrated in the last 3 actions, while goal 2 showed alternated high and low values of GPV, showing different characteristics between these sequences. Also, the use of GPI allows the analyses with emphasis on the actions in which the ball gets close to the target. Goal 1, for example, presented only one high value of GPI (action 7), while goal 2 presented two peaks (actions 6 and 9). GPV peaks do not necessary indicate goal proximity and combined with GPI may be a sign of which actions were the most important to the sequence success.

**CONCLUSIONS:** Although there are various manners to reach the goal on soccer, finding more effective ways to score is very important to all teams. The GPV and GPI average and standard deviation values from every offensive sequences ended in shots from one game were presented. The method proposed on this paper showed how offensive sequences can be analyzed considering the progression to the goal and attack velocity. Studies with a greater number of matches are necessary from now on.

**REFERENCES:**


Figueroa, P. J.; Leite, N. J.; Barros, R. M. L. (2006a). Background recovering in outdoor image sequences: An example of soccer players segmentation. *Image and Vision Computing*, v. 24, n. 4, p. 363-374.

Figueroa, P. J., Leite, N.J., Barros, R.M.L. (2006b). Tracking soccer players aiming their kinematical motion analysis. *Computer Vision and Image Understanding*. 101, 122–135.

Grehaigne, J. F.; Bouthier, D.; David, B. (1996). A method to analyse attacking moves in soccer. In: Reilly, Bangsbo, Hughes (Eds). Science and Football III: *Proceedins of the Third World Congress of Science and Football*. London-New York, p. 258-264.

Moura, F. A. (2006). Análise das ações técnicas de jogadores e das estratégias de finalizaçào, a partir do tracking computacional. *Dissertação (Mestrado)* - Faculdade de Educação Física. Universidade Estadual de São Paulo, Rio Claro.

Yue, Z; Broich, H; Seifriz, F; Mester, J. (2008). Mathematical Analysis of a Soccer Game. Part II: Energy, Spectral, and Correlation Analyses. *Studies in applied mathematics*, 121:245-261.