

## World Congress of Performance Analysis of Sport X

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[Invited Lectures](#): European programs; the profession; instability in soccer; comprehensive performance analysis; table-tennis technology; SoccerLab; Croatia in the football World Cup; Ajax Amsterdam's analyses. [Soccer](#): survival analysis; invasion index; social networks for passing; impulsiveness; goal-line technology; possession; female coaches in masculine culture; shooting accuracy; floaters; perturbations; analysis practice and practitioners. [Basketball](#): tactics; rebounds; drills; US Olympic team; rule change. [Other Sports](#): handball; rhythmic gymnastics; recurve archers; swimming; volleyball; beach volleyball; cricket; rugby union; rugby league; golf; others. KEYWORDS: competition, elite athletes, ergogenic aids, nutrition, performance, talent identification, tests, training.

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This biennial conference of the International society of Performance Analysis of Sport ([ISPAS](#)) was hosted with warmth if not always with sunshine in Opatija, Croatia, by performance analysts from the [Faculty of Kinesiology](#) of the University of Zagreb. Attendance was down on the [previous conference](#), possibly because ISPAS ran several workshops in the previous year. Combining a workshop with the conference should boost attendance and foster more contact between researchers and practitioners. Let's see how it goes in 2016 at WCPAS XI in Alicante, Spain.

Accommodation was great value for money: one of us stayed in a massive well-appointed Austro-Hungarian vintage apartment within a few minutes of the conference hotel at only EUR60 per night, complete with an authentic lovely old landlady who regaled us with glasses of a Croatian liqueur. Opatija itself was full of high-fashion shops for the very rich moored nearby in their super-yachts, but food in the supermarkets was inexpensive, and a restaurant off the tourist track in the hills above Opatija was really good and cheap.

In his welcome address, Nic James defined a good conference as one at which you establish a useful relationship with a new colleague. We found the conference to be successful in this respect and in respect of our own criterion: that there has to be at least one presentation out-

standing in terms of originality, quality and potential for practical application to performance enhancement. Several qualified: [survival analysis](#) of the time to goals or other key events; a new [invasion index](#) for team sport; and possibly [social networks](#) to quantify passing.

The [conference website](#) has links to download PDFs of the [final program](#) and the [book of abstracts](#). Find the abstracts we have summarized by putting the name of the first presenter shown in brackets [...] into the advanced search form in a PDF reader. Email addresses are not included, so to contact an author, use Google Scholar to find a recent article with an email address.

### Invited Lectures

In the opening keynote, the godfather of performance analysis, Mike Hughes, outlined a **program** of courses and work experiences to ramp up sport performance analysis at European institutions. It will all depend on financial support from the European Union. Get involved via the [ISPAS site](#).

Peter O'Donoghue painted a sometimes bleak picture of a **profession** that is undervalued (monkeys working for peanuts) and not without risks to health (long hours at a computer) and safety (driving long distances in a sleep-deprived state). Our conclusion is that market forces should ensure good analysts get treated

right, and ISPAS itself is gradually providing more advocacy for its member analysts.

Does goal scoring in **soccer** arise from **instability** in the pattern of movement of players? Nic James made a valiant attempt to determine whether this concept from dynamical systems theory can be quantified meaningfully and usefully, using the 64 goals that one team made in 20 matches of the English Premier League 2012/13. Our impression: instability won't add anything to the prediction of goal scoring.

Martin Lames tried to synthesize theoretical performance analysis (researchers using quantitative methods with samples) and practical performance analysis (practitioners often using qualitative methods with a single athlete or team) into a concept of **comprehensive performance analysis**. Along the way he called into question the validity of commercial coding of matches, the search for useful non-linear analyses from complexity theory, the role of chance in match outcomes, and the contribution of training to performance.

Arnold Baca presented examples of technology in the analysis of table tennis. Projects performed in his lab included the use of a force plate and 3-D kinematics to reveal changes in technique arising from neuromuscular fatigue, a system for automatic tracking of ball trajectories and impact position to assess player tactics, and a device for testing imbalance of table-tennis balls.

The second day of the conference was dedicated mainly to soccer, in a joint event with the Croatian Football Federation. It started with a presentation about **SoccerLab**, a football information and management system. It was a "sales pitch", where the different modules and their functionalities (video storage, display of tactics, scouting database, and integration with other commercial software, including Sportscode, Polar, and GPS) were presented. The system appears to be a good answer for managing the deluge of data that teams currently face. SoccerLab was initially developed for and is mainly used by soccer teams, but in direct conversation with the representative, application to other team sports is also possible.

A representative of **Croatian Football Federation** presented an analysis of the World Cup 2014. An interesting point was the apparent difficulty on justifying the loss of Croatia against Brazil in the opening match based on

the analysis of performance indicators showing a good performance of the Croatian team. The reality of soccer analysis is that game outcomes are a crude measure of team performance, because chance can play a major role in a game where scores are so low. The development of better measures of team performance is still needed and continues to be an interesting research topic.

The day ended with a presentation of the pre- and post-match routine of the analysts of **AFC Ajax**, Amsterdam's football club. In AFC Ajax, the coaching team places more importance on the post-match analysis, because it is important to understand what worked and what didn't to identify the areas that need improvement. The analyst stressed the importance of an active role of the players in feedback sessions: five key clips of a game are chosen, and in small groups players have to discuss the what and the why of what happened. The presenter emphasized that such exercises also promote communication among team players. Because Ajax's strategy is to develop players from younger ages to play in the elite team, all age-group teams in AFC surprisingly play with the same game tactics (4:3:3) as the elite team. For the analyst this strategy is an advantage: by knowing the requirements to play on the elite team, specific sets of target skills for each age group were identified which then allows consistent monitoring and assessment of players' development.

### Soccer

Instead of goal count or win/draw/lose as the dependent variable in soccer, the authors modeled time to the first goal, a form of **survival analysis**. As a proof of principle, the analysis of 240 matches of a season of the Portuguese premier league revealed some expected outcomes (e.g., greater ball possession predicted shorter time). The authors didn't realize that the approach can easily be extended to analysis of the time to *every* goal or the time to every *shot* at goal. What's really cool is that performance indicators during the match then get associated temporally with these important events, whereas the association is lost with the usual analyses of associations of game totals of performance indicators. The statistical armamentarium of proportional-hazards regression (Cox regression) is just waiting to be applied to this new approach. [José Pratas]

Here's a new potentially valuable perfor-

mance indicator for team sports: the **invasion index**, a measure of how often a team gets the ball closer to the goal end of the field. In the example soccer match shown in the abstract, one team apparently played better than the other on the basis of shots at goal (18 vs 10), yet possession percentages were similar (52 vs 48), and the match was drawn (1-1). The invasion index showed a massive difference (533 vs 278). But it's a bit worrying when the authors go straight on to say that "in other analyzed games, there was no correlation between invasion index and shots at goal." So a team that takes more shots at goal is not a better team after all? [Daniel Link]

Passes between soccer players can be summarized in diagrams showing players as nodes connected by lines in a **social network**. Eight soccer experts rated the diagrams as capturing the "essence" of passing, and two measures derived from the networks were able to distinguish between the kinds of passing that occurred in different game contexts (defenders, midfielders, etc). Interesting, but will it help coaches improve team performance? [Ricardo Duarte]

The psychological measure **impulsiveness** had a small positive correlation with tactical performance of five offensive and five defensive actions of 108 regional-level U-15 youth soccer players. We suggest you try training quick actions rather than attempting to change this trait. [Marcelo Cabral]

The authors of this authoritative study commissioned by the German Football League concluded that an extra camera on the goal line would be far more cost-effective than expensive **goal-line technology** to improve goal-line critical decisions. The extra camera could also be used to improve other game critical decisions. [Otto Kolbinger]

By comparing the frequency of gaining **possession** of the ball in different parts of the field during games of the Spanish team in the 2010 FIFA World Cup, the authors of this case study concluded that the team apparently "prefers to regain possession in their defensive half of the field, probably intending to perform fast counter-attacks immediately after recovering the ball." Nice idea, but stats for other teams would help. [Rodrigo Santos]

Semi-structured interviews with five Norwegian female elite soccer coaches revealed wom-

en were not included in coach networks, had fewer opportunities to coach, and were constantly having to demonstrate their competence to be respected. Coach programs have to change the **masculine culture** of sport. [Ketil Østrem]

When 28 semi-professional soccer players took 10 shots at a goal after each stage of an incremental treadmill step test, their **shooting accuracy** and speed were impaired significantly at lactate-threshold intensity compared with shots taken without preceding exercise. Statistics were shown as F ratios and p values, so the magnitudes of the effects can't be assessed, but anyway, training to reduce this effect of high-speed running (not necessarily "exhaustion") seems like a good idea. [Ivan Radman]

Use of an inside **floater** made little difference to the location of tactical actions in U-11 small-sided games [Gustavo Caetano], but an offensive inside floater might encourage more goal attempts and facilitate control of ball possession [Felipe Moniz], and an outside floater enabled players to perform more tactical actions and have more possession to build offensive actions. [Elton Resende]

Thirteen soccer matches in the 2013-14 Europa League were analyzed from the perspective of dynamical systems theory for relationships between major and minor **perturbations** (shots at goal and foiled attempts thereof, respectively). There were some differences between winning and losing teams. [Mohsen Shafizade]

An on-line survey completed by 65 performance analysts working within professional soccer provides a comprehensive and fascinating account of the current status of the **practice and practitioners** of analysis in this sport. Unfortunately there is no indication of the response rate and therefore the potential for bias in the sample. [Matthew Robbins, two abstracts]

Other soccer analyses: **tactics** in Under-13 players [Pablo Vecchi]; technical **instructions** and **number of players** in elite female small-sided games [Nuno Ganchinho].

## Basketball

In an ongoing long-term longitudinal study of performance indicators in 42 young male and female basketball players, "the **tactical-cognitive components** seem to have greater influence [on an index of game effectiveness]

than the mainly physical-oriented skills", but there are no supporting data in the abstract. [Kevin Melcher]

**Offensive rebound** in basketball refers to the attacking team regaining possession of a missed shot that bounces off the board. (The presenter did not provide [this definition](#) in his talk or in the abstract.) In an analysis of all the games played by the best eight teams in Euroleague 2011/12, offensive rebounds were most successful when there were three (offensive?) players and when (unsurprisingly) the opponents failed to "box out" the opponent (explained [here](#)). [Gabor Csátraljay]

In a study of 21 U-17 and U-15 basketball players, a **drills training** session without dribbles elicited a greater physiological demand and a higher number of passes and interceptions than a session of regular drills. [Daniele Conte]

How come the **US Olympic team** always wins? On the basis of an analysis of quarters in the eight London games, "opponents must increase the level of defensive pressure on the shot by forcing the USA to perform their shots earlier... Assist passes can be reduced by implementing a strategy of full court press with effective communication; this will ultimately force bad passes or passes that are easy to steal." [Benjamin Stanway]

There were two presentations of the effects of a recent **rule change** in basketball [Pedro Silva; Richard Kucsá].

#### Other Sports

Use of survival analysis (see [above](#)) allowed the effect of performance indicators and contextual variables on match outcome to be analysed (a little mysteriously) as the time during the match when the outcome was decided. In the 221 matches of a season of the Spanish **handball** league, **goal-keeper effectiveness**, which also reflects the general quality of a team's defense, was more important for earlier success of home teams in handball than the team's shot effectiveness. [Anna Volossovitch]

Principal components of **skills** of eight **rhythmic gymnastics** finalists at World Championships 2011 were not a well-defined combination of related variables. Principal components analyses need a lot more data, so we recommend using other approaches meantime. [Gaia Livioti]

There was no clear relationship between performance scores and several aspects of **timing**

of 30 shots by each of 11 male and 5 female **recurve archers** of national and county level. A between-subjects analysis appears to have been done here, but a within-subjects analysis might be more informative. [Mario Heller]

A quadratic curve fit allowing for deviations from the curve for the first two and last two laps of 330 swims by 24 elite 1500-m male **swimmers** produced seven parameters characterizing the **pacing** of each swim. Scatterplots of swim time vs each parameter for each race for each swimmer allowed identification of an approximate optimum pacing strategy for the swimmer. [Patrycja Lipinska]

**"Non-scoring skills"** that discriminated the win-loss outcome of 24 **volleyball** games of the men's 2011 World League identified were fairly obvious (attack and service errors, serving and receiving well). Discriminant function analysis would need a larger sample size to reveal more interesting subtle effects. [Paulo Joao]

The heart rates of four **beach volleyball** players got quite high (>90% max) quite often (23% of the time) in friendly matches. They also covered 1.8 km on GPS monitors, but is GPS sensitive enough for the brief **movements** in this sport? [Paulo Joao]

Proprietary (SportsCode) and free open-source (Longomatch) **video analysis software** packages have similar acceptable observation errors, at least in this study of **beach volleyball** at the London Olympics. [B. Pueo]

In this analysis of 3690 batted deliveries in 12 **cricket** matches of the 2013 Champions Trophy tournament, "the main contribution is quantifying the hit **fielding position distribution** by delivery type. A captain's field placement should exploit these distributions... and use bowlers who are the most capable and consistent [with their deliveries]." [Robert Genet]

Teams **batting** in one-day **cricket** would probably get more runs by taking greater risks earlier in the innings, according to an analysis comparing the loss of wickets in the 2011 Cricket World Cup with the expected pattern if batters maintained an equal risk of dismissal throughout the innings aimed at losing an average of 10 wickets in the 300 balls. [Peter O'Donoghue]

**Self-organizing maps** provide a method for condensing data from dozens of performance indicators in hundreds of matches in **rugby union**. It clusters similar matches and identifies

the performance indicators that define the clusters. [Hayden Croft]

Performance indicators for **rugby league** were expressed as **ratios** (e.g., breaks per carry, offloads per pass) but were presented in outline only, owing to a "commercial confidentiality agreement". [Nimai Parmar]

There was little evidence of **streakiness** (non-random runs of good or poor form) in a detailed analysis of stroke-to-stroke performance of **golfers** in the 2011 PGA Tour that took into account the quality of each stroke. [Michael Stöck]

Other analyses: club-level **javelin throws** [Vassilios Panoutsakopoulos]; **time between**

**strokes** in collegiate **tennis** [Hiroo Takahashi]; **attacking phase** in **handball** [Katarina Ohnjec]; **movements** in elite female **volleyball** [Luca Gubellini]; **actions** in **goalball**, a Paralympic sport for the visually impaired [Marcio P Morato; Christoph Weber]; **physiology** in small sided **rugby** games [Luis Vaz] and in a **cycling** stage race [Franco Merni]; **blockers** vs **defenders** in **beach volleyball** [Florian Schabbauer]; **timeouts** in **beach volleyball**. [J.M. Jimenez-Olmedo]

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