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# MODERN TECHNOLOGIES AND METHODS FOR VIDEO ANALYSIS AND INTELLIGENCE IN HOCKEY

Notes

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***Abstract***

*The development of telecommunication, optical and computer technologies at the end of the 20th century (the 80s) is a prerequisite for the rapid introduction of modern digital methods, means and forms for video surveillance, analysis and intelligence in the field of sports, in particular hockey. The purpose of our research is to study the development of modern video, computer-hardware and software systems for monitoring, analysis and intelligence, as well as their application for the diagnosis of game activity in team sports games and field hockey in particular. Achieving the goal requires the following tasks: 1) Research and analysis of the most used in sports practice, in the field of hockey, technologies for observation, analysis and intelligence; 2) Preparation of a technical (model) specification and application guide of the most commonly used technologies and methods for analysis, diagnostics and intelligence in the field of hockey. The object of the study is the technical means of video surveillance, analysis and intelligence. The subject of the study is a description of the technical capabilities, application and functioning of technical means for video surveillance, analysis, diagnostics and intelligence. Analysis of the results of our survey found that NACSPORT is the most used diagnostic and intelligence product in field hockey. Nacsport offers products in five main packages: Nacsport Basic; Nacsport Basic plus; Nacsport Scout; Nacsport Pro; Nacsport Elite; The use of video surveillance and analysis technologies in a tactical aspect allows us to significantly improve the effectiveness of actions - individual, group and collective, in the different game phases - defense and attack, by eliminating errors, problematic situations and moments. Video monitoring and analysis give us the opportunity for effective development and improvement of technique, competition rules, diagnosis and prevention of sports injuries.*

**Key words:** *Analysis, Hockey, Video, Diagnostics, Intelligence, Technology, Software, Hardware*

## INTRODUCTION

In the field of sports, the forms, methods and means of video surveillance, analysis and intelligence entered at the end of the 20th century (70s - 80s), with the development of telecommunication, optical and computer technologies.

About the future in the development of hockey, already at the end of the 90s of the last century and the beginning of the new one, many authors (Jagday, 2000, Antonov, 2006; 2007; Matt et al., 2004, Mitchell et al., 2013; Antonov, Zlateva & Roeva, 2020; Lim et al., 2021) predict that the following factors will have a significant impact on the dynamics of the development of the training process, competitive activity and tactics in general:

- increasingly, the discoveries of physiology, biochemistry, biomechanics, psychology, computer technology and the products of applied science and technology in general will be used;
- coaches, will model their graduates "before their birth". Parents will be consulted on how to think, what to eat, what motor activity to perform in order to give their children the optimal predispositions even in the womb;
- trainers of the future will use orbital training centers for training, giving new meaning to "altitude training". Speed training in zero gravity will contribute to new standards in fitness ( Jagday , 2000);
- the standards of competitive activity will increasingly be determined by scientific achievements and the entry of new technologies into sports for the diagnosis and control of the main indicators and factors of sports achievement (Lim et al. 2021) .
- the entry of modern digital technologies will bring the dynamics of competitive workload to unknown levels of development, as often coaches and scientists will borrow statistical information, good practices, forms and methods successfully applied in other team sports (Matt et al., 2004).
- smartphone ownership potentially makes a large number of technologies accessible to all at all levels of athlete, which will enable remote, digital control and diagnosis of sports training (Antonov 2006, Mitchell et al., 2013).

Antonov (2006) adds that the management of training and competition activities in the future will be optimized and will depend mainly on the implementation of computer "digital-remote" technologies for control and assessment of training, and to the most significant extent this will affect the sports training of the national teams.

According to Bachev (2017), specialists classify the group of optical means and methods based on the physical properties and chemical effects of light, apparatus devices and methods. These are methods and means in which the image of a given object is preserved by means of recording through an optical system - for example, a competitor or a sports event. It is then analyzed according to the research objective. The classification of means and methods according to Bachev (2017) is based on their historical appearance and development, namely:

- Means and methods of classical photography
- Means and methods of digital photography
- Digital video -metric tools and methods
- Systems with light-emitting diodes
- Lasers
- GSM devices, Smart-phone , etc. (Mitchell et al. 2013)
- Systems mounted on " drones "
- Other technologies, methods and means

**METHODS**

**The purpose** of our research is to study the development of modern video, computer-hardware and software systems for monitoring, analysis and intelligence, as well as their application for the diagnosis of game activity in team sports games and field hockey in particular.

Achieving the goal requires the following **tasks:**

1. Research and analysis of the most used in sports practice, in the field of hockey, technologies for observation, analysis and intelligence;

2. Preparation of a technical (model) specification and application guide of the most commonly used technologies and methods for analysis, diagnostics and intelligence in the field of hockey

**The object** of the study is the technical means of video surveillance, analysis and intelligence. **The subject** of the study is a description of the technical capabilities, application and functioning of technical means for video surveillance, analysis, diagnostics and intelligence.

**RESULTS AND DISCUSSION**

Today, in their daily lives, athletes - hobbyists, amateurs and professionals - can choose from hundreds of affordable software technologies and mobile applications (Mitchell Mitchell et al., 2013). Modern smartphone- based accelerometers are primarily used for load diagnostics, both from our daily activities and in a range of standard training loads (James Davey & Rice, 2004; Karantonis et al., 2006; Khan et al., 2010). Research shows that accelerometers can be used to identify human activity for high-energy activities such as walking, jogging, jumping, etc. (Long, Yin & Aarts, 2009; Mitchell et al. 2013). In sports, accelerometers are used to monitor elite athletes in a competitive or training environment (Mitchell et al., 2013) . Of course, in the professional sports world, both applications uploaded to mobile smartphones and purely specialized software technologies are used for the purpose of programming, intelligence and diagnostics of top sports achievements. In the professional sports world, pundits and coaches use a number of applications in modern smartphones (Mitchell et. al. 2013), as well as sophisticated GPS-based applications: a sports analysis system made of missile tracking technology, smart tattoos and tooth-mounted sensors. The identity of the future champions depends (also) on the analysis of the data obtained from these devices. Sports intelligence systems in field hockey are developed to monitor and analyze competitive actions with the goal of establishing game effectiveness - individual, group and collective. Although according to Matt et al. (2004) in the late 1990s and early 2000s, video analysis and intelligence technologies with GPS-based applications were not common, today in hockey practice these advanced data collection, processing and analysis technologies providing valuable ability to make timely and effective decisions in real time are an indispensable assistant of any self-respecting coach.

As a result of our research in the available information sources, we found the sports intelligence systems that can successfully implement in hockey science, theory, practice and are an indispensable part of the toolkit of field hockey coaches:

- **Video Analysis Systems:** These are software platforms that allow coaches and analysts to analyze videos of matches. They provide capabilities for marking in-game events and actions, data visualization, player and team comparisons, and generating statistical reports.

- Sensor systems: These systems use sensors and devices that are worn by players or placed on the hockey stick or ball. They can collect data on movements, strength, speed and other game parameters. This data can be analyzed to evaluate player performance and make recommendations for improvements.

- **GPS systems:** GPS systems have been used to track the positions and movements of field hockey players. They provide data on player distances, speeds and trajectories that can be analyzed for tactical and physical aspects of the game.

- **Analytics platforms:** Analytics platforms are software tools that collect, process and visualize data from various sources. They can combine data from video analytics , sensor systems, and GPS systems to create comprehensive analytical models and draw relevant inferences and conclusions.

These field hockey sports intelligence systems help coaches and analysts gain a better understanding of the game and make more informed decisions about training, tactics and team selection.

There are several software solutions on the market that are used for video analysis and sports intelligence in field hockey. Some of the most used are

**Sportscode:** Sportscode is a popular video analysis software that is used in various sports, including field hockey. It enables video analysis, synchronization with sensor data and event tagging . Sportscode provides tools for data visualization and statistical report generation.

**Dartfish:** Dartfish is another popular video analytics solution used in sports. It provides features for video annotation , object recognition and motion analysis. Dartfish also includes tools for creating training programs and sharing video with athletes.

**Nacsport:** Nacsport is software specialized for video analysis in sports. It provides features for viewing and annotating video footage, tagging events, creating statistical reports and visualizations. Nacsport also has built-in tools to compare games and players.

**Coach's Eyes:** Coach's Eye is a video analysis mobile application that can be useful for field hockey coaches and athletes. It provides capabilities to annotate video, slow down recordings, compare frames and share video with others. Coach's Eye is a handy tool for quick and easy game analysis.

Nacsport is a video analysis software developed for sports teams, coaches and analysts who wish to conduct detailed analysis of video footage. With Nacsport , game situations, individual performances, tactics and many other aspects of the game can be analyzed to help make the best decisions and improve team performance. Some of the main features of Nacsport are:

**Video tagging and classification:** With Nacsport, events on video footage can be easily tagged and classified. Custom tags can be created to suit the needs of your team or coaching staff, and events can be grouped into categories that are convenient for you.

**Timeline and management of video materials:** Nacsport offers a timeline that allows to view the video materials in chronological order and to quickly navigate to specific moments of the game. Important events can be marked and videos created for further analysis.

**Analytical Tools:** Nacsport has various analytical tools that help extract valuable information from video footage. Arrows, lines, text elements, shapes, and other graphical tools can be added to the video to highlight important aspects and present observations more clearly.

Statistical analysis: Nacsport allows statistical data to be extracted from video analyses. Reports can be generated and data analyzed on team performance, player efficiency, playing time distribution and other statistics.

**Data sharing:** Nacsport allows to share the analyzed data with the other members of the coaching team or with the players. Videos, reports and presentations can be generated to be used for training, match preparation or communication with the team.

***Nacsport offers products in five main packages.***

**Nacsport Basic** – a tool for easy analysis. For beginners or people with a limited budget;

**Nacsport Basic plus** – is designed for those who want to get the most out of their analysis at a low price;

**Nacsport Scout** – A professional level tool at an affordable price;

**Nacsport Pro -** High-end tool;

**Nacsport Elite** – A professional analysis tool that provides a wealth of tools;

The difference between the two programs is that Elite builds on and improves on the features already available in Pro, but also has a few tools that are completely exclusive **.** The Pro version allows to make up to three button templates (Figure 1), they can be used for sequential video tagging. Elite on the other hand has no such limitations and can create as many current patterns as needed.

Figure 1. Pro version allows to make up to three button templates.

The first difference between the two versions is that in Elite you can connect the buttons in the template together. For example, a goal in hockey is almost always a shot, when registering a goal, the program will automatically register a hit, which makes the analysis easier and complete (Figure 2)

Figure 2. Connection of buttons

There are also applications such as enabling and disabling links, for example a button can be used to measure team possession by linking to the loss and recovery buttons. This means that when Recovery is pressed, the possession counter will enable and pressing loss will disable it. So three different stats can be measured with just one button press which is useful for data collection.

Another significant difference is with the activation of Heat Map shows what's happening in most of the action on the field (Figure 3).

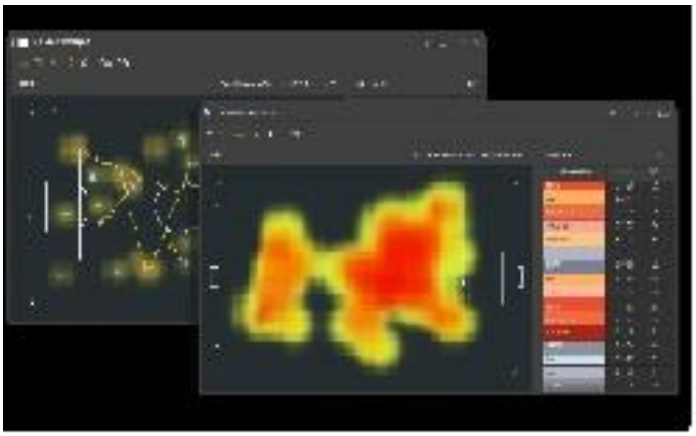

Figure 3. Heat zones

Depending on the program, you can work with one, two, or four videos in one analysis. Nacsport Elite allows working with a maximum of four, and two video streams in real-time analysis (Figure 4).

Figure 4. Video Streams

Nacsport is a powerful video analysis tool that allows you to conduct detailed analysis of hockey matches and extract valuable data and information. It can be useful for coaches, analysts and players looking for a better understanding of the game and improved performance.

## CONCLUSION

In the digital age, the development of modern sports is inextricably linked to the use of technologies for the analysis and intelligence of game actions - own and the opponents. Technologies for video analysis and intelligence are of extremely important importance, both for achieving peak sports achievements, and for the possibility of effective diagnosis of sports training. With particular force, this concerns the development of game actions in collective games, in particular hockey. The use of video surveillance and analysis technologies in a tactical aspect allows us to significantly improve the effectiveness of game actions - individual, group and collective, in the different game phases - defense and attack. Video surveillance and analysis enable us to effectively develop and improve the technique, by eliminating errors, problematic situations and moments, after objectively discovering the cause-and-effect relationships. Technologies also have a significant impact on the development of competition rules, diagnosis and prevention of sports injuries .

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