



# Voice control of a team with a computer coach in basketball (pirs online)

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## Abstract

**Objective of the study** was to evaluate the effectiveness of using the voice control of a basketball team during a match based on PIRS technology.

**Methods and structure of the study.** As part of this experiment, Nano City bluetooth box earpieces were used, operating on Bluetooth 5 within a radius of 200 meters in open space and 50 meters indoors. The following options were considered: the use of software that synchronizes sound from a computer to a smartphone (sound wire program), a collective call in any messenger, software for creating virtual channels for connecting sound transmission devices for a computer (VAC control panel, Audio repeater).

**Results and conclusions.** For the experiment, we took the game of student combined institutes of Yekaterinburg. The unprofessional status of the players made the job difficult. Also, difficulties arose with unexpected substitutions or arrangements for the opponent, since a recalculation of all parameters was required. Some of the players could not adapt to the novelty during the match. It was possible to translate into real action only 36% of the recommended combinations. Nevertheless, we got a result 14 points better than when the same teams played a month earlier.

**Keywords:** *basketball, tactics, computer coach.*

**Introduction.** The PIRS technology and its various aspects have been repeatedly discussed in the pages of the journal [3, 5, 6]. Let us recall several aspects.

In team sports, the result - the difference between goals scored (S) and goals conceded (C) can be decomposed into the differences  $S_i - C_i$  that make up the team of players. For each player, the similarly created difference  $S_i - C_i$  can be decomposed into differences  $S_{ij} - C_{ij}$  of this player in terms of 50 components (technical-tactical martial arts, TTMA) of the game [1]. For the convenience of work, these always paired numbers are translated into one number - the rating. It is convenient that these ratings allow you to compare teams, players, players by game components for those teams that have not yet played with each other. A high degree of rating stability makes this possible.

Existing Instat, WyScout and other systems are forced to somehow work with the data of the team when it plays with the leader on his field and with the outsider on his own, which excludes the usefulness

of their efforts. However, PIRS technology has a difficulty - it cannot be implemented online. As a rule, they get a miscalculation of the previous matches of both future opponents, after which the players of the ward team have to remember a lot of interactions and restrictions. The potential of the technology will be leveled by different abilities of players to memorize and reproduce recommendations. However, we have not yet trained a convolutional neural network (CNN) to qualitatively recognize the technical and tactical martial arts of players. Therefore, the first part of PIRS was done traditionally. The novelty was in the connection of a voice prompt to the player's micro-earphone, which was launched by the coach from among the solutions pre-formed by the computer.

Computer technologies are gradually being introduced into sports. However, several problems stand in the way of this process. First of all, this is the ability to translate the image of a sports duel into technical and tactical actions, techniques performed, etc. The very



model of a team sport causes great difficulties. As a rule, this problem is shifted to the same convolutional neural network (CNN). To do this, CNNs are trained on the decisions of an experienced trainer or statistical patterns. However, shifting the search for the optimal solution to a neural network is obviously an absurd way. CNN will simply repeat what it has been taught.

**Objective of the study** was to evaluate the effectiveness of using the voice control of a basketball team during a match based on PIRS technology.

**Methods and structure of the study.** The specifics of basketball is that 24 seconds are allotted for an attack, and a hint, say, for 15 seconds, is no longer relevant. The coach can use wireless earpieces to control the game. In the framework of this study, earpieces operating on Bluetooth 5 were used within a radius of 200 meters in open space and 50 meters indoors. Such micro-earphones are still little represented on the market. The Nano City bluetooth box has a K5 capsule size that is not visible in the ear. The kit includes a Bluetooth device, an earpiece, a usb cable and two batteries (337SR416SW). According to the duration of work, the bluetooth device works for 20 hours in talk mode, it takes 4-5 hours to charge. The batteries in the earpiece last for 3-4 hours, then it needs to be replaced with a new one. It is characteristic that the purpose of the goods is an earpiece for certification; for the session. Compatible with any smartphones, mobile

phones. It is necessary that the information of the computer assistant reaches 10 earpieces with a minimum time delay.

The following options were considered:

- use of software that synchronizes sound from a computer to a smartphone (sound wire program),
- collective call in any messenger,
- software for creating virtual channels for connecting sound transmission devices for a computer (VAC control panel, Audio repeater).

All options have been tried. The method with the sound wire program, which synchronizes sound between a computer and a smartphone, turned out to be inoperative. Bluetooth in a laptop supports the simultaneous operation of only one device, and in this version, you need to connect 10 smartphones to a laptop and 10 earpieces to smartphones. Then the option was tested with connecting one device to a laptop. The sound from the laptop was also synchronized by the sound wire program and a group call was made from this device to other smartphones. Microphones were connected to them. The sound from the laptop was transmitted to the smartphone connected to it. However, when calling to other devices, it was not audible. The only option left is software for creating virtual channels for connecting sound transmission devices for a computer (VAC control panel, Audio repeater),

for this you need to connect all wireless headphones to a laptop and assign each one its own virtual communication channel, in this case the sound from the laptop really reaches everyone earpieces connected to it, but the transmission occurs gradually (from the first channel to the second, from the second to the third, etc.). At the moment, this is the most effective option. Another task is scoring from the side of the computer itself. For this, the capabilities of Excel were used (Fig. 1)



**Figure 1.** Speak function in Excel

**Necessary information presented to the players.** Initially, it is clear that the hint is needed in a timely manner and should not develop into a lecture. Players simultaneously heard information common to them. It was structured like this:

- **replacements.** Example: 16, 18 replacing 4, 8. Explanation - No. 16 and No. 18 leave. Come out No. 4 and No. 8

- **changes in defence.** Example: 4 and 6; 5 and 14; 18 and 64; 42 and 15; 82 and 11. Explanation - these are five pairs - the numbers of "our" and the opponent in the exchange when playing on the defensive. The player understands who to patronize.

- **the most deviating from the required indicator.** Example. No. 4 - 3-point shots - 4 on 2. Player No. 4 only needed to make two 3-point shots, and he already overshot to 4.

**Attack combination.** The most difficult aspect. There are about 200 combinations in the dataset, which can have an individual name. To advance in this matter, it was decided to name the exchange and the type of technical-tactical martial arts (TTMA).

Example: 4 and 8 "beating", 16 and 8 - "throw". Explanation. Player No. 4 of "our" team beats No. 8, pulls No. 8 onto himself and allows No. 16 to be thrown.

**Clue moment during play:** after a successful attack on both rings, time out or any stoppage of the game. In basketball, there are many stoppages of the game, which makes it much easier to bring information to the player. Receiving tips, the player gradually learns how best to act against this opponent. Even when it comes to counter-attacking, where the hint doesn't keep up with the game.

The analyst-coach (Fig. 2) looks at the composition of the game participants, the formation, finds it in the match scenario and launches a voice prompt with previously planned solutions in PIRS technology.

The experiment was carried out during the tourna-



**Figure 2.** Schematic representation of the operation of the voice assistant

ment - the championship of the Student Basketball Association (ASB) division of the Sverdlovsk region. The participants are student men’s basketball teams of the Nizhny Tagil State Social and Pedagogical Institute (NTSSPI) and the Ural State Economic University (USEU) (Table 1).

**Results of the study and their discussion.** Initially, there was doubt that non-professional players could remain motivated to play an undecided game and be able to follow directions. The effect increased during the game from the first quarter to the third. As fatigue accumulated, the desire for game creativity gradually disappeared.

In this case, two matches were played. The first allowed to collect information on the players of both teams. This game took place on 03/11/2022. The score of the first meeting was 87:82 in favor of NTSSPI. One of the authors (I. Kudryavtsev) is the coach of the USEU national team, and a study was done in favor of this team. The first match was lost by USEU with a difference of five points. The replay of the teams took

place on 04/16/2022. The score of the game with the participation of PIRS online technology is 104:83 in favor of USEU. Thus, the first attempt led to a change in the score from -5 to +21. That is 26 points. However, the calculated limit value of the score with the ideal game of USEU gave 62 points of advantage. In the direction of growth, the most affected were:

- Three of the weakest players of the USEU team did not receive playing time. The team began to play in 1-2 substitutions;
- restrictions for each player on the number of shots made;
- the response of team players to a planned TTMA in the absence of such in case of improvisation.

**Table 1.** Participants of the match

NTSSPI		USEU	
Ve-v Danil	№ 6	Sa-v Ruslan	№ 4
Er-n Egor	№ 8	No-v Danil	№ 5
Le-v Vyacheslav	№ 11	Mi-n Daniel	№ 6
Mu-v Alexey	№ 13	Da-v Timothy	№ 7
Co-v Vitaly	№ 3	Che-y Arseny	№ 8
Fe-v Artem	№ 9	Av-v Eugene	№ 11
Hu-y Alexander	№ 2	Ku-v Roman	№ 12
Sht-y Artemy	№ 4	Hee-v Bogdan	№ 13
		Mi-ch Mikhailo	№ 14
		Ar-v Arseniy	№ 16
		Ep-v Vyacheslav	№ 17

**Table 2.** Deviations of the overall balance of martial arts from the recommended level in the last quarter of the match

Player	Attack		Defense		Deflection
	Recommended	In fact	Recommended	In fact	
5	12	9	8	20	-9 ↓
12	8	5	5	7	1 ↓↑
11	6	10	13	11	-2 ↓↑
13	6	7	6	4	1 ↓↑
16	3	8	6	7	-6 ↓

As an example, let’s show table 2 for the last 4th quarter. First of all, the PIRS algorithm left five players on the field for the last quarter without substitutions. The players managed to get closer to the requirements for martial arts in the attack, but there was a big deviation when playing on the defensive. With a quick transition from defense to attack, players often did not have time to sort out the attackers on the recommendation.

**Conclusions.** The journal Theory and Practice of Physical Culture previously published articles on the



PIRS technology [2, 4, 5], which allows you to build a scenario for the upcoming meeting from exchanges, restrictions on game martial arts, combinations for the opponent's placement to achieve the maximum possible result. However, it is still unrealizable online and requires the player to memorize all the recommendations.

An attempt to transfer the technology online was associated with involvement in the management of the game with the help of micro-earphones, which are not visible from the outside. The algorithm calculated in advance the most effective solutions for each opponent's arrangement. During the game, the analyst-coach compared the picture on the field with the arrangement on the field, chose the matching option in the match scenario and included the voicing of the recommendation by the "speak cells" function in Excel. The signal was sent directly to the player's Bluetooth by the VAC control panel program.

For the experiment, we took the game of student combined institutes of Yekaterinburg. The unprofessional status of the players made the job extremely difficult. Nevertheless, we got a +21 result better than when the same teams played a month earlier.

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