STUDIA SPORTIVA 2011/5, Nr. 3, p. 63-72

Kinematic Structure of Selected Viennese Waltz Dance Figure

Špánik Milan[1] , Psalman Vladimír[2] , Zvonař Martin[2]

[1]Fakulty of Physical Education and Sport, Comenius University Bratislava, Slovakia
[2]Faculty of Sports Sciences, Masaryk University, Brno, Czech Republic

Abstract:

The goal of this study was to gain knowledge of the kinematic structure of the dance figure Fleckerl dance Viennese Waltz (standard dances). Then we try to document the variations in the technique in two levels of performance presented by pairs, one represented the highest performance Class „S" in dance sport and the second pair was for medium performance Class „B". For recording we used two high-speed cameras Basler A602FC and Simi Motion Markers. The processing and evaluation of the kinematic parameters we obtained by using the software Simi Motion 3D created by German company SIMI Reality Motion Systems GmbH. We focused on key moments – arrival (touch) the ground and rebound (take off) in selected dance steps. Afterwards we compared the two different performance classes at selected moments of the movement. For evaluation of movement we used the method of expert evaluation realized by dance sport judges with the highest international judge license in order to ascertain (to be sure) whether dance figure was done correctly from technical aspects of the movement.

Key words: *Dance sport, Viennese Waltz, Natural Fleckerl, 3D Kinematic Analysis of Movement*

INTRODUCTION

Dance sport as a sport discipline has very short history, even though the social dances are known worldwide for a long time. In recent years, this sport discipline moves forward as a sport and as dance art not only in the world, but also in Slovakia and the Czech Republic. We are inclined to opinion of Špánik st. (2002), that the dance sport is artistic and athletic form of social dancing. Social dance is divided into three competition disciplines: Standard dances (5 dances), Latin dances (5 dances) and a combination of both (10 dances).

Dance sport supports and forms of physical fitness, endurance, discipline, teaches aesthetic feeling, collective feelings and develops a relationship with music. All mentioned is because there is connection between art and sport, and motion activities are carried out by two people of different sexes. Odstrčil (2004) characterizes the dance sport in a special way: For athletes – dancers it is like a lifestyle. It gives them everything like also other sports offer - physical and mental exertion/loading, fitness, knowledge of different people, countries, cultures, a sense/feeling of victory and lost, team spirit as well as individual excellence. The basis of the standard dances, such as points Komora (1982) and Odstrčil (2004) is mainly natural walking step up which efforts to ease and form that lifted up into the field of aesthetics.

The technical characteristics of the Viennese Waltz is primarily based on the definitions of Loja (2006), Komora (1982) and SZTŠ (2010). It is specific and active movement of the perimeter of the floor. Dancing is at a high pace, which puts great demands on the physical condition of dance pairs. The beat in the Viennese Waltz is ¾ and frequency during the compe-

tition was recorded in range 58-60 beats per minute. One music beat has three strokes. Each stroke consists of one step. Like the other standard dances also the Viennese Waltz has rises and falls, but they are not as great as in the English Waltz. Swing to the rotation is performed in the first part of turn.

Technical description of the steps examined routine is as follows. Partner: The first short step flat with the right leg is in forward direction. The rotation begins to the right. Direction is completed facing diagonal wall. Foot touch on the floor is through the heel and the movement continues further from the tip of the foot. The second step is made flat by left leg with weight distributed on both feet. Rotation is performed in the range of 135 ° (3/8) to the right. Direction is completed in backing line of dance and touch is on the fore-foot. The third step is the rotation on the right leg in the range of 180 ° (1/2) right on the flat finished in facing line of dance. Touch is performed across the front part of the foot up to the heel. The fourth step is realized by left leg flat to the right side with rotation of 45 ° (1/8) and is completed in facing wall position. This step is performed across the front part of the foot up to the heel of supporting leg. The fifth step is strongly crossed by the right leg and the weight remains on left leg with a rotation of 180 ° (1/2) right flat. Foot touch on the floor leads across the front of the foot and flat. The rotation is completed at the facing diagonal center against line of dance. The sixth step is the rotation on the left leg with foot rotation of 180 ° (1/2) right and flat. Touch is made across the front part of the foot to the heel with facing diagonal wall finishing. Technical description of the woman partner steps: Steps of woman are danced oppositely to her partner. She starts her movement by using steps 4, 5 and 6 and then dance steps 1, 2 and 3. Change is in steps 5 and 6 which are not danced flat, but dancing with soft rise.

Rhythmic values (Beats) of the both partners steps are: 1, 2, 3, 1, 2, 3. The sport performance in the dance sport is evaluated by judges. Their task is to distinguish each other and compare the performances presented pairs in the observed area, which is available. By the evaluation of Odstrčil (2004) we have the following criteria:

A - Timing and basic rhythm
B - Body lines
C - Movement
D - Rhythmic interpretation
E – Footwork
F - Floorcraft

In improving of technical preparation plays a biomechanical motion analysis one of the key role, because it recorded temporal and spatial changes during specific dance figures and lines in their phases and micro phases. It highlights the key features of the sport technique of dancing figures, which may subsequently improve practice through preparatory exercises. Based on these facts, the process of motor learning is improved (Duvač, 2006). It is necessary to divide each step in two phases: a step and a cradle.

Step is part of the movement when the moving lower limb begins to move on the floor in the space-time, passes the stance leg further forward or backward to the moment of contact the ground, when begins the cradle. This is the first phase of the step in each dance figure.

The cradle (wobble) is part of the movement, when feet do not move on the floor space. From the moment of stopping the movement of the lower limbs in space, through a center of gravity shift from the stance to walking leg, which will be the further standing leg, up to the moment

when exceed that in the moment becomes stance leg up to the moment when the toe or heel of the new walking leg does not move in space on the dance floor. It is the second phase of the step during the movement in the each dance figure (Špánik, 2009).

We agree with the statement of Psalman (2009), that sport technique is a useful way of dealing with physical tasks, according with the individual capabilities, with biomechanical laws of movement conducted on the basis of neurophysiological mechanisms of motion control. Dance performance required fitness, coordination, physical and psychological assumptions of athletes.

Biomechanical three-dimensional (3D) motion analysis contributes to the accurate and detailed assessment of technique and brings a possibility to detect weaknesses and strengths in the technical demonstration (Sebera et al., 2007). The subsequent analysis can highlight the key factors influencing the final dance performance. The advantage of this measuring system has no effect on the behavior of the measured object, because the actual measurement is not performed on a particular object, but only on his/her record (Psalman,2010).

METHODS

The research sample was composed of three dance pairs. Two couples belong to high dance performance Class „S" are members of Slovak National Team. One of these pairs is champion of the Slovak Republic and the second is actual vice-champion. The third pair of the research has dance performance which is indicated like Class „B".

Table 1 – Age, weight and height characteristics of research sample

Characteristics	Man Pair 1	Woman Pair 1	Man Pair 2	Woman Pair 2	Man Pair 3	Woman Pair 3
Calendar age	29	20	24	21	21	25
Weight [kg]	72	60	70	53	87	55
Height [m]	1,775	1,684	1,825	1,679	1,815	1,682

To obtain a selected kinematic parameters of dance figures, which were made in Basler training conditions, we used the method of recording by using two high speed cameras A602FC with frequency of 500 frames per second. Cameras captured the movement from two different directions and were calibrated by measuring two poles of known length. This method allows us to capture video and then create a realistic three-dimensional space. Using this we are able to obtain a very precise kinematic indicators in all three axes x, y, z (horizontal, vertical and lateral movement) and they sufficiently recorded not only selected segments of the body, but also a movement of the athlete.

During recording, the music for the all couples was the same. Viennese Waltz - Wonderful Copenhagen - World String Orchestra and Choir were in rate of 60 beats per minute. For processing and evaluation of the obtained kinematic parameters was used software Simi Motion 3D of German company SIMI Reality Motion Systems GmbH. With this software in each frame the observed points were highlighted by reflective markers of Simi Motion with the aim to track body segments (left and right: shoulder, elbow, wrist, hip, knee, ankle). In the case, if it would not see the body segment, the software generates a point on the previous and next image information.

Using three-dimensional biomechanical analysis of movement, we observed the following key phases of movement:

- Setting the first step (knee joint) - the angle of arrival, the angle of rebound, support time, time duration of the step and cradles,
- Setting the second step (knee joint) - the angle of arrival, the angle of rebound, support time, time duration of the step and cradle,
- Setting the fifth step (knee joint) - the angle of arrival, the angle of rebound, support time, time duration of the step and cradle,
- Height of center of gravity of the dance pair.

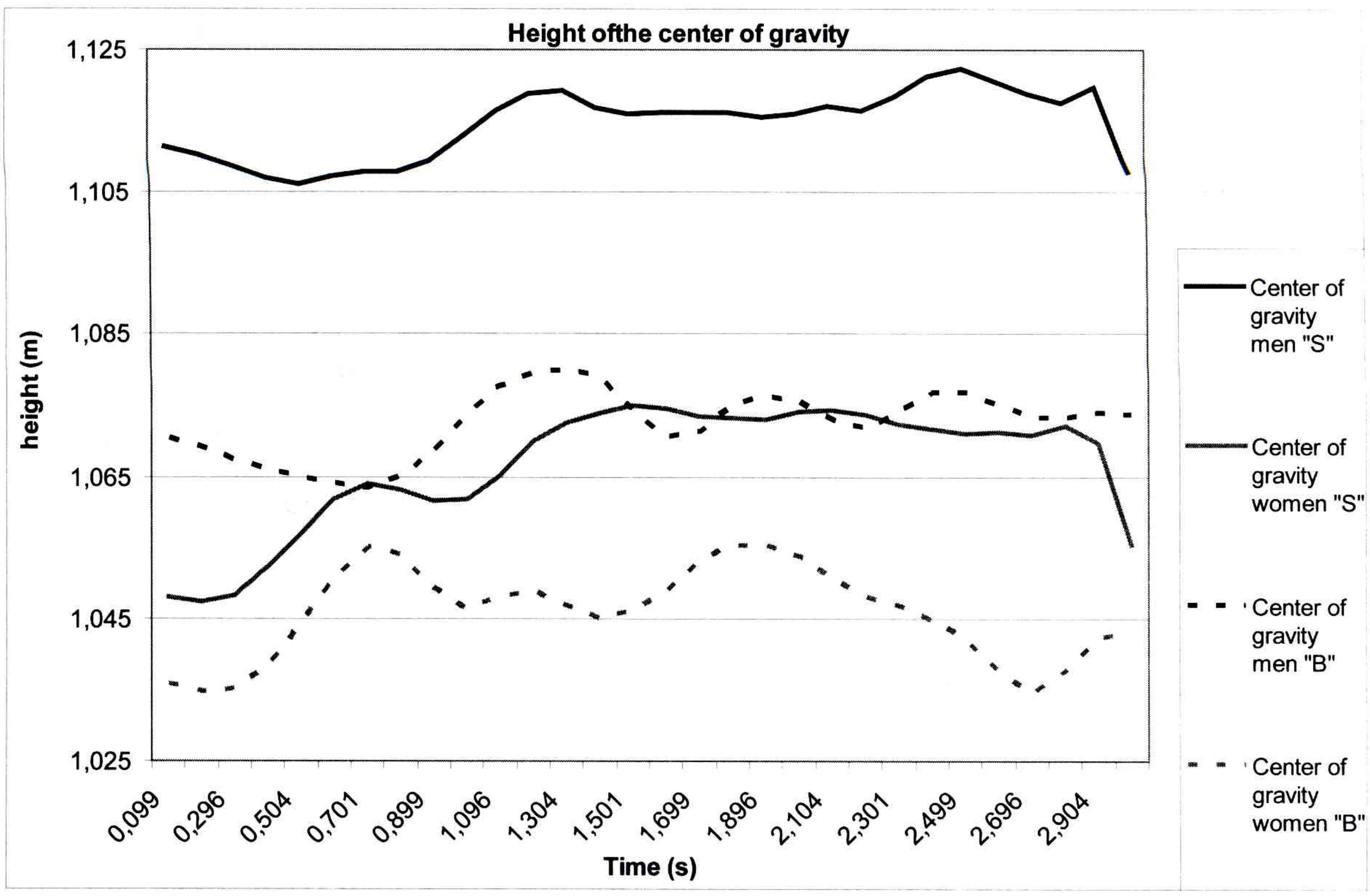
RESULTS

From all measured values we calculated average values from three attempts of dance performance Class „S" (2 pairs) and Class „B" (1 pair). We recorded the height of the center of gravity during the first six steps of dance figure. Time difference is approximately 0,1s.

Table 2 – Height of the center of gravity (COG) during dance figure

Time (s)	Height of COG (m) Man in pair 1	Height of COG (m) Woman in pair 1	Height of COG (m) Man in pair 3	Height of COG (m) Woman in pair 3
0,099	1,112	1,048	1,070	1,036
0,198	1,110	1,047	1,069	1,035
0,296	1,109	1,048	1,067	1,035
0,405	1,107	1,052	1,066	1,038
0,504	1,106	1,057	1,065	1,044
0,602	1,107	1,062	1,064	1,051
0,701	1,108	1,064	1,063	1,055
0,800	1,108	1,063	1,065	1,054
0,899	1,109	1,062	1,069	1,049
0,998	1,113	1,062	1,074	1,046
1,096	1,117	1,065	1,078	1,048
1,205	1,119	1,070	1,079	1,049
1,304	1,119	1,073	1,080	1,047
1,403	1,117	1,074	1,079	1,045
1,501	1,116	1,075	1,075	1,046
1,600	1,116	1,075	1,071	1,049
1,699	1,116	1,074	1,071	1,053
1,798	1,116	1,073	1,075	1,055
1,896	1,116	1,073	1,076	1,055
2,005	1,116	1,074	1,075	1,054
2,104	1,117	1,074	1,073	1,051
2,203	1,117	1,074	1,072	1,048
2,301	1,118	1,072	1,074	1,047
2,400	1,121	1,072	1,077	1,045
2,499	1,122	1,071	1,077	1,042
2,598	1,121	1,071	1,075	1,038
2,696	1,119	1,071	1,073	1,034
2,805	1,118	1,072	1,073	1,038
2,904	1,120	1,070	1,074	1,042
3,003	1,108	1,056	1,074	1,043

The pairs of Performance Class „S“ offers more improved performance of dance figures, the shape of the curve of centers of gravity is more similar, thus both partners have smaller differences in vertical fluctuations between them. Demonstration routine is compact, smooth and without any disturbing elements in the contact of dancing couple. At the third pair of Class „B“ is visible a different amplitude in curve of center of gravity and therefore a dance is not so compact. The pairs of Class „S“ have trajectory of the center of gravity flatter than a pair of Class „B“ as shown in picture 1. During this routine should not greatly alter the center of gravity, as the proper performance of dance figures is flat. The movement of the centers of gravity are shown in table 2.



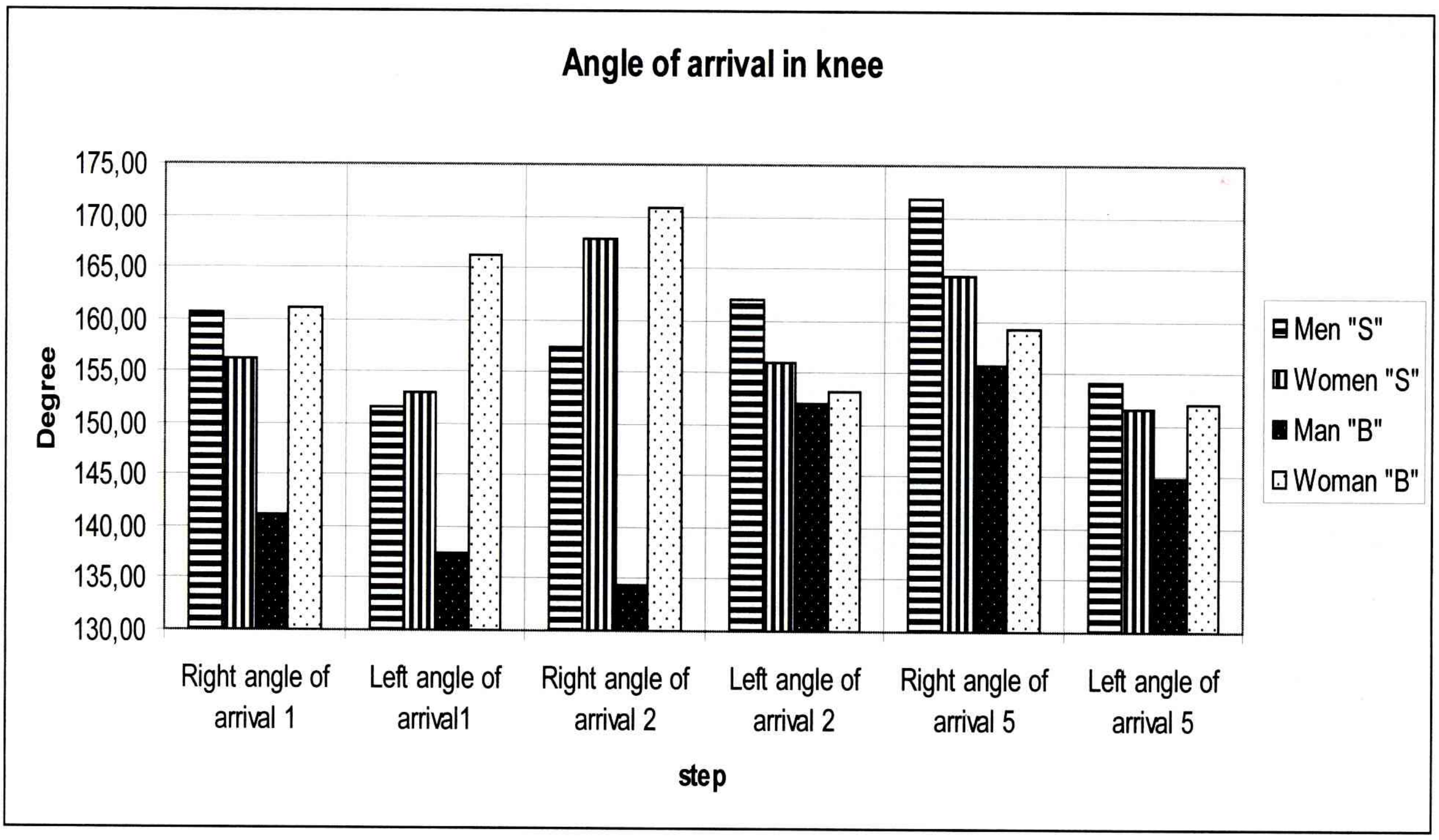
Picture 1 – Height of the center of gravity

Step 1

The partners of the highest performance class „S“ achieved in the first step in the moment of leg arrival on the floor mean values of knee joints, it was 160.69 ± 2.48° for the right and 151.67° ± 6, 83 for the left knee. At the pair of Performance Class „B“ was found a sharper angle 141.08° ± 16.39 for the right knee and 137.46° ± 5.64 for the left knee. The duration of the first step in this performance was 0.69 ± 0.1 s, comparing to pairs of the highest performance class with a value of 0.66 ± 0.16 s. Female partners “S” grade attained angles at the moment of arrival in the right knee of 156.28° ± 12.17 and 152.86° ± 26 in the left knee. Duration of the step was 0.47 ± 0.15 s. The knee angles of the female partner „B“ grade was measured in the right knee of 161.08° ± 6.3° and in the left 166.25 ± 1.4, with step duration 0.53 ± 0.05 s.

It follows cradle (time value from the moment of arrival up to the moment of rebound), which was found in male partners of Class “S” time value 0.07 ± 0.05 seconds and female partners of 0.09 ± 0.03s. For a pair of Class „B“, we found values of 0.08 ± 0.07s - male partner and 0.11 ± 0.06s – female partner. Graphical presentation is shown in picture 4. At the moment of rebound to the next step we evaluated the following values in the knee joint at the pairs of Class „S“. The right knee of male partners is 163.79° ± 5.53 and left 145.31 ±

12.74. Male partner of Class „B“ has reached a lower values: 141.9° ± 13.51 (right knee angle) and 128.5° ± 5.98 (left knee angle). Female partners of the highest performance class achieved the following angles: Right knee 167.12° ± 7.48 and left knee 149.59° ± 28.25. Female partner from lower class „B“ reached angle 167.68° ± 2.76 in the right knee and 165.74° ± 1.95 in the left knee. All the angles are shown in pictures 2 and 3.



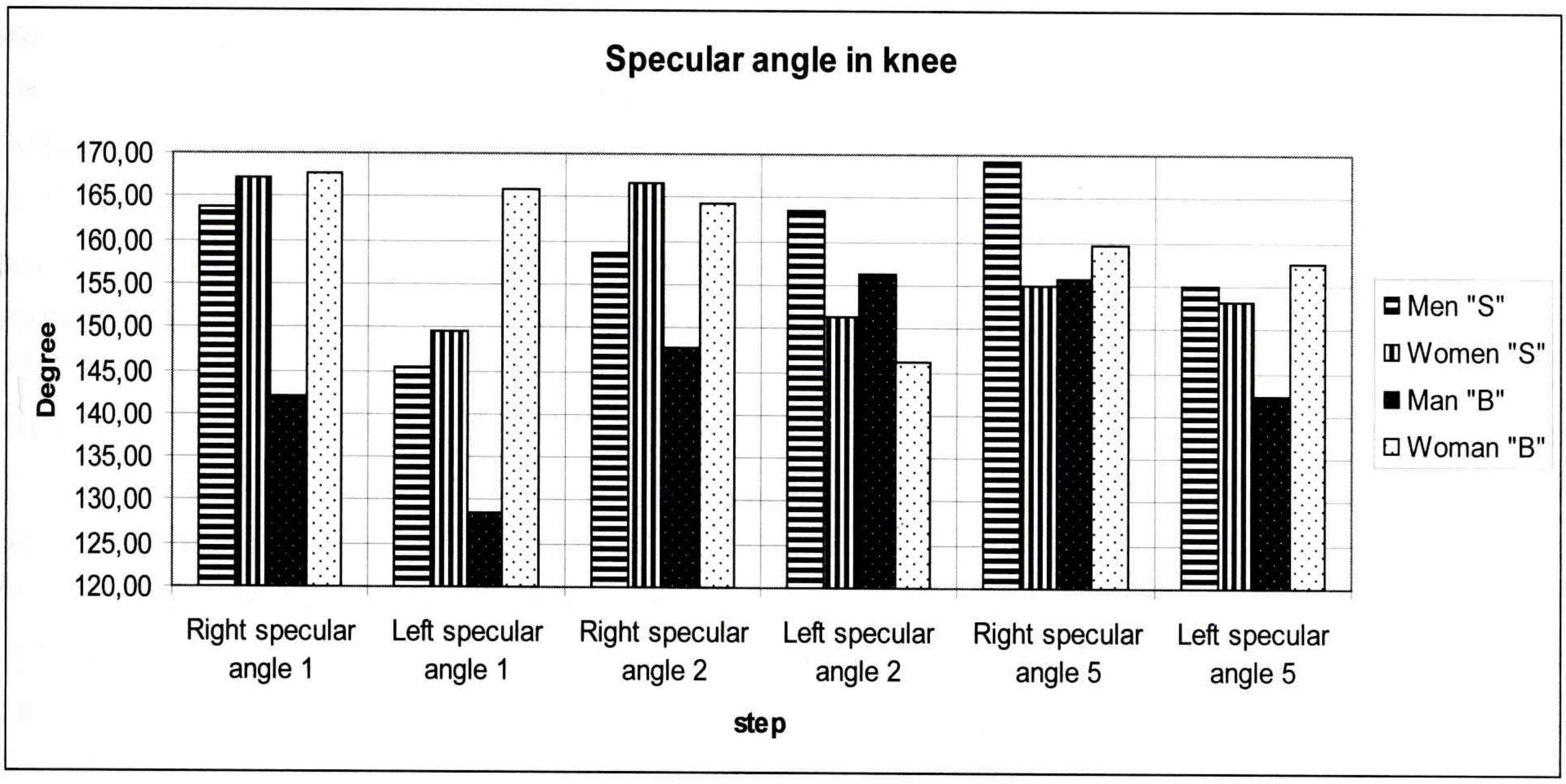
Picture 2 – Angle of arrival in knee joint

Step 2

Male partners of the Class „S“ in the moment arrival on the floor achieved following mean values of knee angles: 157.48° ± 6.2 (right knee) and 162.12° ± 5.59 (left knee). Male partner with performance Class „B“ made sharper angles in knee joints like in the step before and achieved values: 134.36° ± 25.85 (right knee) and 151.99° ± 6.6 (left knee). Duration of the second step was 0.24 ± 0.02s for pairs of Class „S“, which was significantly different from the dance pair of Class „B“ with a value of 0.38 ± 0.06s. Female partners of Class “S” obtained at the moment of arrival in the right knee angle of 167.75° ± 5.15 and in the left knee 156.07 ± 9.67. Duration of the step was 0.43 ± 0.05s. Female partner Class „B“ had angle of 170.75° ± 6.42 in the right knee and 153.30° ± 3.11 in the left knee with step duration of 0.48 ± 0.07s.

Then followed the cradle in which was found in male partners of Class “S” time value of 0.11 ± 0.04s and 0.07 ± 0.03s in female dancers. For a pair of Class „B“, we found values of 0.14 ± 0.04s (male partner) and 0.06 ± 0.03s (female partner). These results are shown in picture 4.

At the moment of rebound to the next step we evaluated the following values for pairs of Class „S“. Male partners reached right knee angle 158.54° ± 10.62 and left knee angle 163.55° ± 8.35. Male partner Class „B“ went to the lower values again, as it happened in step one. The angle of the right knee was 147.62° ± 17.89 and of the left knee 156.33° ± 5.54. Female partners Class “S” achieved the following angles: right knee 166.51° ± 5.84 and left knee 151.37° ± 7.60. Female partner from the lower Class „B“ had recorded the following angles 164.22° ± 5.54 in the right knee and 146.29° ± 7.82 in the left one. All these angles are shown in pictures 2 and 3.



Picture 3 – Specular angle in knee joint

Step 5

Measured knee angles of male partners from the highest performance class at the moment of arrival were 171.74° ± 7.48 in the right and 154.22° ± 9.88 in the left knee. At the partner of Class „B" was found a different angle 155.83° ± 18.87 in the right knee and 144.86° ± 3.19 in the left knee. Duration of the fifth step was 0.45 ± 0.03s comparing to the pairs of the highest performance class with values of 0.31 ± 0.08s. Female partners Class "S" obtained it the moment of arrival in the right knee angle 164.31° ± 6.63 and the left 151.51° ± 13.56. Duration of the step was 0.26 ± 0.02 seconds. Female from Class „B" had measured angle of 159.27° ± 5.52 in the right knee and 152.12° ± 7.18 in the left knee, duration of the step was 0.32 ± 0.03s.

The measurements during the cradle position found following values in partners Class "S": time value of 0.06 ± 0.02s (males) and 0.07 ± 0.04s (females). For a pair of Class „B", we found values of 0.06 ± 0.03s (male) and 0.12 ± 0.04s (female), which represents picture 4.

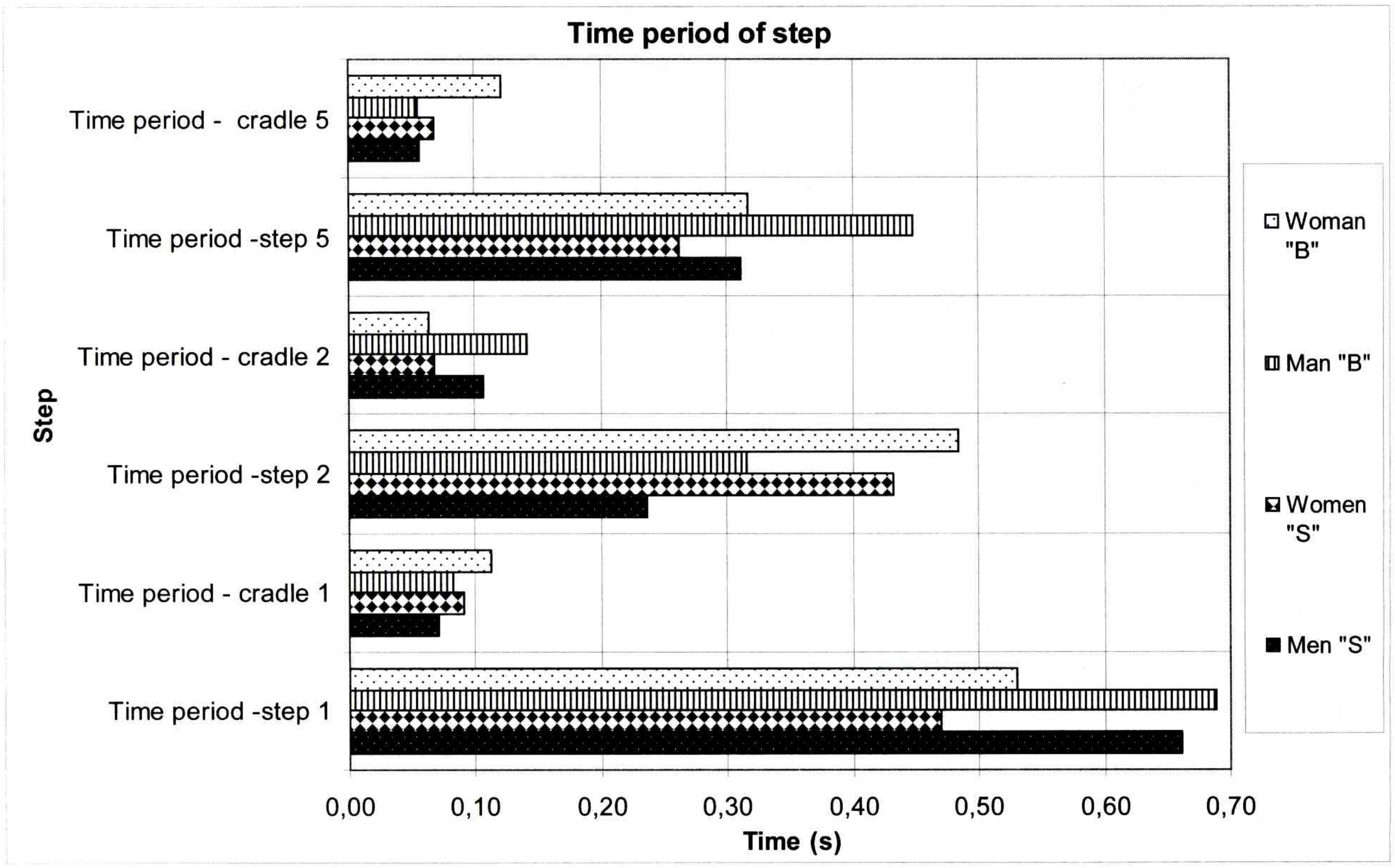
At the moment of rebound in the sixth step, we measured the following values in the knee joints with couples Class "S". Recorded values of males were 169.15° ± 5.33 (right knee) and 155° ± 8.76 (left knee). Male partner from Class „B" reached 155.85° ± 24.02 in the right knee and 142.39° ± 3.43 in the left one. Female partners Class "S" achieved the following values: right knee 155.03° ± 7.01 and left knee 153.22° ± 18.89. Female partner class „B" has reached an angle of 159.77° ± 6.14 in the right knee and 157.56° ± 6.56 in the left (see pictures 2 and 3).

The angle of the knee joint in arrival and rebound moments are clearly sharper, so that male partner with performance Class „B" is dancing in a very bent knees. Couples from Class „S" reach higher angles of the knee, allowing them greater flexibility in presentation. It gives them the opportunity, if necessary, use a wider range of work in the knee and then correct the performance of dance figures. Male partner Class „B" is seen it the arrival time of the fifth step unreasonably long time value, which can cause delays in rhythmic demonstrations. This was confirmed by worse judge evaluation.

Female partner of Performance Class „B" has minor differences comparing to the knee values of females from Class „S". The time values of the steps and the cradle are

more similar than it was in male dancers. There were found only minimal differences, which should not undermine the performance of dance figures.

The pairs of class „S" reach both male and female partners more similar angles resulting in a more compact presentation of dance figures. By that, the male partner from Class „B" does not have sufficient mastery of technique and movement, his angles in the knee joints are sharper, unlike his partner's ones. This leads to incompact performance and its quality is evidently lower.



Picture 4 – Time period of selected steps

DISCUSSION

Three-dimensional kinematic analysis in dance sport was realized in the Slovak Republic for the first time. For this reason, we have obtained results which cannot be compared to the other authors, because studies published in the world are concerning other dances, or other dance figures. Each dance has a different dance figures, beat and rhythm and therefore dance are hardly comparable. A similar study was researched by Špánik (2009), which analyzed dance movement in Slowfox dance, especially figures of Feather step and Tree step with the help of two-dimensional biomechanical analysis. The differences in these dances do not allow us to compare these results with each other. There also exists some studies from sport gymnastics or sports aerobics but they are incomparable with dance sport, because from biomechanical point of view they are evaluated in other way than dance figures. The main difference between the dance sport and other sports is, as is also seen in the publications that the performance in dance figures, brought the perfect pair performance, varies. It shows the high values of standard deviation for each data referred to, which is even seen in the pairs from the highest performance Class "S". In all experiments the judges evaluated their performance as very good. So the dance pairs did not any serious technical errors and their presentations of the dance figures are differed.

This can be attributed to their perfect techniques and variability in a similar way and they can hide any defects or technical problems during dance figures that the judge had no opportunity to see them. For a dance pair of Class "B" are these differences due only to motor learning of dance figures. As the performance of dance figures were also by the meaning of judges at a lower level, there appeared some mistakes in technique and timing.

CONCLUSIONS

The evaluation in dance sport is not based on kinetic analysis of movement, because the judges do their decisions by comparing dance pairs together. They do not evaluate performance of dance figures and presentation separately. For a proper understanding of dance figures, for its proper performance, whether it is man, woman or pairs, the biomechanical analysis and kinetic analysis as its part as well, has a significant contribution to the further development of dance sport.

We believe that monitoring of technical variants in selected figures of standard dances contributes to the improvement of the training process and to the best demonstrations in dance competition. Transfer of this knowledge into the sport praxis could help coaches in working with dance pairs, especially in area of the compactness of the pair.

In the future it would be a significant benefit if three-dimensional biomechanical analysis of movement was realized in cooperation with World Champion dancers because each champion has a lot of variations due to individual presentation techniques of dance figures. All mentioned above is valuable for description of perfect technique and this brings a contribution from the world champions. Based on this information and the differences, mistakes in dancing could be corrected in many dance pairs. Although it should be noted that the dance sport is an art sport, which belongs to the aesthetic sports and dance judges evaluated the pairs not by their mistakes, but their evaluation is based on comparison of pairs in the dance competition.

References

DUVAČ, I. 2006. Meranie a testovanie v telesnej výchove a športe. In: Štruktúra poznatkovej bázy vied o športe. Bratislava: FTVŠ UK, s.85-101. ISBN 978-80-89197-65-1.

KOMORA, J. 1982. Základy Štandardných tancov. Bratislava: Tanečné oddelenie Osvetového ústavu a Krajské osvetové stredisko v Košiciach, 1982, s. 3-47.

LOJA, P., 2006. Technika štandardných tancov – Valčík. Bratislava: Slovenský zväz tanečného športu, 2006. s. 44.

ODSTRČIL, P., 2004. Sportovní tanec. Praha: Grada Publishing, a.s., 2004, s. 115. ISBN 80–247–0632–6

PSALMAN, V., ŽÁK F., 2009. Športová technika a jej hodnotenie prostredníctvom 3D biomechanickej analýzy pohybu. In: Slovenský školský šport: Zborník prác z národnej konferencie o školskom športe. Štrbské pleso: Slovenská asociácia univerzitného športu v spolupráci s Ministerstvom školstva Slovenskej republiky, 2009, s. 228-237.

PSALMAN, V. 2010. Hodnotenie športovej techniky z aspektu biomechaniky. ICM AGENCY. ISBN 978-80-89257-22-5.

SEBERA, M., ZVONAŘ, M., BEDŘICH, L., CHARVÁT, M., PSALMAN, V. 2007. SIMI Motion – 3D biomechanická analýza. In: Studia Sportiva, 2007. č. 1, s. 26-31.

SLOVENSKÝ ZVÄZ TANEČNÉHO ŠPORTU, 2010. Súťažný poriadok. Bratislava: SZTŠ, 2010. 67 s.

ŠPÁNIK st., M., 2002. Teoretické spracovanie modelu rozvoja koordinačných schopností v tanečnom športe v kategórii Junior a Mládež. Záverečná práca. Bratislava: FTVŠ UK, 2002, 62 s.
ŠPÁNIK, M., 2009. Biomechanická analýza vybraných tanečných figúr v štandardných tancoch. Diplomová práca. Bratislava: FTVŠ UK, 2009. 91 s.