

Vach,K.: Analyses of E.Nool's foot movement during the alleged overstep at OG in Sydney 2000. (Selected parts of the Technical report, EuroGV, 2001)

1. Technical order, data overview

The order at the EuroGV, s.r.o., was performed on the base of the Czech Athletic Union (CAU) demand of:

Analyses of E.Nool's foot movement during the alleged overstep at OG in Sydney.

Following accessible data were given by the CAU for the task analysis:

- sport shoes – disc shoe, run shoe, high jump shoe,
- Athletics rules (IAAF rules in the version of the Handbook manual 1998 – 1999, approved by the Executive, committee of the CAU in March, 1998),
- standpoint of the alleged overstep of Mr. Karel Pilný, CAU chairman, from October 10, 2000,
- CD-ROM with individual photos recorded from the television record of the Czech television at Olympic, Games in Sydney during the alleged overstep,
- diskettes with photos made from the same record in the CASRI company workplace.

2. Applied method for the photo evaluations

Multi-photo intersection digital photogrammetry was chosen as the most suitable method for the analysis of photos of the foot movement recorded by cameras. Rolleimetric CDW plus was used as a software. The system is applied during photogrammetric evaluation of convergent photos (axis of photos intersect each other). The system does not demand complex and voluminous measurement of an object itself or exact determination of photography standpoints during photography. Beam courses are restored in digital way in the space between photo and object during evaluation, or the photography situation is restored and the transformation relation between photo coordinate system and object coordinate system in such way that one point surveyed on photos corresponds unambiguously just to one object point in chosen coordinate system. The software allows performing calibration of survey cameras, their orientation, adjustment and then detail point evaluation.

General demands for photos processing are as following:

- it is necessary to know at least one distance between two reliably identified in advance marked points of the

- surveyed object,
- it is possible to find unambiguously identifiable control points on photos,
 - it is possible to choose a clearly defined coordinate system,
 - elements of internal orientation of recorded photos are known or selfcalibration can be performed.

3. Dimension analysis of the alleged overstep

20 photos were chosen and oriented altogether for the analysis. It was verified by surveying from these photos:

- accuracy of the method,
- shoe dimensions of the competitor,
- circus hoop height above the internal circus surface.

The course of movement of E. Nool's foot is recorded from 2 standpoints, thus from cameras No 3 and 4 during the critical throw (Fig.1). Following photos done from standpoints No 3 and 4 were chosen for detailed evaluation of E. Nool's foot position at the problematic 3rd throw (Fig. 2, Fig. 3)

It is possible to evaluate only visible parts of the sole and of other parts of the competitor shoe on these photos. Evaluated points were surveyed by the intersection forward from two photos (two-photos method). Resulting surveyed points are shown on the Fig. 4.

Conclusion of performed measurements: point No 32 and point No 33 (boundary line of the sole) are on the perpendicular, therefore they are projected to the circus edge in the ground plan (x, y plane). The height difference of both points determines x-value, the height of the upper part of sole (boundary line) is above the circus edge. Points No 27, 29, 25, 18 are in the circus as it results from determined coordinates. „Optical semblance" that points are out of the circus and that it is an overstep, occurs due to unfavourable position of camera No 4 during visual comparison.

4. Dimensional (geometric) analysis (Fig.5, Fig. 6)

1) points 33, 38, 37, 36 (Fig.4) determine the sole slope to the circus plane: $\alpha=36^\circ$

2) the sole height (Fig.5): $a=23 \text{ mm}$,

3) height of point 33 above the circus edge through the point 32: $x=36 \text{ mm}$,

4) height of the circus hoop above the internal circus plane was surveyed: $c=15 \text{ mm}$,

5) distance b is calculated: $b= a/\cos \alpha : b=27\text{mm}$,

6) distance y , height of E. Nool's sole above the circus is determined: $y=x-b$ **$y=9\text{mm}$** ,

5. Conclusion

It is possible to conclude from performed analysis of accessible data that the „alleged“ overstep did not occur. 9 mm distance was between E. Nool's sole and the circus hoop (on the perpendicular) in the lowest shoe position of the competitor (Fig. 6).

Graphic presentation of the foot position corresponding to the performed analysis was done. Following figures show:

- complete view of the circus with the competitor shoe position from the top (Fig. 7)
- computer views of the shoe in directions of prospective cameras where it is clear that the overstep did not occur (Fig. 8, Fig. 9).

Příloha: obr. 1 – obr. 9