

# Makin Every Second Count

## Implementation of the Smart Rings Jury Tool to Evaluate Hold Time during the Men's Artistic Gymnastics European Championships 2016

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## 1 OBJECTIVES

Within competitive gymnastics, a still rings routine consists of swing, strength and hold elements (FIG, 2015). The difficulty and execution of these elements is evaluated by a panel of judges. Although the human eye can distinguish quite accurately between different elements and whether an element is correctly executed, internal research by the European Gymnastics Union (UEG) has shown that the timing of the strength and hold elements is less accurate. Consistent and precise timing of these elements is crucial, because a deduction of 0.3 point must be given when the Hold Time (HT) is less than 2.0 seconds. This deduction could make a big difference as can be seen in small gaps of the scores of the still rings final at the EC in 2014 and 2015: 0.200 point between first and fifth place and 0.333 point between second and last place respectively) (UEG, 2014; UEG, 2015).

A digital support tool, Smart Rings Jury Tool, was developed to support the evaluation of HT. The aim of this study was to implement and evaluate this tool during the Men's Artistic Gymnastics (MAG) European Championships 2016.

## 2 METHODS

During the European Championships Gymnastics 2016 in Bern (Switzerland) the Smart Rings Jury

Tool was implemented in the junior MAG competition. For the senior MAG competitions datasets and jury evaluations were collected, but implementation of the tool in competition was not allowed due to Olympic regulations.

For both rings, force transducers connected directly to the cables of each ring were built in the upper beam of a FIG certified still rings apparatus of Spieth. The forces exerted by the gymnast were captured with a sample frequency of 1 kHz together with 50 Hz reference video and automatically saved to a measurement computer. A modified computer mouse was connected as a measurement tool to manually start and stop the timing. A computer screen, placed on the jury table, presented the force signals, the video of the gymnast and the judges expert input (Figure 1).

Next to the regular jury panel, two HT judges were assigned to evaluate HT with the Smart Rings Jury Tool. The left mouse button was pressed by one of the judges at the start of a correctly executed strength or hold element, the button was held during the element and was released when the hold ended or when the element was not held in the correct body position anymore. After the exercise both judges evaluated the HT by checking the screen, where the duration of the judges input was presented within the graph of the force signals. The judges input signals became green if the duration was 2.0 seconds or longer (Figure 1).

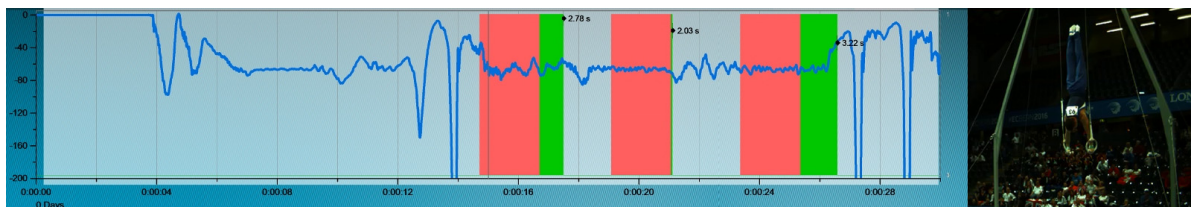


Figure 1: Part of the user interface of the Smart Rings Jurytool, showing the negative force signal (blue line), expert input (red and green blocks), hold time indication (text after blocks) and reference video (right).

Table 1: Number of exercises, number of holds, holds per exercise, hold errors by Smart Rings and actual deductions given by the jury during the Junior (Junior CI) and Senior qualifications (Senior CI) and total (Junior CI and Senior CI combined).

	Number of exercises	Number of holds	Holds per exercise	Hold errors Smart Rings	Deductions
<b>Junior CI</b>	123	587	4.77	57 (9.7%)	63 (10.7%)
<b>Senior CI</b>	91	559	6.14	116 (20.7%)	104 (18.6%)
<b>Total</b>	214	1146	5.36	173 (15.1%)	167 (14.5%)

### 3 RESULTS

During the European Championships 2016 in Bern, 278 complete datasets of ring exercises were recorded, of which 214 datasets of the qualifications (CI). As can be seen in Table 1, within these 214 qualification exercises, 1146 hold elements were executed. On average, in 15.1% of these hold elements a hold error was reported by the Smart Rings Jury Tool (which means the button was pressed for less than 2.0 seconds), while in 14.5% of the hold elements indeed a deduction was given after evaluation of the judges. This shows the benefit of the combined force and video signals.

The above statistics show that in Senior competition a larger number of hold elements are performed per exercise, but also a higher percentage of hold errors were found by the Smart Rings Jury Tool (9.7% and 20.7% respectively) and consequently also a higher percentage of deductions were given after evaluation (10.7% and 18.6% respectively). This indicates that implementation of the tool during Senior competition is even more important for accurate and objective evaluation of strength and hold elements.

In Junior CI on average 18.4% (7.1%-32.1%) of the total deduction consisted of HT deductions, proving that it is a very important aspect of still rings judging.

### 4 DISCUSSION

In this study the expert input of the judge is used to determine for what period all criteria (i.e. body position) for a strength or hold element are met. A previous study of Aarts and Pluk (2015) showed that a fully automatic evaluation of HT based on force was not able to check these criteria. Also slow transitions between strength elements were difficult to detect with an automatic system.

There are some differences between the HT errors reported with the Smart Rings Jury Tool and

the actual deductions given after evaluation. This might appear due to an interruption in the hold element: it can be decided to release the button if an element does not meet all criteria anymore and start pressing again after correction. In this case, the judge would have pressed twice within one element and only one deduction of 0.3 points can be given. It also occurred that a jury incorrectly started pressing when it turned out not to be a hold or strength element. In those cases no deductions were given.

In this implementation, the two HT judges were allowed to discuss during evaluation of the HT decisions of one judge. It might be preferable to have two separate judges' evaluations and take the average, or discuss those differences. Overall, the Smart Rings Jury Tool proved to be a precise and consistent way to evaluate HT.

### ACKNOWLEDGEMENTS

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