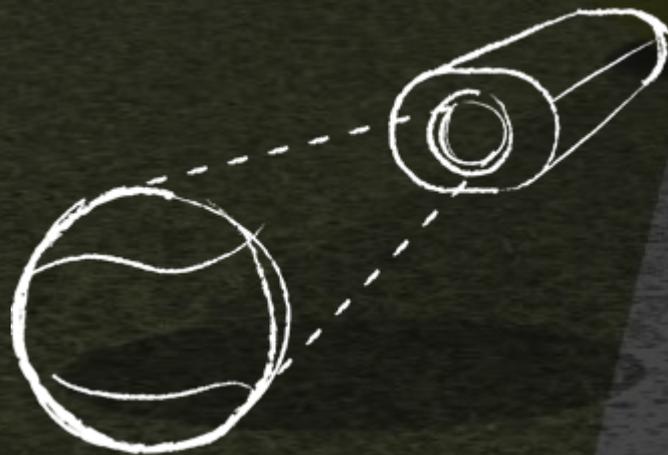




Hawk-Eye's Accuracy & Reliability

Electronic Line Calling



Accuracy & Reliability

This document provides additional information about Hawk-Eye's Electronic Line Calling technology and its accuracy and reliability.



During ITF testing in 2005 Hawk-Eye passed a number of stringent parameters, meaning that it would be the first electronic line calling system to be officially accredited. Results showed the system to have a mean error of only 3.6mm when compared to a high speed camera located on the playing surface.

Following a combination of technological and software advances, alongside a decade of experience at major sporting events, Hawk-Eye's electronic line calling technology now has a mean error rating of 2.6mm.

Testing of the system is an on-going process at all events prior to main draw competition, including tests conducted outdoors, encompassing situations that take the following factors into consideration:

- Wind (and therefore camera wobble)
- Bright sunlight at different times of the day
- Shadows covering part or the majority of the court
- Dark or overcast conditions
- Artificial floodlights

Although the accuracy of the existing system has been proven to meet the ITF rules and regulations, the company is constantly developing and refining the system to raise the bar further still. Equally Hawk-Eye listens to feedback from customers and officials to ensure that Hawk-Eye remains the very best in the market in accuracy, reliability, speed and from a broadcast point of view.

Regarding accuracy specifically, it's interesting to observe high speed video footage (1000fps), similar to that obtained during ITF testing, see link below:

Video: <https://vimeo.com/135357489>

Why a line call can look deceptive on television?

Television replays look deceptive because the cameras are at the wrong angle looking down at the ball. The ball also has a lot of motion blur and the cameras do not work at a sufficiently high frame rate (25fps) to capture the crucial part namely when the ball first touches the ground:

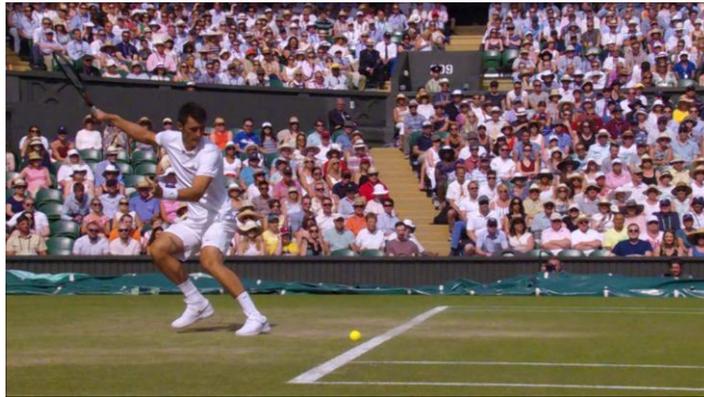


Figure. 1 – Example of broadcast footage

The following examples of high speed video footage (1000fps) shows what actually happens:

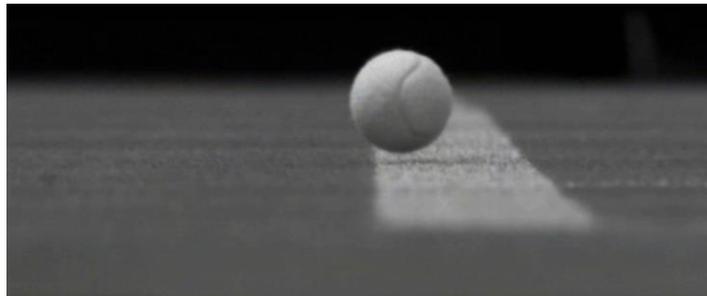


Figure. 2 - Just before the bounce, in a similar position to the ball in Figure 1 of the broadcast footage above.



Figure. 3 - Ball just touches the line.

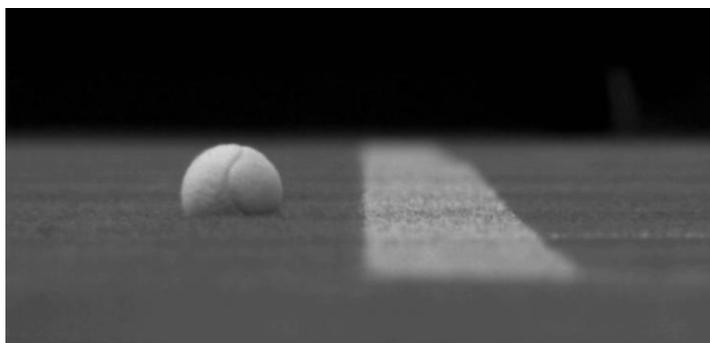
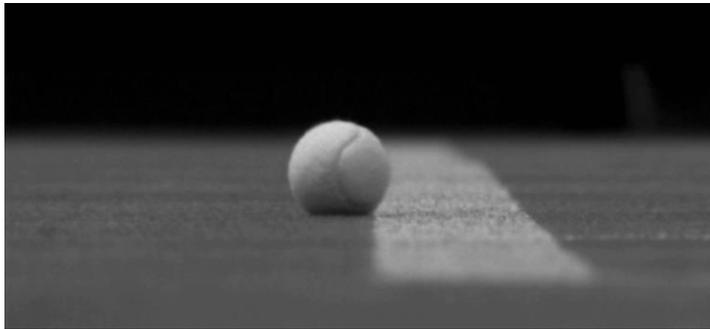


Figure. 4 - The same time has elapsed between this frame and the first frame in this sequence as between a single frame of the broadcast footage. The ball here is very similar to where it is in Figure 1 of the broadcast footage.

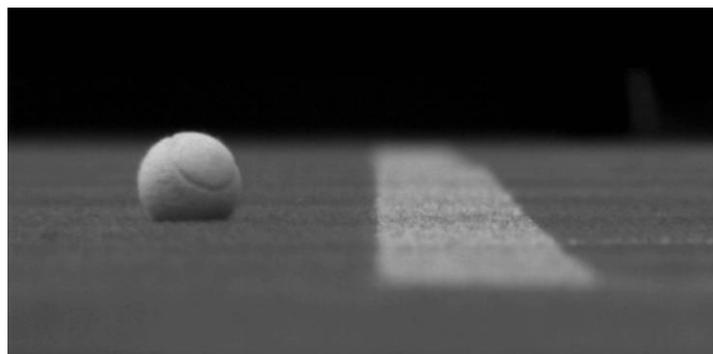


Figure. 5 - The ball is still on the ground, but now at least 10cm (the width of a line) beyond where it first made contact with the ground.

If viewed from a regular broadcast camera (25fps), it's clear that the viewer's perception of where this ball had landed will be influenced significantly by the limited frame rate and zoomed out field of view provided by live broadcast footage.

Not only does the system boast excellent accuracy results, the system needs to be extremely reliable - tracking hundreds of thousands of tennis balls throughout the tennis

season. Although a protocol remains if the officiating system is not able to provide an answer with utmost confidence, this is an extremely rare situation, where onsite operators are not 100% confident in the accuracy of the system for that given shot. The level of accuracy and reliability have been proven to be significantly better than any potential competitors, proven by the system remaining (after 7 years) to be the only accredited system.

If you have any further questions, please [contact us](#)