clearview

case studies

Broadcast | Ball-Tracking Technology

The game of cricket has been governed by a series of Codes and Laws for over 250 years, often subject to additions and alterations recommended by the ruling authorities of the time. And, like numerous other sporting activities, the game of cricket is not immune to current technological advancements. In fact, the International Cricket Council (ICC) agreed on using a new ball-tracking system from Roke Manor Research that would aid umpires in making correct LBW (Leg Before Wicket) decisions.

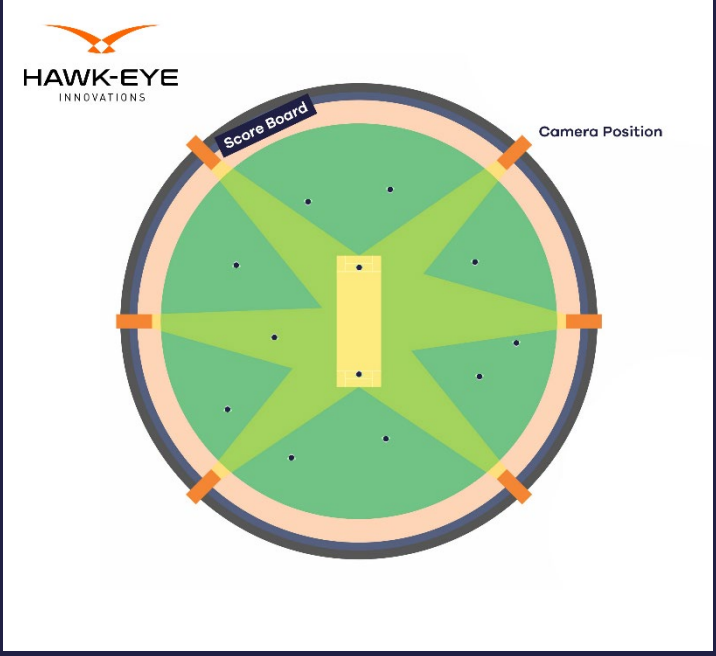
The LBW (Leg Before Wicket) ruling has caused as many controversial moments in cricket as the offside ruling in football, the forward pass in rugby and line-call decisions in tennis. In fact, the LBW result determines a batsman's innings and often the outcome of the game.

For a batsman to be given out LBW, an initial call of 'How's that?' must be given by a fielding player to the umpire, who in turn must decide whether or not the ball was travelling at such an angle that it would have hit the stumps, and whether or not it hit the pads before hitting the bat. The batsman would not be given out LBW if the point of contact between the pads and the ball was outside the line of off-stump or if the ball was pitched outside the leg-stump. This complicated ruling is not made any easier for the umpire by the fact that the average ball is travelling at 80mph from the bowler's hand. It is no wonder that this is one of the trickiest decisions made in cricket and one that leaves plenty of room for uncertainty.

Enter Hawk-Eye

However, a technology called Hawk-Eye erased all doubt from the minds of umpires, players and spectators by providing an analysis of the ball and wicket to within an accuracy of 5mm.

Invented by Dr. Paul Hawkins, a British scientist with Roke Manor Research near Southampton, Hawk-Eye incorporates image analysis and missile tracking technology. Six fixed monochrome cameras, with a 120Hz frame rate, are placed around the playing field at key vantage points - two at each end at a 30deg angular displacement, and two side cameras (see diagram). These synchronised cameras track the ball's entire trajectory - at intervals of every 1/100ths of a second - from the moment it leaves the bowler's hand until it stops.



The six cameras are gen-locked into two sets of three cameras, each set being captured by a Matrox frame grabber and the Matrox Imaging Library (MIL-Lite) software. The resulting images are processed into a 3D image by the Hawk-Eye system which then calculates - in a split second - where the ball pitched, the extent of its lateral movement in the air and off the wicket, its velocity and bounce, and - if applicable - exactly where it contacted the batsman's pad.

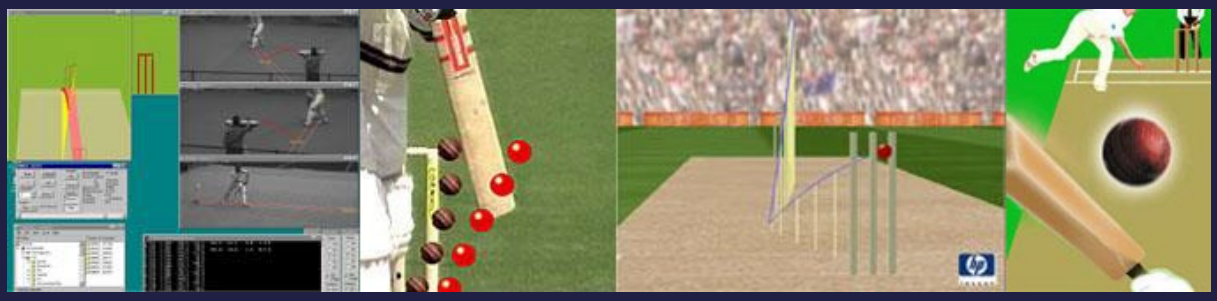
The future path of the ball is also extrapolated by fitting the trajectory of the ball into a parametric model, thereby determining whether or not the ball would have carried on to hit the stumps, bounce over, or go past the wicket. Hawk-Eye then uses a Matrox frame grabber to overlay a graphical representation of this trajectory onto a video image, which is encoded and transmitted to a video bank accessed by television producers.

"A major challenge for us was transmitting the analogue signal down the long cable lengths (ranging from 250-650 meters) of high-quality triax cable to the

capture cards, without losing the signal," says Hawkins. "However, the MIL-Lite software was able to cope with the resultant signal degradation."

All of the information calculated by Hawk-Eye is available within 1-2 seconds of the ball being bowled. This data could then be sent to umpires on the field using a transmission technology similar to local pagers or mobile telephones. Each umpire would carry a small, hand-held receiver with a display window that - within four or five seconds - would give the umpire all the information he needs to make the LBW decision: whether the ball pitched outside the leg stump; whether the ball hit the batsman in line with the wickets; and whether the ball would have hit the stumps. Unlike the third umpire that is brought in to make a final decision when the first two umpires cannot agree - Hawk-Eye would not slow down the game, as it would determine the correct answer in less time than it would take for an umpire (or umpires) to make a decision.

However, Hawkins stresses that Hawk-Eye "was presented as an aid to the umpire not as a threat to him. Umpires quite rightly will always be required."



After two years of development, Roke Manor Research's Hawk-Eye technology went live at the Lord's cricket match with great success. Shown here are four examples of the video images derived from information gathered by Hawk-Eye technology.

In-depth coverage

Hawk-Eye is credited with having revolutionised the way live cricket coverage is transmitted. It is being used by television broadcasters to present more in-depth coverage of cricket. It also allows cricket commentators to support their assessment of a batting or bowling performance with

graphs and statistics. This will hopefully make cricket easier to understand and thus make it more attractive to a wider audience, says Hawkins.

With this technology, users can view where each ball pitched and passed the stumps, as well as analyse which areas have been most productive for each batsman and bowler. These statistics can be extended to cover the entire team's performance, in any match.