SWEET SPOT DETECTION OF CRICKET BATS USING ACOUSTIC TRACKING

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ABSTRACT
In a sport like cricket in which you have to strike the ball with a bat, it is very important to have the ball hit the bat at the right place. Also as far as cricket is concerned this spot falls below the bat maker’s sticker. What this paper discusses in detail is how to give real-time feedback to the batsman when he is hitting the ball as to whether the ball hit the sweet spot or not. I use acoustic tracking to help me in this venture.

Keywords
Sport impact zone, acoustic tracking, max msp, amplitude, and decibel level.

THE PROBLEM
Currently especially in the sport of cricket there is no real way to find out real-time as to whether he batsmen hit the ball to the best of his ability. Now this does not mean hitting the ball just hard but it also is important to note whether the ball struck the bat within a zone called the sweet spot, which is located just below the bat maker’s name. This is problem I am trying to resolve, that of the ball meeting the bat at the right spot and how to convey this to the batsman who is batting. This is highly effective when the batsman is practicing; one note that s/he is hitting the ball at the center of the bat every time s/he bats is really important and this has to be quick.

OVERARCHING SOLUTION
The solution to this problem was fairly simple. It was first important to find out the exact sound the ball made upon impact with the bat at its sweet spot. Then every time the bat makes a similar choice you can decipher that the ball hit the sweet spot or not.

THE SETUP
I fixed the bat onto the ground and attached a microphone to it. This microphone was used to get intensity of the sound from the bat. I dropped a table tennis ball onto the bat (for demonstrational purposes) on to the bat from a fixed height. Each time the ball hit the bat it made different kinds of sounds. Based on the sounds I was able to decipher as to which part of the bat the bass was hitting. Also I placed the bat on a towel cloth, which acted as the buffer around the bat and did not produce any sound when the ball hit the ground. I then had to fix the bat to this towel in such a way that I did not tilt.

THE EXPERIMENT
I first tried hitting the bat with the ball at different parts from a fixed height. As the height was the same the velocity at which the ball made contact with the bat was constant due to the free fall. Once the velocity was constant the other thing to consider was the direction at which the ball struck the bat. For experimental purposes I kept the bat faced upwards so that the ball hit the bat straight and there was no angle
associated it. In real-time environments it would be necessary to simulate all the angles at which the ball could possibly strike the bat.

Once I had a concrete idea of what are the ranges of amplitudes or decibel levels that were produced when the ball hit the sweet spot, I negated the rest and considered only this range. Once I fixed this range I simply dropped the ball on the bat several multiple times and devised an algorithm in Max MSP such that only those sounds produced within the specified range were detected, i.e. when the ball struck the sweet spot. Based on this I triggered a signal every time the ball struck on the sweet spot and hence the batsmen could have a look at it and judge his performance for himself.

LIMITATIONS
One of the major limitations was the ability to capture the exact intensity of the sound produced on impact. If we have state of the art equipment is would be able to measure the minutest shift in the decibel levels and get a more complete picture. Also the marking of the sweet spot would be very concise and precise if I could distinguish between the slightest of shifts in the decibel levels.

Secondly, I was measuring the sound for a certain velocity and a certain angle as mentioned earlier. To be specific it would take simulation and data collection strategies that have to encompass all the possible solutions to this problem as these variables can never be constant, they would always change ball by ball.

There might have been some element of human error induced as the balls were thrown by hand. If done completely mechanically, it would have been easy to replicate tries again and again.

OTHER APPLICATIONS
The applications of this technique are vast. For instance it can be used in any sport that involves a ball and a bat or racquet. It has vast implications as the players can better themselves while practice by hitting the ball to areas where they want to and making contact with the ball at exactly the spot where they want to make contact at.

Also in other sports like table tennis, where the ball has to land on the surface of the table and not hit the edges this technology might be helpful to determine exactly where the ball hit the table, as it would make different sounds on the table and on the sides of the table. Being a table tennis player, I can assure you that it sometimes becomes very unclear due to the pace of the ball as to where the ball landed i.e. on the edges or atop the table. This might be an inexpensive technique rather than using other expensive means like Hawk Eye technology etc.

This methodology can be used in other fields to. For example in the field of construction this can be used to find out the hollowness or the denseness of a certain space, as knocking on a hollow surface would result in a different kind of sound when compared to knocking on a dense surface.

CONCLUSION
Although this is highly useful in various fields this methodology is highly material dependent.

I would like to say that this would be extremely useful from a stand point of providing real-time feedback to the batsman and he/she can correct his/ her shots at that relevant hour rather than looking back and later reflecting.