Sports Special

DENNIS BAXTER is to sports audio recordists what "Q" was for James Bond.

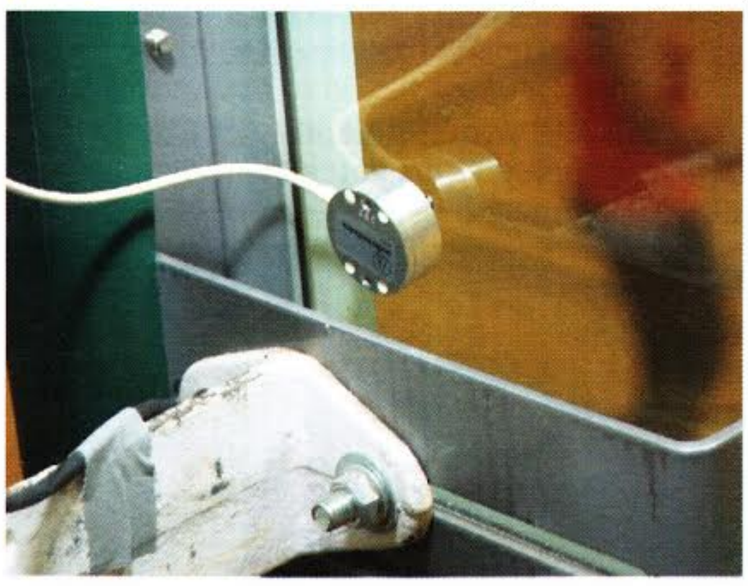
Live audio capture for sports continues to be increasingly difficult because of excessive venue noise levels from PA systems and mechanical racket from generators and HVAC. When you factor in poor acoustics, the resulting soundfield is an acoustic soup. Traditionally, sound capture for sports has been done from less than desirable distances, making the process as much about what sounds you are trying to reject as sounds you are trying to directly capture. This may explain a reliance on traditional shotgun microphones.

However, with traditional microphones, unwanted background noise is cumulative so that each open microphone adds additional background noise along with the desired sound. Each additional open microphone dilutes the detail of your sound quality because a part of the background noise is buildup of off-axis sound that generally lacks any full frequency fidelity. Unfortunately, with traditional transducers this situation is impossible to avoid because microphones are not precise in their detection and do not just stop picking up sound once they have captured what you are trying to catch. Of course this situation is further complicated by sound reflecting off surfaces back into the microphone, even though much of this reflected sound may be off-axis.

Here is some fuzzy math that makes sense to me. When you open one microphone you pickup the desired sound plus an audible amount of undesired sound. For the sake of example, let's say 2dB of extra noise is barely noticeable. But when you open two, three, or four additional microphones, each adding an additional 2dB of background noise, then you have buildup of 6 to 8 dB of background noise which is distinctly higher.

Non-Acoustic Transducers — An acceptable solution to background acoustic noise is non-acoustic transducers. In the early 90s, innovative sound practitioners took a page from amplifying the acoustic guitar and found an interest in contact microphones. During the folk music boom, sound engineers had a difficult time amplifying the acoustic guitar until a transducer was applied directly to the resonating surface of the instrument.

The contact microphone is not sensitive to air vibrations but only detects the structure-borne sound. This type of transducer/microphone does not add any acoustic noise — only desired signal. Given that all solid surfaces resonate complex sound waves, this technique has a lot of possibilities.



I discovered the Audio-Technica Contact Microphone in 1994 and my first successes with this type of transducer was with gymnastics. Gymnastics is a sport that has up to 5 events taking place simultaneously during the qualification rounds. This is complicated with the fact that women's floor exercise uses high levels of music which bleeds into everything. I put contact microphones on the balancing beam, pommel horse, and vault runway as well as under the podium for floor exercise and heard detailed sounds without music.

The contact microphone works well with sounds that have a variety of pressure intensities — like running on a wooden ramp, the percussion of a basketball on the backboard, or the sounds of a roller-skate on a wooden ramp. Along with its non-acoustic characteristics, the contact microphone gives distinct, in-sync sound with each sound source making it very useful for separating a lot of sounds. As a creative tool, the contact microphone offers some interesting additional possibilities. For example, the contact microphone is used on skateboard ramps and captures a sound that is longer in duration than what is possible with an acoustically captured sound. The stretched sound that a contact microphone can capture is an interesting sound design concept, that can be effectively used in simulating motion and speed by dynamically panning the sound in the vertical or horizontal plane.

Array Microphones — Dimensional sound capture with microphone arrays is nothing new and gained traction in the late 70s with the Soundfield Microphone and Ambisonics recording. The Soundfield was an array of three closely correlated capsules that could be combined to form different polar pickup patterns. Since this dimensional approach was introduced, I have not been very excited about closely correlated microphone arrays that use 4 or 5 capsules, because their capture is generally focused on the horizontal plane. However, several years ago I saw a microphone array that had hundreds of transducer capsules — with a price tag in the hundreds of thousands — but it clearly demonstrated the concept of "steering", or directing the microphone to focus on very specific sounds.

With consideration of some familiar theories from the Ambisonics days, it was concluded that once you extend the concept to a much higher order of microphone capsules, things get interesting. A transducer redefining concepts in acoustic audio capture is the em32 Eigenmike®. There have been several microphone designs that use multiple capsules to achieve some directional characteristics. Once you combine several capsules together there is the possibility to aim the microphone at the sound you want or away from the sounds you do not want. This 32 capsule transducer along with some clever and unique software delivers next Higher Order Ambisonics, and offers some unique possibilities to acoustic capture.

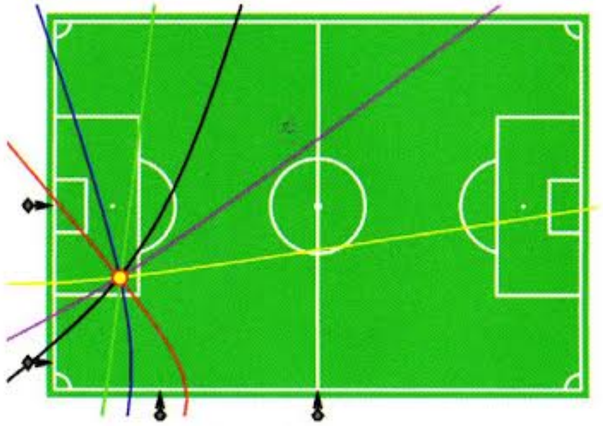
Microphone steering utilizing spatial filtering (which is a process used in sensor arrays) achieves directional reception. Beam-forming or polar pattern sculpting can be used in order to achieve spatial selectivity by controlling the amplitude and phase of each sensor and constructively (or destructively) combining the waves for new patterns. If my analysis is correct, this would eliminate the need for precise on-axis microphone directing because the capture pattern can be shifted for optimum capture or rejection.

The benefits of this technology became very apparent during some testing at an extreme sports competition. Over the last decade, we have seen a further integration of sports and entertainment along with the relentless use of music. An Eigen microphone was placed at the side of an extreme skateboard ramp with the sports action in front and the PA speakers behind. Through beam steering, several front reaching polar patterns were aimed at the sports sound, clearly improving sports signal while reducing the obnoxiously loud PA noise.

Gary Elko and Jens Meyer are the developers of the Eigenmike. They told me that currently the transducer and software could output up to 30 sculpted beams with a minimum of around 10ms of latency — independent of how many beams are formed. Now consider a Tennis match with an Eigenmike courtside. A beam could be focused on the each backcourt, front court, judge and crowd. Since Tennis is a very dynamic sounding sport — the 8 to 10 beams could be positioned in such a way that they create an interesting immersive experience and simply be left alone. A final thought: since this concept is computer driven and rendered, I imagine there would be possibilities for real-time tracking of live, dynamic sound sources and generating whatever sound a sound designer considered interesting through the triggering of a sampler.

Sound Tracking and Sound Augmentation — Those of you who have read my musings already know my opinions (for the good and bad) on using samplers for sound augmentation. First, in my opinion, live sports broadcasting is about entertainment. Even so, with the influence of the hyped-up sound of digital games and movies, today's viewer has different expectations of sports sound. I found some really smart folks North of London who have developed an interesting approach to automated mixing — one that is definitely not your typical audio follow video. The brains behind this are Dr. Ben Shirley and Dr. Rob Oldfield at the University of Salford.

They have developed Spatial Automated Live Sports Audio (SALSA), a method that uses the existing 12 shotgun microphones around the pitch to detect the ball kicks. The system not only looks for overall level intensity, but also the envelope across a range of frequency bands for each sound event type that a sound mixer might want to capture. Additionally, Ben and Rob have developed a number of "acoustic feature templates" that define the range of sound types that sound mixers are looking for and want to capture. For football, these include ball kicks/headers and whistle blows, but there would be different templates for other sports.



When the software detects a match to a template in one microphone, it identifies the same event in other microphones. Then the system does some triangulation based on sound arrival at each mic to derive a line across the pitch along which the ball kick must have occurred. Once these conditions are met, the system can determine with confidence that there was ball kick. The SALSA algorithm is capable of detecting ball kicks that are virtually inaudible on the microphone feeds and is more reliable at recognizing sound events than our ears. To make it work accurately and reliably, you keep a high detection threshold to avoid raising faders for inaudible ball kicks.

During live production, SALSA uses one of two approaches. It can automate a mixing console's faders to capture each on-pitch sound event or use the frequency/envelope information of the ball kick to trigger pre-produced samples. These sounds can be added to the on-pitch sounds or can replace the game sounds when the on-pitch capture is poor. If you want it to sound like an EA Sports Game or a Saturday afternoon match on SKY, it is up to you as the sound designer.

This method is already working in the domain of audio objects. Each ball kick and each whistle blow is defined within the software as a "short-term audio object" with metadata. Each object is tagged with metadata that says what kind of object it is (e.g. Ball kick, whistle blow), the sound duration, and its coordinate location on the pitch. All this is achieved completely independent of camera cuts and the traditional audio follow video, which at the end of the day, really does not work well in most situations. As a production tool, the SALSA system can provide the sound mixer with separate channel feeds for ball kicks and whistle blows that can be mixed with crowd and commentary feeds leaving the mixer free to concentrate on making it sound awesome, instead of chasing the ball with console faders.

Final Considerations — For sound practitioners, there is a comfort zone in finding and using a microphone that they know works well for the application. Microphones are personal and clearly subjective, but how do you compare a £70 Shure to a £1,000 Schoeps microphone? They both sound good for certain applications and it could be concluded that both sound great for the same application.

When evaluating a microphone price should not be a consideration, performance should. Brand should not be a qualification because it may lead us to over-paying for performance. Microphones should be evaluated in the context of the mix and performance. A microphone may have a neutral and natural sound but does that co lour and tone fit the sound design? A contact microphone has very different tonal characteristic, but I have found that once you put your mix together it can give an acoustic edge that makes the sound mix fit together.

Certainly in this day of low budget sound production, there are a lot of options beyond what we have become comfortable with. My advice? Put your ears on — a little listening can go a long way. ■