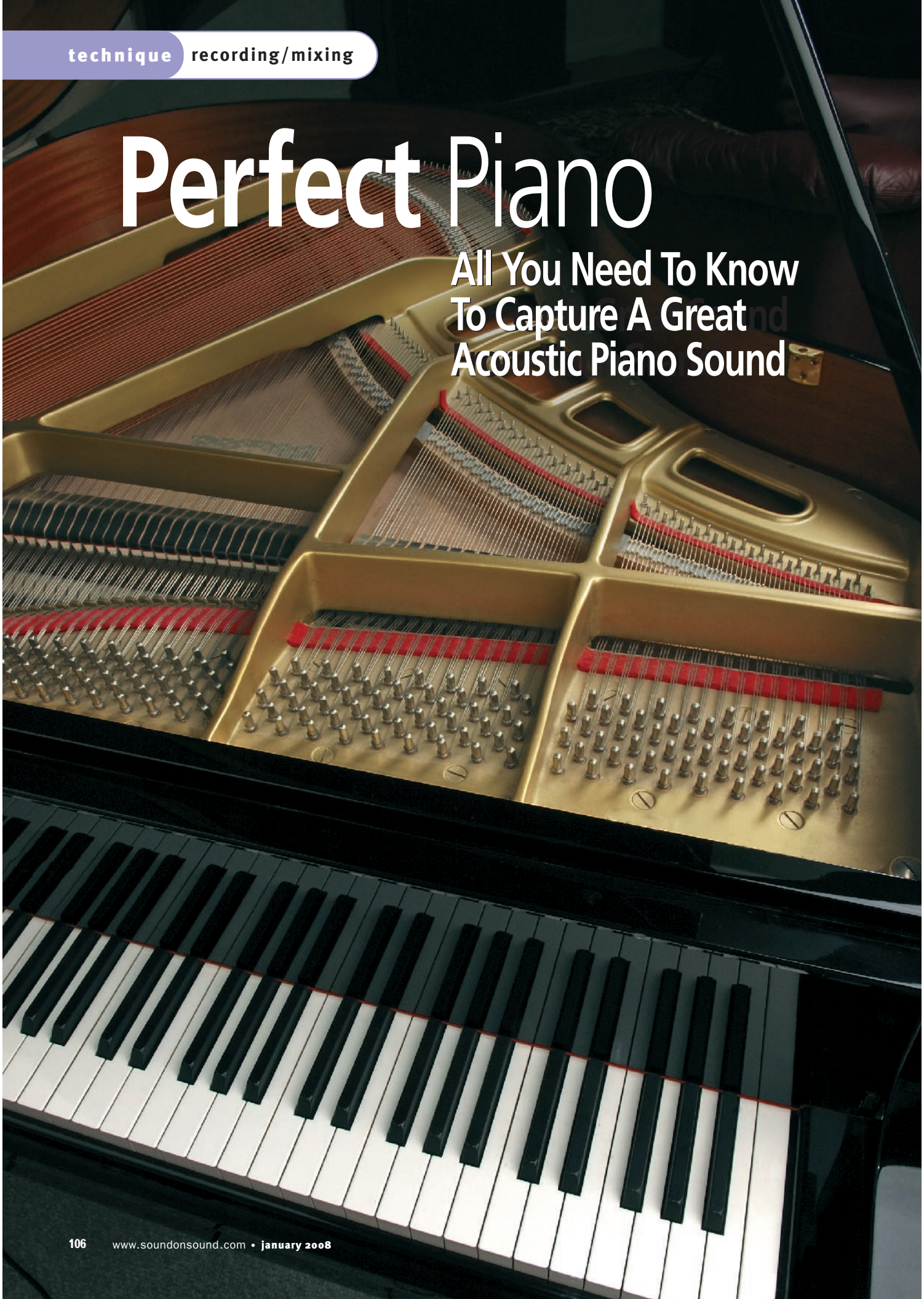
Perfect Piano

All You Need To Know To Capture A Great Acoustic Piano Sound



Mike Senior

With the number of high-quality sample libraries around these days, recording a real piano can feel like a lost art. For those times when only the real thing will suffice, here's how to do it justice.

Recording an acoustic piano presents enormous challenges for many home recordists. The instrument's size and sonic complexity are contributing factors, making great technical demands on mics and other recording equipment, but that's only part of the problem. For a start, few of us are lucky enough to have access to a decent piano for a long enough period to develop any significant experience of recording it. There's also the fact that the number of 'correct' mic techniques is enormous, yet any given one of these might be completely inappropriate for the sound you're after.

The aim of this article is to take some of the guesswork out of getting a great piano sound, bringing together a wide range of recording techniques suggested by various different authorities and then illustrating them with audio examples. Surf to www.soundonsound.com/sos/jan08/articles/pianorecordingaudio.htm, and judge for yourself whether these techniques are the dog's danglies or a dog's dinner.

What Type Of Mic Should I Use?

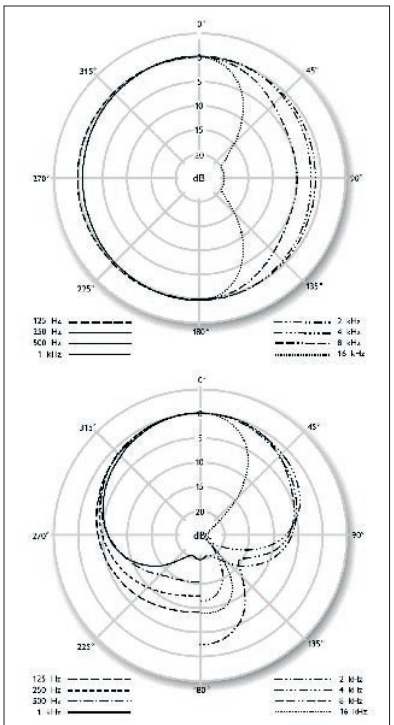
Because of the nature of the piano as an instrument, certain types of microphone lend themselves better to recording it than others. It should be pretty obvious that the piano generates a very wide frequency range, starting at around 26Hz (the fundamental frequency of the lowest note) and extending well beyond the 20kHz upper limit of the audible spectrum. This makes most dynamic mics a questionable choice, as their comparatively heavy diaphragms simply can't track the delicate, fast air movements of the highest frequencies as well as can lighter ribbon- or condenser-mic diaphragms. For the same reason, dynamic mics tend to blunt the edges of the piano's percussive transients, so unless you're after a special effect, leave your SM57s in the cupboard (that said, engineer Geoff Emerick has said that his favourite piano-miking technique for Beatles sessions comprised a pair of AKG D19 dynamics — there's always one...)

The extended range of the piano's low frequencies is also relevant to the choice of polar pattern. The frequency-response charts of many directional mics tend to dive much more rapidly at the low end than those of omnidirectional designs, and this is one reason why omnis are often chosen. Directional mics also exhibit proximity effect, and this bass boost can make it difficult to get an even sound when close-miking the inside of the piano.

The sheer dimensions of the instrument are another reason why many engineers choose omni mics for close-miking. Even directional mics that have a fairly wide forward-facing lobe on their polar plot have a tendency to 'spotlight' the section of the instrument they're pointing directly at when close-miking, thus exaggerating the level of one aspect of the sound at the expense of others. A lot of engineers address this potential problem by using a coincident pair of directional mics, thereby expanding the effective pick-up width of the rig as a whole.

The off-axis response of the microphones is of particular importance with piano ▶

Boundary microphones, such as the Beyerdynamic Opus 51 pictured here, are often used in piano-recording applications because of their well-behaved hemispherical polar patterns, slim design, and comparative affordability.



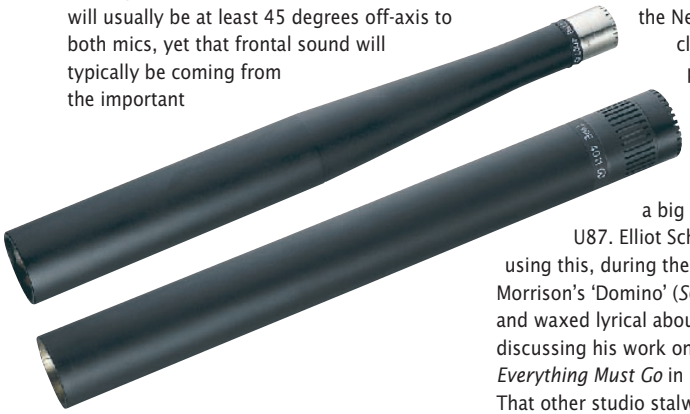
Here are two of the published polar-response diagrams for Neumann's M149 multi-pattern tube mic (a favourite of Al Schmitt, as discussed in the main article), which demonstrate how the frequency response of even a top-flight microphone changes depending on the angle a sound arrives at the mic's diaphragm. Note that the omni polar pattern (above) narrows fairly progressively towards a figure-of-eight pattern at high frequencies, whereas the cardioid pattern varies in a much more complex manner — this is one of the reasons why many engineers prefer to use omni mics rather than cardioids for critical tasks such as piano recording.

Recording The Audio Examples

For the sake of drawing comparisons for this article, I wanted to use several identical small-diaphragm mics for the sessions, with a choice of omni and cardioid polar patterns for each — Source Distribution kindly loaned me six of their new Rode NT55 mics (reviewed in *SOS* September 2007), which fitted the bill perfectly. These mics enabled me to record the same performance with several different mic techniques simultaneously, and I've tried to be clear in the main text of the article which example files were recorded together. The main advantage of having done it like this is that it means that you can import the files into your own DAW, line them up so that they start together, and then mix them together for yourself — the files are still worth listening to one at a time, but A/B'ing and processing them together is much more revealing.

The recording sessions for this article took place in the Colin Hill Recital Room at Hills Road Sixth Form College, making use of their 7-foot Yamaha grand and Yamaha upright pianos, as well as the Music Technology department's adjoining control room — thanks to the Director of Music, Jonathan Sanders, for making this possible. Heartfelt thanks are also due to Jon Whitten, our heroic pianist for the sessions, who played his piano riff for two days solid, an ordeal which even now probably still has him waking up in the middle of the night screaming! Dan Jeffries and Tom Adams were also a great help, fighting their way through torrential downpours (you can even hear the rain in the background of a few of the example files) to assist with all the setting up and moving of mics.

recording, regardless of your mic technique, because very little of the sound you're hoping to catch is likely to arrive directly on axis when you're dealing with such a large instrument. This is especially relevant to crossed-pair stereo techniques, as the sound arriving from directly in front of the setup will usually be at least 45 degrees off-axis to both mics, yet that frontal sound will typically be coming from the important mid-range strings when you're close-miking inside the piano, or from the centre of the soundstage when you're using more classical-style ambient stereo miking techniques.



DPA's 4000-series small-diaphragm mics (formerly available under the B&K moniker) are some of the most well-respected models for recording piano. The cardioid 4007 and 4011 models are particular favourites for crossed-pair stereo techniques, both inside and outside the piano.

Budget large-diaphragm cardioids are usually the worst offenders when it comes to this aspect of performance, particularly at high frequencies. It is easier to design small-diaphragm models with good off-axis characteristics, and omni and figure-of-eight polar patterns also tend to be better behaved in this regard as well. Another option here would be to try a boundary mic or PZM (pressure zone microphone), as these are constructed in a way which allows exceptionally even tonality across their characteristic hemispherical polar pattern. (The majority of PZMs are immune to proximity effect too, but they do need to be mounted on a large, solid, flat surface to deliver their best bass response.)

Irrespective of the model of mic used, if you're going to close-mic, check that the mic you are using can cope with high SPLs, because pianos can get very loud and create lots of powerful percussive transients which can easily distort the internal electronics of mics and preamps. Engaging the mic's pad switch is also a sensible precaution if there's one available.

Some Pro Selections

With all the above factors in mind, lets look at some real examples of mics top engineers have name-checked, to see how they stack up against the theory. Perhaps surprisingly, given what I've said about off-axis response, large-diaphragm condensers are quite a common choice. Al Schmitt (the multi-Grammy-winning engineer responsible for, amongst many others, several Diana Krall records) is a great fan of the Neumann M149 for close-miking inside the piano. Jon Kelly, while discussing his work with Kate Bush in *SOS* June 2004, professed himself a big fan of the Neumann U87. Elliot Scheiner also mentioned using this, during the recording of Van Morrison's 'Domino' (*SOS* February 1996), and waxed lyrical about the AKG C12 when discussing his work on Steely Dan's album *Everything Must Go* in *SOS* August 2003. That other studio stalwart, the AKG C414, also crops up in a number of *SOS* interviews: Chris Kimsey used a couple for the piano on the Rolling Stones' 'Start Me Up' (*SOS* April 2004); Jay Graydon mentioned using a vintage C414EB for his album *Bebop* (*SOS* December 2001); and Nashville engineer Brian Tankersley opted for a spaced pair for his work on Lonestar's chart-topping track 'Amazed' (*SOS* October 2002).

These mics have a couple of important things in common. Firstly, they are all multi-pattern, and on the few occasions where a polar pattern is mentioned, it's usually the omni. Secondly, they are all fairly wallet-melting purchases and, as you would have every right to expect, they offer excellent low-frequency extension and about as benign an off-axis sound as you'll find from a large-diaphragm design, particularly where omni mode is used.

Small-diaphragm condensers are also common, and Ed Cherney (who's worked with high-profile piano players such as Billy Joel and Elton John) is one amongst many who single out the Brüel & Kjaer 4000-series microphones for their recordings — the mics came under the DPA (Danish Pro Audio) brand in 1992, but are still very much current products. Originally, B&K primarily manufactured measurement microphones, and they meticulously designed these small-diaphragm mics for ruler-flat frequency response both on and off axis. Ed Cherney and Jay Newland (most famously associated with the Norah Jones records) have mentioned selecting the cardioid 4011s and 4007s respectively for XY coincident miking inside the piano, while Richard King, one of Sony's senior classical recording engineers, stated a preference for a spaced pair of omnidirectional 4009s for his ambient stereo recordings. Naturally, B&K aren't the only game in town: the Neumann KM84 is another recurring favourite, numbering David Bowie's producer Tony Visconti amongst its aficionados (according to Howard Massey's book *Behind The Glass*), and Mike Hedges remarked in *SOS* July 1998 that he often goes for a pair of Sennheiser MKH40s.

Clearly, there are no easy answers when it comes to choosing a mic for recording piano, especially because certain mics are suitable only for certain techniques — so I'll be returning to this issue as we now start looking at some of the different miking approaches.

Ambient Techniques

One way to record a piano is to attempt to capture its sound within a suitable room acoustic, as naturally as possible using ambient microphone techniques. These days this approach is primarily used for classical music recordings, where the intent is effectively to recreate a 'best seat in the auditorium' sound for the listener at home. This type of recording is normally too reverberant for any other music style, and because you can't really change or reduce the room sound after the recording has taken place, it limits your options during a multitrack mixdown.

The alternative is to go for something a bit more like what the pianist is hearing, close-miking the instrument's inner

Which Piano Should I Use?

Although this article focuses primarily on recording techniques, it's also the role of the recording engineer to select the appropriate instrument for the style of music. With grand pianos, the instruments that tend to be associated with classical styles have a mellower tone, with Steinway and Bösendorfer being well-known brands associated with this kind of sound. For pop styles, brighter instruments tend to appeal more, because this helps the sound compete better with other instruments in a busy commercial mix, and names I associate with this kind of timbre are Kawai and Yamaha.

The size of the piano is also a factor you have to consider, particularly at the bass end, where a 10-foot Bösendorfer can produce the most incredibly deep and powerful notes. As instruments get smaller, their low notes lose the low-end power that comes from stronger lower harmonics, and the notes become richer in much higher harmonics, not all related to the frequency of the fundamental — this can make it quite difficult to discern the tuning of the low notes on a small instrument such as a baby grand. The sustain of the higher-register notes also suffers on shorter instruments.

workings. This reduces the levels of ambience, not only allowing usable recordings to be achieved in less-than-stellar recording spaces, but also making it much easier to place the piano sound within a mix, using processing and effects. Both approaches are valid in their own right, so I'll deal with them each in turn.

For classical-style recordings, the basic recording approach in most instances is to select your favoured stereo microphone technique and then to search for the best location for that rig within the room — a position which balances the different registers of the instrument, gives a suitable level of room ambience, creates a sensible stereo image, and represents the instrument's tone in a pleasing manner.

The main difficulty with achieving this aim is that the different frequencies emanating from the piano's strings and the resonant wooden soundboard beneath them are affected by the piano's casing and lid in different ways, which means that the tonality captured by the mics changes in extremely complex ways as you reposition them. This can make mic placement seem like that lucky dip at the end of the school fete, where you hunted around for ages and then only came up with a pack of 'My Little Pony' Top Trumps.

The mic positions shown here were recorded for the 'HorizDispLidOpen' audio examples to demonstrate the complex horizontal frequency-dispersion characteristics of the grand piano.

Horizontal Dispersion

Fortunately, there are some basic rules of thumb which help you home in more reliably on a suitable mic position for the sound you're after. The first thing to realise is that high frequencies tend to travel in straight lines, whereas low frequencies find it easier to diffract around obstructions. The first ramification of this is that the sound behind a piano (even with the lid fully open) is almost always unusably dull-sounding. On top of this, the thunking of the pedal ▶

mechanism is often more prominent out back as well, so that position's likely to be a duffer most of the time.

On the other side of the piano, the lid affects the dispersion of high frequencies in a different way, bouncing them out towards the audience. Roughly speaking, it does this most effectively along the line of the instrument's hammers, so a mic placed on that line will capture pretty much the brightest sound. As the miking position moves towards the foot of the piano, the lid gets less effective at reflecting the highest frequencies, and the sound loses some of its airiness. A similar effect occurs for mic positions on the keyboard side of the instrument, behind the player.

At this point it's time to turn to my first set of audio examples. You can access these in both WAV and MP3 formats on the *SOS* web site at www.soundonsound.com/sos/jan08/articles/pianorecordingaudio.htm. (Further information about the recording sessions can be found in the 'Recording The Audio Examples' box.)

To illustrate the range of tonal variation I've been talking about, I recorded six identical omni mics around the piano, all angled towards the instrument about 1.5m from its centre and 1.7m off the ground, as you can see in the photo on the previous page. The recordings can be heard in the following audio files:

- **HorizDispLidOpenMic1:** The first mic was on the keyboard side of the piano, behind and slightly to the right of the player to try to avoid high-frequency shadowing of the upper strings by his body.
- **HorizDispLidOpenMic2-5:** Mic two was in front of the piano, directly on the line of the hammers; mics three and four were positioned progressively around towards the foot of the piano; and mic five captured the sound directly at the foot of the piano.
- **HorizDispLidOpenMic6:** The final mic was positioned behind the piano.

Although it's possible to hear general trends in the dispersion of the very high

Miking An Upright Piano

I've focused in mainly on recording grand pianos, and for reasons of space haven't gone into detail on recording uprights. However, many of the considerations are the same for both types: you still need to think about the distance and height of your mic placement. There are some differences, though. For example, unless you can take some of the panels off the instrument, the only way to get access to the strings is to open the lid at the top and mic from above.

If you're using a spaced stereo technique, extremely close miking is likely to risk a hole in the middle of the stereo image, even if you're using good omni mics, so it would also make sense to space the mics more closely than you might when close-miking a grand.

One other thing to bear in mind is that the very characteristic which helps spaced stereo techniques to give grand pianos a more diffuse and blended sound also tends, in my experience, to emphasise the 'honky-tonk' element of an upright's sound, so you might prefer to go for a coincident technique if you hoping for your upright to make the best of a grand's job.

A more natural and open sound can be achieved with upright piano by removing the casework panels to expose the instrument's strings and soundboard. Spaced stereo techniques tend to be prevalent here, and the three different pairs seen here were compared for the 'UprightPanelsOff50cm' set of audio examples.

frequencies, it's also plain that the sound around the piano changes in a lot of other less predictable ways, especially at the low end. Mic one is particularly boomy, for example. This is because each mic sees different phase cancellations between the reflected sound from the lid and floor, and each is also affected by the room's resonance modes in a different way. Some theoretical knowledge will help you get into the right ballpark as regards mic position, but there's simply no substitute for a bit of trial and error if you're going to get your mics into a truly star-spangled position.

What About The Lid?

Now I've been assuming for the moment that the piano lid is fully open, but what if it's not? Well, closing the lid completely is rarely a good idea, because the closed box attenuates high frequencies more than low frequencies, so you get quite a muffled sound that's rarely of much practical use. If you're lucky, some high frequencies from the strings might still escape from the narrow aperture behind the music stand, where they could be picked up by a mic on the keyboard side of the instrument but, frankly, it's pretty meagre pickings. You can hear the effect of closing the piano's lid in my 'HorizDispLidClosed' set of audio examples, which were recorded with mics in exactly the same positions as for the 'HorizDispLidOpen' set above.

For chamber music, the balance of the instruments is sometimes improved by using the shorter support stick to open the lid only part-way. As you can hear from the 'HorizDispLidHalfOpen' audio examples, this more subtly mellows the tonality as a whole, but the relations between the tonal characters of each mic position remain broadly similar, and the frontal positions still capture the most high frequencies.

Although removing the lid completely can be worthwhile when close-miking, this is unlikely to give you a suitable sound with ambient mic techniques. Without the lid, the high-frequencies direct themselves primarily upwards, rather than being focused outwards towards any of the mics, which dulls the sound out at the front of the instrument. Furthermore, the removal of the lid also changes the resonant qualities of the instrument and often results in a reduction in the sound's low-end weight. Overall, the timbre becomes more uniform around the piano, as you can hear in the 'HorizDispLidOff' audio examples (recorded with the same mic setup).

Vertical Dispersion

Clearly, the piano doesn't just radiate its sound in two dimensions (who'd want a flat sound anyway?), so the height at which you set your mics also needs consideration. As in the horizontal plane, the sonic changes resulting from mic movements are complex, but there are some principles which can help guide you. Again, the high frequencies from the strings like to travel in straight lines, so putting your mic high enough for it to 'see' the strings over the edge of the piano's case will help get you the brightest sound. However, if you're miking at the front of the piano and go too high, then the open lid will start to shadow the high frequencies as well — you'll find you get the clearest high-frequency reproduction somewhere underneath the line of the open lid. The other thing to bear in mind is that the reflections from the piano's soundboard to the floor will become more prominent in the recording if your mic is lower to the ground, giving what I'd characterise as a more strident timbre.

My next set of audio examples (filenames beginning 'VertDisp') gives some idea of how these changes in miking height affect the recorded sound. I set up six identical omni mics in front of the piano (in the same place as mic two from the 'HorizDisp' files), all of them 1.5m from the centre of the instrument, but at different heights above the floor: to be precise, at 280cm, 235cm, 195cm, 155cm, 115cm and 85cm high for mics one to six respectively. Mic one was just below the line of the piano lid, and both mics one and two deliver a bright, clear sound, whereas mics three and four begin to sound a bit mellower. Mics five and six were below the point at which they could 'see' the upper strings and demonstrate a greater contribution from the soundboard.

Again, the general principles I've mentioned are only one set of factors involved — there's a considerable low-end tonality difference between mics one and two, for instance — but the other changes in the sound are a lot less easy to predict. That said, I've found that vertical repositioning doesn't seem to have quite as drastic an effect as moving the mics around the piano, so I'd recommend first finding a rough position for your mics in the horizontal plane before faffing about too much with their heights.

Direct Versus Ambient Sound

The other major decision you need to make is how far away from the instrument you place the mics, the primary issue being that you get a more reverberant sound as you move the mics further away. To illustrate this, I set up my six identical omni mics along an imaginary line reaching from the centre of the piano through the first mic in the 'VertDisp' setup, as shown in the photo. The mics were distanced from the centre of

When creating an ambient recording of a piano, the distance of the microphone dictates to a great extent the ratio between the direct and reverberant sound levels captured. You can hear this in action in the 'Distance' audio examples, where six identical omni mics were set up at different distances from the centre of the piano, as shown in the picture.

Getting An Even Sound

One final useful little trick to keep in mind when setting up a close-miked sound is to get the pianist to play a simple full-range scale, as this reveals level unevenness between different registers much more quickly than normal playing. If you find a problem with this test when using a spaced pair, then you can try changing the distance between the mics or raising them higher over the strings. With crossed coincident pairs, the mutual angle can be used to balance the mid-range levels with those of the outer registers — increasing the mutual angle will increase the relative level of the outer registers.

the piano by 325cm, 285cm, 250cm, 220cm, 185cm and 140cm respectively, with mic one furthest away and mic six closest in. The recordings from these mics can be heard in the 'Distance' set of audio files.

If you're recording a live classical concert, remember that the ambience levels you get while setting up before the gig may not hold for the final performance if the auditorium is empty. When the hall is later packed with the great and good of the parish, their besuited persons will absorb more room ambience, and may leave your recording sounding too dry.

Once more, it's apparent that the change in miking distance affects not just the amount of room ambience, but also the piano's tone, so there's little use in sweating over fine position tweaks to get the tonality perfect if the level of ambience you're getting isn't yet suitable. It makes more sense to get the ratio of direct to ambient sound pretty much right before finessing the recorded piano tone with small changes in mic position.

How small does a change in mic position have to be to make a difference? Well the simple answer is that even minutely different mic placements sound a bit different, but the real issue is whether movements of a few inches make a big enough difference that they're worth sweating over when you're short of session time. This is obviously a very subjective thing, so I created the next set of audio examples to help you decide for yourself. I left mic four set up from the 'Distance' file recordings, and then set the other mics around it within a few inches of each other (as shown in the photo) to create the 'TightPattern' examples. (Of course, I might just have copied the same file six times to mess with everyone's minds...)

How much difference do small changes of mic position really make in practice? To answer this question, six mics were set up very close to each other and their outputs recorded to create the 'TightPattern' audio files — judge for yourself!

Spaced Stereo Techniques

So far, I've deliberately simplified matters by recording my audio examples with just a single mic in each test position. However, mono piano recordings are pretty thin on the ground these days, so let's look at what kinds of stereo techniques you might try.

One common tactic is to use a spaced ▶

stereo pair. As we've already heard from the 'HorizDisp' audio examples, the differing tonalities of two differently positioned mics will give a kind of stereo effect straight away, but the stereo imaging mostly relies on time-of-arrival differences between them. One of the significant advantages of this approach is that you can use omni mics, with the low-end and off-axis benefits these afford. However, there are also some disadvantages with spaced-pair techniques. The first is that the stereo imaging tends to be rather vague, although a lot of classical engineers and listeners find this sound more musically satisfying, so this could, conversely, be seen as a benefit. What is more clearly problematic in certain situations is that if you don't pan the mics hard left/right you will get phase cancellation between the two signals, which can change the tonality of the sound dramatically. Even if you're not planning on changing the pan settings at all yourself, it still pays to audition any spaced mic pair in mono to check that the sound doesn't completely collapse, as some broadcasters still transmit in mono.

Because it's tricky to adjust the stereo width of a spaced-pair stereo recording without its tonality suffering, it's important that you try to get the image width you need while recording, by adjusting the distance between the two mics (the further they are apart, the wider the image). A word of caution here, though, as putting the mics too far apart can cause the sound to bunch up towards the edges of the stereo image, producing an effect often called 'a hole in the middle'. I think you'll find that any spacing above about 1m is liable to start running into difficulties, and at the other extreme, Richard King has sometimes placed his mics as close as 45cm apart for piano recording. One way around the hole-in-the-middle problem is to set up a third mic between the main pair, and use this if necessary to fill out the centre of the stereo picture. This can be a good safety net, but a side-effect is that the left and right mics will both cause phase cancellation with the central mic, so it may take a bit longer to get the recorded tonality you're after in the first instance.

There is nothing to stop you using spaced-pair techniques with directional mics as well, although the mics will need to be placed further away from the piano to achieve the same degree of room ambience. Depending on how you angle the mics, you may also find that a hole appears in the middle of the stereo image earlier than it would with omnis, so you should keep a keen ear out for this. And talking of mic angles, even if you use omnis you might still want to experiment with angling them towards the higher strings if you're after the brightest sound, because the high-frequency response of your mics will almost certainly be best on-axis, especially if you're using large-diaphragm models.

This picture shows the three different spaced-pair stereo rigs lined up together for the 'SpacedPair' audio comparison files: wide omni and cardioid pairs on the outside and a narrower omni pair on the inside. A further central mic was added to demonstrate one way of dealing with the 'hole in the middle' problem when working with spaced-stereo methods.

The next set of audio examples shows how some of these mic-placement variables affect the sound. I set up an array of seven spaced mics roughly centred on the position of my favourite mic in the 'TightPattern' setup. All the mics were pointing straight ahead, but angled down towards the centre of the piano, and were recorded to the following files:

- **SpacedPair1:** A pair of Rode NT55 omni mics spaced at 40cm.
- **SpacedPair2:** A pair of Rode NT55 omni mics spaced at 1m.
- **SpacedPair3:** A pair of Rode NT55 cardioid mics spaced at 1m.
- **CentreMic:** A single Shure KSM141 omni mic placed centrally between the other mic pairs.

A quick note about stereo polarity here: for all the ambient techniques in this article I've stuck with the convention of having the higher strings of the piano to the left of my stereo image and the lower strings on the right, which is fairly common practice in the classical domain where you're usually trying to recreate the audience's perspective. However, in pop productions engineers usually prefer a player's perspective

Where Should I Set Up The Piano?

If you're using ambient recording techniques for classical-style recordings, it's vital that you find the best possible acoustic for your recording sessions, as it will be all over the final recording. Whatever venue you're in, the question of where to set up in not easy to answer. One thing to factor in is that having the piano right back against a wall or in a corner is likely to boost the low frequencies, because of the way reflected sound from the walls interacts with sound heading out into the room — rarely a desirable effect for classical recordings.

A hard wall within a few metres of the piano can help to brighten the sound overall, by reflecting some high frequencies directly back to the recording mics. If there are no walls close by, the sound of the piano has to go a long way to be reflected back, and as high frequencies don't travel through the air as efficiently as low frequencies, the reflected sound will be duller. However, any strong reflection from a nearby surface may cause some phase-cancellation artifacts at the microphones, which may make it trickier to find decent mic positions.

To give an idea of the scale of these effects in practice, I've recorded the same grand piano with the same omni microphone in four different locations within a concert hall to create the following audio example files:

- **LocationCentreOfHall:** For this recording, the piano was in a position about two-fifths of the way down the rectangular hall, and was firing down the long dimension towards the microphone and the remaining three-fifths of the hall. This was also the piano position where the majority of the other audio examples for this article were recorded.
- **LocationAgainstWall:** The piano was moved to the end of the hall, firing down the long dimension towards the mic.
- **LocationInCorner:** The piano was moved into the corner of the hall, firing out towards the centre of the hall and the mic.
- **LocationFiringAtWall:** The piano was four-fifths of the way down the hall, firing at the wall, with the mic set up between the piano and the wall.

Here you can see a number of commonly suggested close-miking setups where the mics remain outside the piano's casing. You can listen to how these sound by checking out the 'CloseOutside' audio examples.

(high and low strings the opposite way round), so I've made the audio examples that way for the close-miking discussion later on. If you'd rather hear things the other way round, you'll just have to go and listen to the files in the mirror...

Other Stereo Mic Setups

If you're concerned, as a lot of broadcasters are, about mono compatibility, then spaced-pair stereo techniques don't really cut the mustard, no matter how good they might sound in glorious stereo. In such cases, coincident techniques are the order of the day, all of which place the microphone diaphragms as close together as possible so that phase-cancellation artifacts are negligible when the signals are summed to mono. Because of the mono-compatibility of these techniques, you're also free to narrow the stereo image of the recording at a later date, simply using the pan controls on the two mic channels.

The main family of coincident setups are the crossed pairs, which derive the stereo image from level differences between the mics. The width of the stereo image is proportional to the angle between the mics, usually called the 'mutual angle' — the larger the angle between the mics, the wider your stereo picture will be, although mutual angles beyond about 130 degrees may begin to open up a hole in the middle of the stereo field. Crossed-pair techniques typically give a much clearer and more precise stereo image, but at the expense of what detractors sometimes describe as a rather 'clinical' sound. The fact that such approaches require directional mics, with their potential for off-axis and low-frequency deficiencies, is another reason why some engineers steer clear of them.

There is another coincident option, though, which does allow you to use omni mics: the Mid/Side (M/S) technique. This also gives you the ability to control the stereo width of your recording without moving the mic setup at all, which is great for situations where the best mic position isn't the most accessible. If you're interested in investigating M/S further, or just need a bit more information on stereo mic techniques in general, check out the links to Hugh Robjohns' articles in the 'Help! I'm Buried In Jargon!' box.

Something of a halfway house between the spaced and coincident methods is another family of near-coincident techniques. These use directional mics with fairly small spaces between them in order to capture both level- and time-difference information about the stereo field. On the one hand, you could say that this combines the more precise imagining of the coincident techniques with the more musically involving sound of the spaced techniques. Alternatively, you could also say that this combines restricted mic choice with the potential for phase-cancellation problems! To help you decide which side of the fence you're on, here are some more audio examples. I left one pair of spaced omnis set up from my 'SpacedPair' recordings, and set up coincident and near-coincident pairs between them. All the mics were angled downward towards the centre of the piano, and you can hear how they sound by listening to the following audio files:

- **StereoPair:** Two Rode NT55 cardioid mics in a coincident crossed pair at a mutual angle of around 110 degrees.
- **StereoPair2:** Two Rode NT55 cardioid mics in a near coincident pair at a mutual angle of around 110 degrees and with the capsules 17cm apart (the 'ORTF' standard developed and widely used in French broadcast circles).
- **StereoPair3:** The pair of Rode NT55 omni mics spaced at 1m, as before.

One final thing to mention before we move on to closer miking methods is that some engineers combine the techniques we've been talking about, in order to overcome potential problems with specific approaches. One example of this would be setting up a single low-pass-filtered omni mic alongside a coincident stereo pair for better low-end response. Another common tactic is mixing in a little of the signal from a widely spaced stereo pair with a main closer coincident pair — the omnis give a more involving ambience and good bass

Help! I'm Buried In Jargon

Talking about mic techniques can get pretty technical. if you're feeling a bit daunted by all the jargon, you'll be glad to know that help is at hand from the *SOS* web site. Here are a few links that I'd particularly recommend:

• Paul White's comprehensive introduction to different microphones and their usage can be found in *SOS* September 2006.
W www.soundonsound.com/sos/sep06/articles/microphones.htm

• Detailed explanations of all the stereo mic techniques I mentioned (and many more besides!) are given in Hugh Robjohns's encyclopaedic two-part series in *SOS* February and March 1997.
W www.soundonsound.com/sos/1997_articles/mar97/stereomictechs2.html
W www.soundonsound.com/sos/1997_articles/feb97/stereomiking.html

• If any bits of techno-speak still sneak through the net, then try the *SOS* web site's huge on-line glossary as well.
W www.soundonsound.com/information/Glossary.php

response, while the coincident pair fills the hole in the middle of the widely spaced omni image and gives clearer stereo imaging. Once you get a feel for the principles we've been discussing, these combined techniques present no greater fundamental problem than the simple techniques, beyond the practical considerations of setting up, positioning, and phase-checking extra mics during the session.

Moving Closer In

If you're not recording classical music, then you'd be forgiven for stifling the odd yawn so far. Why bother with all this stuff about ambient recording techniques when they are rarely appropriate for more modern commercial production styles? The answer to this question is that a lot of the same principles also apply when you're close-miking, so it's useful to have an understanding of them even when you're planning to move your mics in much closer — which is what we're going to do now.

Most of the information I've found on close-miking grand pianos deals with positioning mics inside them, somewhere over the strings. However, before we get carried away with that, it's worth considering positions just outside the case, in the curve at the front of the instrument. This is an area Hugh Robjohns recommended in his piano-recording article back in *SOS* May 1999, and there are two different techniques like this mentioned in Huber & Runstein's *Modern Recording Techniques*.

Once you're this close to the instrument, the positions of the different strings inside the casing begin to have a greater impact on the sound as you move mics around. The upper strings occupy a comparatively small space behind the right-hand side of the music stand, while the mid-range and lower strings extend right down into the foot of the case, crossing over as they do so. Positioning mics closer to one set of strings or the other inevitably affects the balance of the sound, as does angling directional mics in this way.

Finding a good mic position still isn't quite as simple as that, given the reflections from the instrument's lid, so I've recorded some audio examples to give a taste of the sonic range on offer here. I set up four omni mics at different points along the curve of the piano, and also set up a coincident crossed pair in the middle. You can see how these microphones were placed relative to each other from the photos (opposite), and you can hear the resulting recordings in the following audio files:

- **CloseOutsideMic1-4:** The individual omni mics were all 30cm from the instrument and 30cm above the lip of the case (to minimise shadowing of the high strings). Mic one was closest to the foot of the piano and mic four was closest to the keyboard.
- **CloseOutsidePair1:** This stereo file combines the inner pair of omni mics to create a fairly tightly spaced stereo pair.
- **CloseOutsidePair2:** This stereo file combines the outer pair of omni mics for a wider image.
- **CloseOutsidePair3:** A crossed pair of cardioids, set up with the two capsules pointing to the high and low strings respectively.

Inside The Piano

Broadly speaking, techniques for close-miking inside the piano fall into two main categories: spaced-pair techniques and coincident techniques. Looking at the former to start with, there seem to be two main schools of thought when it comes to deciding where to put the two mics. The first is to tuck them somewhere fairly close ▶

A variety of spaced stereo techniques can be seen in action here, as used for the 'InsideSpaced' sets of audio examples. The pair behind the music stand (in conjunction with the extra crossed pair up by the edge of the lid) was used to recreate techniques described by legendary audio engineer Al Schmitt, while the remaining four mics are set up in line with the preferences of two other experienced professional engineers, Brian Tankersley and Cookie Marenco.

▶ behind the music stand, covering the two halves of the instrument's register before the low- and mid-range strings start seriously overlapping. Al Schmitt, for example, talks in *Behind The Glass* of setting up his pair of Neumann M149 omni mics in this way "usually a couple of feet off the high end and a couple of feet off the low end, kind of at 45 degrees to each other". He also adds, in another interview, that he tries to aim the mics at the hammers to get sufficient attack in the sound.

The second basic approach is to place one mic (typically an omni) over the middle of the group of high strings behind the music stand, and a second mic closer to the foot of the piano, catching the low- and mid-range strings roughly where they cross over. Brian Tankersley referred to this technique back in *SOS* October 2002, and it also crops up in Hugh Robjohns' article and Huber & Runstein's book. I came across another interesting technique courtesy of an engineer called Cookie Marenco, who uses a near-coincident rig in the middle of the piano, taking advantage of the directional characteristics of two cardioid mics to pick out the low and high strings respectively.

To compare these different sounds, I placed three pairs of Rode NT55s 30cm above the piano strings (as shown in the photo) to create the following audio files:

- **InsideSpaced30cmPair1:** This recording is from two omni mics behind the music stand, positioned roughly as described by Al Schmitt.
- **InsideSpaced30cmPair2:** Here, I had one omni mic over the high strings, and another omni closer to the foot of the piano, where the low- and mid-range strings cross over.
- **InsideSpaced30cmPair3:** Two cardioid mics were positioned in a near-coincident pair over the middle of the piano, with the two capsules pointing downwards and angled towards the upper and lower strings respectively.

Irrespective of which spaced technique you might decide to use, it's worth checking how your mic setup's tonality comes across in mono. If phase cancellation is destroying your carefully adjusted sound, try shifting the mics a couple of inches in relation to each other — this will usually change the effects of the phase cancellation quite a lot in mono, while making very little difference to the sound in stereo.

You may already have spotted that there is an extra crossed pair of mics in the photo up by the crook of the lid. I put those there to check out another of Al Schmitt's recommendations, namely adding some extra stereo ambience from a crossed pair in this position to supplement the sound from the omni close mics — I used a crossed pair of Shure KSM141 cardioids for this, recording them alongside the NT55s. You can hear them on their own in the 'SchmittAmbience' audio file, and I've mixed them in with the close mics at a fairly subtle level for 'SchmittMix'. Schmitt isn't the only engineer using this kind of technique (Tony Visconti, for example, mentions using additional room mics in *Behind The Glass*) so it's worth having a go, especially as you can probably get away with using less high-quality mics for the ambient pair than for the main pair.

An additional mic underneath the piano can help bolster the low end of the piano sound when close-miking — for my 'UnderPiano' audio example I used a C414B-XLS in omni mode, positioned as shown here.

Different Heights For Close Mics

There is some disagreement amongst different authorities as to how high the mics should be within the piano, with some engineers (often in pop, blues, or rock styles) preferring a closer position, where each string is more distinct, and others (such as Al Schmitt) favouring a more distant placement where the harmonics of the different strings have more chance to blend. The more distant placement has the practical advantage that it keeps the levels of the notes in different registers sounding more even — a mic placed very close in will pick up the strings next to it much more strongly than it will the strings further away.

You can let your ears decide which sound you prefer by listening to the 'InsideSpaced15cm' audio files, which were created from the same mic positions as before, but this time with the mics only 15cm above the strings. While I was repositioning the mics, I also set up another mic (an AKG C414B-XLS omni) underneath the piano and recorded it alongside the 'InsideSpaced15cm' mics to create the 'UnderPiano' file. This mic placement was something which Paul White mentioned might be worth experimenting with in his piano-recording article back in *SOS* October 1994, the idea being that it picks up a more mellow sound from the soundboard.

A lot of *SOS* readers don't have access to omni mics, though, so what kinds of results might you be able to expect using the two spaced-omni techniques with directional mics such as cardioids instead? The biggest risk is that the directionality of the mics will 'spotlight' certain regions of the strings at the expense of others, making certain ranges of notes over-prominent, and also potentially leading to something of the hole-in-the-middle problem we've already encountered in relation to ambient miking. You'll also get a drier sound than with omnis, although you might prefer this on a subjective level. To help give an idea of the kind of change involved, listen to the 'InsideOmnisToCardioids30cm' files, where I used the same mic positions as for the first

For studio productions some engineers, notably Elton John's producer Gus Dudgeon, like to place their microphones further from the piano's strings by removing the instrument's lid. To demonstrate the effects of this approach, the 'InsideSpaced' configuration of microphones was repositioned at a greater height in this way, as you can see in the picture, and recorded to generate the 'InsideSpaced60cmLidOff' audio examples.

two 'InsideSpaced30cm' recordings, except that I switched the mics' omni capsules for cardioid ones.

When we interviewed Gus Dudgeon in July 2001, the legendary producer of Elton John remarked: "I never close the lid on a piano. It's the worst thing you can possibly do. Taking the lid off is even better, if you can get the lid physically off. The lid is only there to bounce the sound out into the hall when you're playing live with an orchestra." This is a view shared by a number of recording engineers, so I felt it would be worth investigating how this affects the sound by removing the lid and re-recording exactly the same mic pairs I used for the 'InsideSpaced30cm' recordings. These recordings can be heard in the 'InsideSpaced30cmLidOff' files.

Clearly, removing the lid gives you more scope to raise the mics, something which Gus Dudgeon went to great lengths to take advantage of, even though that meant building an elaborate baffle to reduce spill from other instruments during his recording sessions. To try to give a sense of what kind of difference a bit of extra height makes, I moved all my mic pairs up as far as I could (so that they were all about 60cm above the strings), and recorded the 'InsideSpaced60cmLidOff' files.

Coincident Pairs Inside The Piano

For similar reasons that some classical engineers favour coincident stereo techniques over spaced pairs, there are also devotees of coincident methods inside the piano. Probably the most commonly mentioned position is somewhere behind the music stand. Both Ed Cherney and Jay Newland advocate this approach and this option also appears in Huber & Runstein's book. Although there appears to be some consensus that a sensible height for these mics is about 20-30cm from the strings, exactly how far behind the stand the stereo pair should be seems more open to debate. Positions closer to the hammers give a brighter and more percussive sound, whereas the tone gets progressively warmer the further back you go. To hear this for yourself, check out the 'FrontToBack' audio files, where I set up six identical omni mics along the centre of the piano roughly 30cm from the strings. Mic six was right behind the music stand, and the other mics were progressively further towards the foot of the piano.

Huber & Runstein describe one other coincident position that is also worth considering. This is where the mics are placed just inside the piano (over the soundholes) at a height roughly midway between the case and the lid. The two mic capsules are then pointed diagonally down towards the low and high strings respectively to create the stereo picture. Because of the positioning over the sound holes, you get more of a contribution from the soundboard than with the other technique, which gives quite a different timbre (this is a tone for which Tony Visconti expresses a preference in *Behind The Glass*, although he adopts a spaced-pair approach).

The following files give some idea of how the sounds of these techniques compare in practice (you can see how all the mics were rigged from the photo, below left):

- **InsideCoincidentPair1:** A crossed pair of cardioids 30cm directly above the hammers, pointing downwards.
- **InsideCoincidentPair2:** A crossed pair of cardioids 30cm above the strings in the centre of the piano, pointing downwards.
- **InsideCoincidentPair3:** A crossed pair of cardioids set up just inside the front of the piano, as described in Huber & Runstein's book.

In the case of the first of these pairs of mics, the position gives quite a bright sound, so it's not uncommon for engineers to mix in the signal of a further mic to reinforced the low end. An approach that Ed Cherney has used is to mike up one of the low soundholes really close with a directional mic, such that the already bassier sound at that point of the piano is exaggerated by the proximity effect of the mic. Jay Newland also likes to put an additional mic towards the foot of the piano, resting on a piece of foam, for a similar purpose. So, while recording the above audio examples, I also had an AKG C414B-XLS cardioid mic and a Shure KSM141 omni running to test out Cherney's and Newland's techniques respectively. You can listen to these mics for yourself by downloading the 'ChernyBassMic' and 'NewlandBassMic' files.

Narrowing Down The Choices

It would be fair to say that the number of options available to the recording engineer when recording piano can be bewildering, and most home studio owners simply don't get a chance to hear enough different mic techniques to decide what does and doesn't get the sound they hear in their head. If you've been able to work your way through the audio files as you've been reading this, though, you should already have a much clearer idea of which miking approaches are likely to work best for you. That means you'll already be armed with a couple of good starting points for miking up your next piano session, and can spend the session time refining them into something that sounds stunning, rather than wasting hours eliminating masses of less suitable alternative rigs. SOS

Here you can see the three coincident stereo close-miking techniques and you can compare them using the 'InsideCoincident' audio files. You can also see two extra mics at the foot of the instrument (a C414B-XLS cardioid on a stand and a Shure KSM141 omni resting on a folded towel), the placement of which follows suggestions from high-profile engineers Ed Cherney and Jay Newland.