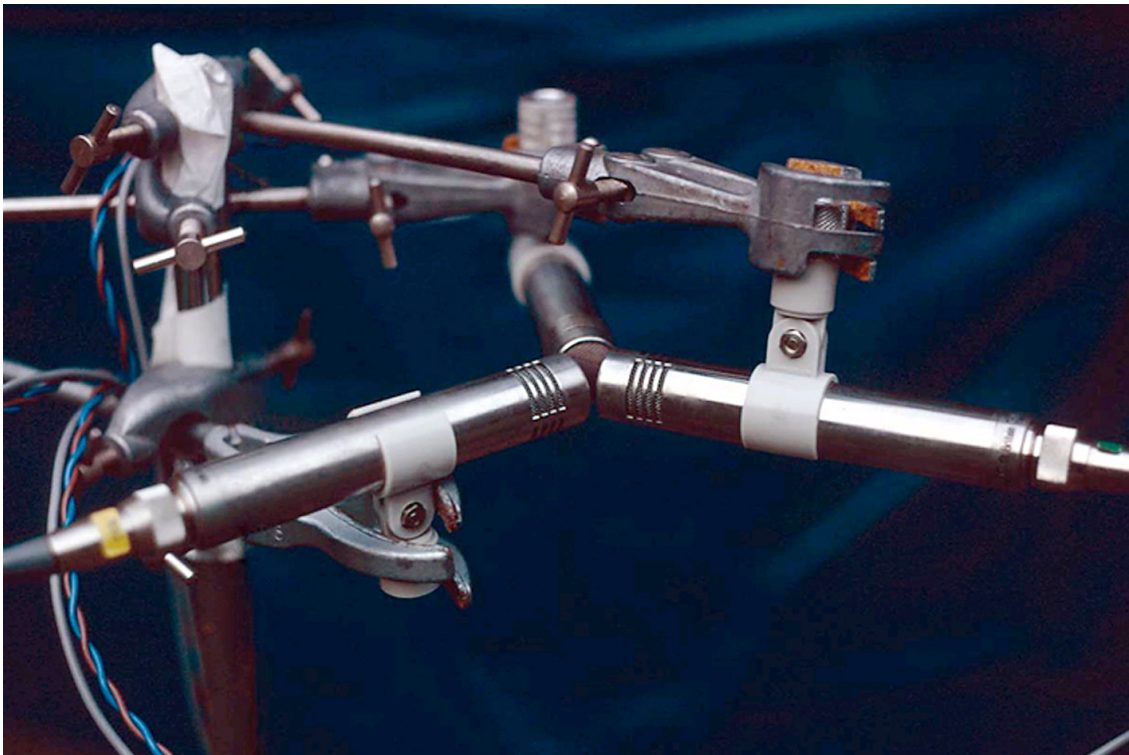


THE CALREC TRIPLET

Michael decided to purchase three Calrec CM 652 cardioid capacitor microphones which were pointed towards each other in the horizontal plane at an angle of 120 degrees. Peter designed a matrix circuit to produce an output from the three cardioids equivalent to a pair of 90 degree figure-of-eights, the device becoming known as the **TWITGO: Three Will Into Two Go**. He also designed an equalisation circuit which we called the **CRONIC: Circuit for Removal Of Nastiness In Calrecs**. It gave a flatter frequency response by removing a peak centred at about 7 kHz.

At first, the microphones were stacked on top of each other so all had an unobstructed 'view'. Michael then wrote a vast summary of his findings on two-channel reverberation pick-up of all different types of mikes, including the defects of our present three-Calrec system due to its non-coincidence. Clover leaves and vertical figure-of-eights keep creeping in - it sounds horrid. Anyway, if we alter the arrangement of mikes slightly, it will help.

This meant changing to a coplanar arrangement so that the microphones were more truly coincident.



Session in Oriel College Hall

I took the first photos of a recording session using this arrangement in January 1971 in Oriel College Hall, a venue which we hadn't used before. The music included Stravinsky's *The Soldier's Tale* [C236/207], Walton's *Façade* [C236/208] and Monteverdi's mass *In Illo Tempore* [C236/327]. The setting-up, rehearsal and recording of the performance went well, but we didn't like the acoustic in the Hall, which was very dead when filled with the audience. We analysed the tapes closely, to find out if we could hear differences from previous microphone set-ups. I thought 'the acoustic was pretty nasty, though quite natural and gave good illusion of depth: could find relative position of performers quite easily though the absolute position was not pin-sharp'. Sibilants I thought sounded worse than on a previous recording of the Isis Singers in Worcester College Chapel, 'so difficult to compare MAG's new mike arrangement'. I noticed a curious effect in the Walton: the 'dry acoustic enhanced the pointilliste writing, but the [reciters] seemed further away than most of the instruments', even though they were standing at the front.

Soon after, we used the new microphone set-up to make a recording of Stravinsky's Mass [C236/331] and other works performed by the Schola Cantorum of Oxford in Merton College Chapel. We regularly recorded the choir in this venue so it was easier to compare the new microphone arrangement with our previous ones. Peter and I listened to the tape and came to different conclusions.

He didn't like the sound, saying there was no reverberation, but though it didn't sound like Merton Chapel, it was probably preferable to our earlier stuff with 4038s. Apparently there is less treble than Michael predicts with coplanar triplet, especially in the reverb. signal - surprising. Had a dull, flat quality which Peter associates with the triplet, and which I associate with Merton Chapel.

Conclusion

Our increasing experience, and experiments with alternatives such as that in the Holywell Music Room, confirmed Michael's view that carefully placed coincident microphones with a figure-of-eight polar diagram gave the most natural sound on almost all types of music.

However, our experience with different types showed that there was no ideal microphone for those with high standards but a limited budget. The best combination of good signal-to-noise ratio, flat frequency response and accurate polar diagram was not easy to achieve even with expensive professional microphones. **The advantage of the three-Calrec arrangement was that Michael could readily extend it to a four channel system, as described in the next section on Tetrahedral Recording.**

Publication

Michael Gerzon, 'Why Coincident Microphones?' Studio Sound Vol. 13, pp. 117, 119, 140 (March 1971).

Why Coincident Microphones?

By Michael Gerzon

In the February *Studio Sound*, Bob Auger gave an eloquent and persuasive defence of multimicrophone recording techniques for classical music. However, many of his points are somewhat debatable, and a few are downright wrong. There seems to be a need to state the case for coincident microphone techniques. Up to now, only defenders of multimike techniques have stated the 'objective' reasons for their standpoint, coincident enthusiasts tending to confine themselves to subjective assertions that they get more 'realistic' or 'pleasant' results.

No assessment can be purely objective, as the results one wants depends on what sort of musical effect one is after. This in turn requires an examination of the effect of various technical and psychoacoustic points on the aesthetics of music. Therefore a statement of one's subjective standpoint is important. The first such statement, that few will disagree with, is that even the best two-channel stereo is incapable of sounding very much like the real thing. If one accepts this, then it is clearly a subjective judgement to say that such-and-such a technique is most 'realistic' as different people will disagree about which absent qualities of sound are most important.

Bob Auger believes that the recorded sound should sound *better* than reality since it is heard in the home, not at a concert. Yes, well what is 'better'? Let me state, as my articles of faith if you like, those aspects of multimike recording that I do *not* consider 'better'. If you disagree on these points, then you clearly find a very different meaning in classical music from me.

I do not consider music 'better' if the musical balance between musicians is made different from their original carefully judged intention, or if an instrument (e.g. harp, harpsichord continuo) is made clearly audible when it only intended to 'colour' the sound without being too distinct, or if a soloist is made to drown out the interplay of accompanying instruments in order to make him or her 'audible' all the time. It is not 'better' if all the orchestra is made to lie in a line between the speakers rather than being spread out in space behind them; it is not 'better' if undue prominence is given to the front of the orchestra relative to the back. It is not 'better' if the blended quality of orchestral transients is greatly modified, to the extent of changing the rhythmic attack, by the elimination caused by multimiking of the usual acoustic time delay of sound from the back of the orchestra. It is not 'better' if the unpleasant harsh high harmonics of strings and woodwinds that are normally sprayed harmlessly into the air above the heads of

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the audience are picked up by high-up mikes. It is not 'better' if acoustics which have strongly influenced and modified the musicians' performance are greatly altered in quality. It is not 'better' that the continuous spread of live stereo sound is replaced by a relatively small number of discrete but poorly defined islands of sound. It is not 'better' that the performance of great musicians should be modified greatly merely so as to conform to whatever happens to be the preferred hi-fi sound of the day, especially if this means that many subtleties of dynamics, rhythm, tone colour and reaction to live ambience are not perceptible to even the most knowledgeable of musical listeners.

In short, I do not believe that it is 'better' to disguise the inevitable imperfections of a human performance and not to be able to hear what the intentions of the players were. Most British multimike recordings capture the 'gross' qualities of the musical performances, i.e. the approximate dynamics, the basic rhythms, and the approximate balance between groups of orchestral instruments. Often lost are the subtle qualities of musical performances, such as the balance within a group of instruments, the musical use of acoustics to round off imprecise attack and to fill in staccato phrasing, the merging together of groups of instruments as a homogeneous whole when required, the arrival of a soloist's sound slightly earlier than that of the main orchestra, the avoidance of subjective mono distortion effects given by a small degree of spatial separation between nearby instruments, the alteration of tone colour, balance, attack and rhythm caused by the musicians adapting to the qualities of the live acoustics.

It is a strange fact that most of these subtleties of musicianship are well preserved on many pre-war electrical 78s, despite their technical imperfections and the then current fashion of recording orchestras in extremely dry studios. When played with no, or moderate filtering on correctly equalised top-quality equipment (e.g. Decca *ffss* 78 head, Quad valve amp, Quad *ESLs*), it will be found that a sense of distance has been well captured, that the musical balance has not been tampered with, and that many of the more subtle qualities of the original sound can still be heard behind the crackling curtain of scratch. The magical quality of the blend in the Cortot/Thibaud/Casals Schubert *Trio No. 1* is often heard live, but rarely on record. Or listen to the light yet firm quality of Schnabel's piano against the harsh rustic blend of the orchestra under Sargent in Beethoven's *Emperor*. Or compare the infinite charm and delicacy of Elgar's performance of the *Wand of Youth Suites* with the garish technicolor of Boult's modern recording.

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The recordings were almost certainly made with a single omnidirectional microphone. This technique can hardly be excelled for mono, especially as the all-round sensitivity to reverberation prevents any room-mode from being over-prominent.

Many of the subtler musical qualities were also captured by early coincident-mike stereo recordings, but often not so convincingly. The very best of the EMI *Stereosonic* recordings had a sense of space, an undistorted instrumental balance and tonal quality, and the quality of orchestral attack was well preserved. Unfortunately, many of these recordings suffered from faults such as modulation noise and a relatively dirty sound, and the stereo image quality was not always convincing. Nevertheless, it is easy to listen through the imperfections of these recordings and gauge the performer's intentions. Many Supraphon and Philips recordings of more recent vintage are also coincident-mike, although they suffer from varying degrees of dynamic compression.

Modern music particularly suffers from the lack of reverberant information, incorrect balance and wrong tone colours that seem to be inevitable with multimike recordings. An example of what good coincident recording can do is the Philips disc *SAL 3539*, in which Dorati's performance of the allegedly difficult Webern *Op. 10* orchestral pieces has a sweet mellifluous quality very different from the 'plink-plonk' sound usually given by multimike recordings of Webern. It is in modern music that the gross musical effects of even skilful multimike recordings are most apparent, as the necessary reverberation-fill-in between staccato sounds is rendered impossible by the 'presence' so sought after by multimike engineers, and adding separately recorded or artificial reverb muddies the sound unacceptably.

Some multimike recordings suffer from faults that could easily be avoided if the principles of stereophony, as expounded in N. V. Franssen's readable Philips book 'Stereophony', were better understood. In particular, ambience mikes are often used for stereo or four-channel, placed more than 10 m further from the orchestra than the main mikes; as is (or should be) well known, this causes the sound to be heard twice in a 'double-image' effect which can render the sound very confusing and fatiguing. With choirs or solo singers, distances of as little as 4 m can cause the double-image effect. This effect also rears its head when spot-mikes are used to reinforce the image given by a more distant main stereo pair, and the delayed echo can often be suppressed only by turning up the spot-mike gain ludicrously so as to swamp it. The double-image effect is severely troublesome when large choirs are recorded with orchestras by multimike

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techniques, as mikes have to be placed at a reasonable distance from choirs to get the internal choir balance right, but have to be placed close to avoid picking up sounds intended for other microphones. The result is either poor image balance in the choir, or a double-image effect that manifests itself in a confused and muddy choral texture, or both.

The real argument against multimike technique is that it is incapable of making a recording in which the original tone colours, balance between instruments, reverberation effect and attack quality are preserved sufficiently well to hear their effect on the original musical performance. A remarkable example of what can happen when people are exposed to an actual coincident microphone recording is provided by the exclamations of musical revelation with which the Supraphon (Crossroads in USA) coincident mike recording of the Berg violin Concerto was greeted in both Britain and America. Never before had the critics heard the glorious subtleties of Berg's orchestration in a recording, and most attributed this to the recording. It is worthwhile looking up these reviews, especially in *High Fidelity*.

However, if coincident microphone techniques are used, they must be done correctly for best effect. One suspects that many engineers turn to spaced or multimike techniques after failing to follow the rules of good coincident recording and getting inconsistent results. Almost all coincident techniques will give quite good results sometimes; the problem is to get good results all the time. The first rule is that the coincident microphones should have a polar response that does not vary very much with frequency, especially in the treble. In particular this can rule out many of the most popular professional stereo mikes, such as the variable characteristic types. The effect of using mikes that become more directional in the extreme treble is that of an orchestra close at the edges and distant in the middle, because of the mid-stage sound's poorer treble.

A second rule is that the angle between the microphones should be chosen carefully. If the microphones are angled too widely apart, the edges of the stereo stage become overprominent, which upsets the musical balance, and distracting pools of echo appear at the edges, which severely reduces the centre-stage image sharpness and depth. If the microphones are angled too narrowly apart, the sense of sound spread characteristic of good stereo is diminished, and the stereo effect is disappointing. The basic rule which seems to work is that there should be an even spread of reverberation across the whole stereo stage, being concentrated neither in the middle nor at the edges. This requirement is extremely difficult to fulfil with spaced and multimike recordings. Theoretical

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computations and practical experiments agree here, and show that good coincident cardioids should be angled 120 degrees apart, although this gives a narrowish direct stereo image. The gain of the S signal in an M-S recording should be such as to cause a sound 70.5 degrees off the axis of the cardioid to be reproduced from only one speaker, and figure-of-eights should be angled 90 degrees apart. It is also possible to use closely-angled cardioids with out-of-phase cross-talk introduced between their outputs; if the cardioids are 90 degrees apart, the sum signal should be cut by 4 dB, if 60 degrees apart, by 8 dB, and if 40 degrees apart, by 12 dB. With this technique it is necessary to ensure that the cardioids used are matched well and are as coincident as possible. Another requirement for best results is that some of the *reverberation* should come from 'off the end of the stereo image', i.e. be slightly out of phase. This helps to increase the apparent width and space of the stereo although usually all direct sound will seem to come only from between the speakers. This rules out 120 degree cardioids for the finest and most consistent results; in any case they give a narrow stereo image. It is found that the most satisfactory of all stereo images is obtained by the classic Blumlein technique, i.e. the use of 90 degree-angled crossed figure-of-eights. (It is incorrect to call other coincident techniques 'Blumlein', as his original patent application only referred to the use of 'moving strip', i.e. ribbon, velocity microphones). Blumlein recordings have a most remarkable stereo stability, giving a well-centred image almost everywhere in the listening room. This freedom from the stereo seat is a great relief from the severe discipline imposed by multimike recordings. Not only is the sound stable, but the stereo resolution is exceptionally good, with fine details of placement being clearly audible. This is notable, as good multimike recordings seem superficially 'analytic' but aren't, while Blumlein recordings don't seem superficially 'analytic', but are, in the sense that one can hear a lot of what has been recorded. Possibly the most surprising feature of Blumlein recordings is the fact that it is possible to gauge quite accurately how far away from the microphones a sound was, this being the only two-channel technique that seems to capture depth and distance well.

Having an omnidirectional horizontal stereo energy pick-up, the Blumlein technique captures an accurate musical balance, and seems to be the stereo technique giving results most comparable to omni mono recording technique. There is, of course, one fly in the ointment. Figure-of-eight recordings sometimes seem to have a slightly 'swimmy' quality. It is a matter of taste whether one feels it worthwhile sacrificing all the above advantages to get rid of occasional 'swimminess' or not but, if the ability to judge the original sound is important, figure-of-eights seem superior to other coincident techniques.

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It is most regrettable that an ideal figure-of-eight microphone appears not to exist; most capacitor figure-of-eights having a poor treble polar response. The best mike that I know for Blumlein recording is the BBC-type STC 4038 ribbon. While this gives good results as it is, it is improved by electronically equalising the gentle bass and treble roll-offs. (Nearly all professional microphones can be improved by equalising their frequency response.) The 4038 does have a slightly coloured quality, absent in the best capacitor mikes, and it is conceivable that such small imperfections are responsible for the occasional swimminess. The impecunious amateur should note that cheap figure-of-eights seem to be superior to other microphones in their price range, and a pair of Reslo *RBT* seems a good initial choice.

Having optimised our coincident mike technique, we can only get the best results by careful placement. The rule here is so astonishing and difficult that many engineers seem to think that balancing up twenty or so mikes is a lot quicker. The rule is to walk around during a rehearsal or first run-through, find out what position makes the *music* sound best live, and then place the microphones at that precise spot at ear height! This rule has been tested experimentally by the (initially sceptical) author and by others, and works excellently. Sometimes a best position cannot be found, and then one has to choose a compromise position; in any case the process need not take more than five or 10 minutes. One must resist the temptation to move the mikes closer unless the live sound is better closer.

Subjectively, the sound of a Blumlein recording can only be impressive if the live sound is; more often it is unassuming but liveable-with if one's interest is in listening to the performance.

In his article, Bob Auger claims that it is necessary to record multitrack and with maximum clarity so that 'the original tape can be taken out of the vault and redubbed later in an attempt to copy the sound fashion of the time'. Perhaps he will enlighten us with a further article on how a multitrack recording can be redubbed to sound like, say, a Blumlein recording; this is certainly way beyond the ability of present-day techniques. An astonishing sentence of his reads 'it should be remembered that one can always "cloud-over" the sound, or subtract "presence" during dubbing, but is very hard to conjure up information not there in the first place'. This is true enough but contains the barely-concealed assumption that reverberation is just something that can be added and which 'clouds-over' the sound. As observed above, the effect of the reverberation present on good coincident microphone recordings is quite the reverse; it

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provides extra information that allows the ears to resolve the stereo image more accurately (a phenomenon that is well-documented for live sounds) and to deduce the distance of each sound. As far as reprocessing multitrack recordings goes, it is indeed very hard to conjure up information (such as the original live pattern of reverberation) not there in the first place!

The ears use reverberation in a fundamental, though poorly understood, way to deduce spatial position and the particular 'quality' and directional properties of stereophonic reverberation seem far more important than the mere quantity or duration. The only way in which a Blumlein recording essentially differs from an 'ideal' multimike recording is in the presence of a pattern of reverberation related precisely to the original sound, and yet this is what gives Blumlein recordings their remarkable qualities.

An example of coincident mike qualities is given by the Philips *SAL 3644* recording of Debussy's *Sonata* for flute, viola and harp, in which one can easily distinguish which end of the flute is which, despite the total chamber group occupying only a third of the stereo stage. With one's eyes shut, one hears them playing, a natural distance away, in a concert hall.

Bob Auger also remarks that he can't understand why the Dolby A system is not in universal professional use. While we tread here on exceedingly controversial grounds, it should be remarked that, despite the undoubted engineering excellence of this device, there are those who are not totally convinced that it introduces no side-effects. In particular, one series of tests showed that it seemed to eliminate the above-listed virtues of Blumlein technique recordings, making the reverberation sound muddy and seemingly unrelated to the direct sound; in fairness, these results could have been due to misalignments in the tape machines. It is rare for commercial recordings of orchestral music to be made using a rigorous unadulterated Blumlein technique nowadays so this fault, even if it exists, may not have been observed elsewhere.

Coincident techniques have special virtue for four-channel stereo, as they seem to give a larger listening area than spaced techniques. At first one would expect the 'precedence effect' (the early sound catches the ear) to make spaced microphones preferable in this respect, but experience contradicts this expectation. Furthermore, contrary to Bob, simultaneous recording for both two and four channel coincident stereo is perfectly practical. All one does is record with four small cardioid or hypercardioid microphones whose capsules are in close proximity pointing along the four axes of a tetrahedron. Simple matrixing

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of the recorded signal will then yield Blumlein stereo and, depending on the effect required, the four signals may be fed to the four speakers either directly or via matrixing. While there seems to be no reason *not* to include height information in the recording, even if it is not normally used on playback, a horizontal-only recording can easily be made using just three coincident cardioids angled at 120 degrees from one another with matrixing, and an excellent Blumlein stereo can also be obtained by matrixing the resultant recording.

It may well be worth a multitrack engineer's while to devote a couple of tracks to a Blumlein recording; even if the Blumlein recording is not to his taste, its difference signal makes an excellent ambience signal, so the tracks are not wasted, and it widens the options available. As suggested below, having such a recording may cater for future public taste, and the clincher is that Blumlein recordings may be converted to four-channel by a Hafler-type matrixing scheme.

In conclusion, it is my belief that modern multimike techniques of recording not only damage many of the subtleties that lead to profound musical enjoyment, but are actually harmful in a purely commercial sense. By producing records with a glamorous 'hi-fi' sound, one certainly excites the record buying public into purchasing the latest recorded marvels, at least at first. The trouble is that many record collectors seem to lose interest in collecting after a while, as the novelty of the 'hi-fi' is not enough to sustain interest, and the remaining effect prevents a full satisfaction and involvement with deeper aspects of the music. People tend to blame the ennui on to insipid musical performances, without realising what the recording technique has done to the music. Indeed, my own active interest in recording coincided with the realisation that many performers who I had thought grossly superficial and unmusical on record were in fact subtle and profound; yet their recordings were often praised as pinnacles of the art in *Hi-Fi News* and *The Gramophone*.

It is often difficult for the active recordist, musician, or critic to realise the effect of multimike recording techniques on most musical but not musicological listeners, as the expert's knowledge allows him to compensate unconsciously for the musical distortions caused by the recording; the listener has no such crutch to lean on, and can only revel in the gorgeous sound until he eventually grows tired of superficialities. It is significant that in the USA, where multimike tendencies have gone further, a slump has hit the classical recording industry, although this has always done relatively poorly. One would have thought that any audience weaned onto classical music would have been 'hooked', and with the dearth of

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live concerts in the USA, would have persisted in buying records. That such a dramatic slump has occurred indicates something profoundly wrong. Perhaps in its efforts to 'improve' on reality, the record industry is killing off the long-term musical interest so necessary for its continued health.