

# LISTENING BY ART DUDLEY

THIS ISSUE: Optimizing the behavior of pivoted tonearms.

## Acoustical Systems Smartractor

I have flip-flopped between these points of view: that some audio products or technologies are better suited than others to specific styles of music, and that any good product or technology should be equally at home with rock'n'roll, chamber music, large-scale classical, hard bop, techno, ragas—even George Crumb.

At age 19, in my first job as a hi-fi salesman, I was asked to adopt the first of those views. The shop I worked in carried only two loudspeaker lines—EPI and Ultralinear, both long gone—and the owner urged me to push the former on lovers of classical music, and the latter on rock fans.<sup>1</sup> So I did. To paraphrase Jiang Qing, I was the shopkeeper's dog: What he said to bite, I bit.

At various times in my life as an audiophile, I have tried to adopt the other, more absolutist point of view—sometimes for good reason, sometimes just for the fun of it, never with lasting success: I persist in thinking that, when choosing playback gear, it's best to bear in mind one's favorite records. And now I've discovered that a *setup* technology I've used for decades itself depends on the music I play, if obliquely. (There's a joke in there. Sort of.)

### Angling for complements

By now, most serious phonophiles recognize the need to properly align a phono cartridge relative to both the tonearm that holds it and the center of the turntable's platter, to minimize lateral tracking error. LTE is created by discrepancies between the radial line traveled by the cutting stylus when an LP's master is created, and the arc traveled by the playback stylus of a cartridge mounted in a pivoting tonearm—discrepancies that result in measurable and audible distortion.

In the 1920s, it was suggested—by an audio journalist!<sup>2</sup>—that a pivoting arm's LTE could be minimized by modifying the cartridge's position in two ways: angle its body laterally so that the cantilever and stylus point inward toward the record spindle by a precise angle called the *offset*, and position the cartridge so that the arc traced by the stylus has a radius longer

than the distance between the spindle and the tonearm's pivot. The latter ensures that the stylus of a cartridge so mounted extends beyond the center of the spindle by a similarly precise distance called the *overhang*.



### When Erik Löfgren published his work, there were no such things as LPs.

In 1938, that suggestion was refined by an engineer named Erik Löfgren (1896–1987). He modeled the problem as one in which playback alignment is defined by a series of triangles on a lateral plane, each comprising one moving point (the position of the playback stylus) and two fixed points (the center of the record and the point around which the tonearm pivots). From that, he devised a series of geometric calculations, weighted to take into account

the record's dimensions (I'll come back to that in a moment) and the preemphasis/deemphasis curves used in its making. The result was an alignment scheme in which the playback stylus exhibits perfect tangency—and thus zero LTE—at two *null* points along the tonearm/cartridge's arc of travel, and minimal LTE everywhere else along that arc.

It caught on: 80 years later, we're still using Löfgren's alignment, or

variations thereupon.<sup>3</sup>

The story doesn't end there. As hinted above, phono-cartridge alignment is also governed by the points at which the modulated portion of the

1 Not that anyone ever heard rock in that shop. It had been banned by the owner, a born-again Christian who ordered me and the store's other employees to put religious tracts—crazy little wads of fevered bigotry that equated long hair on males with homosexual tendencies and the “devil's beat” in black music with drug abuse and violent crime—in with every piece of merchandise that left the store. I can laugh about it now.

2 That would be Percy Wilson (1893–1977), professional engineer, amateur spiritualist, and *Gramophone* magazine's original technical editor, who also conceived of the first wet-wash, vacuum-dry record-cleaning machine.

3 In 1941, Erik Löfgren's work was translated from German into English by H.G. Baerwald, whose name was thereafter associated with what we now refer to as either *Löfgren A* or *Baerwald* alignment.

groove begins and ends. The beginning point, typically 146mm from the center of the spindle, isn't crucial, but the ending point surely is: as groove radius decreases, distortion goes *way* up. The apparently popular explanation—that a tightly curved groove impedes tracking by means of a “pinch effect”—has merit but is incomplete; arguably more critical is the fact that, despite the disc's unchanging speed of rotation, the linear velocity at which the groove is dragged under the stylus is considerably slower at the end of the groove than at the beginning. As the record-mastering lathe nears the end of the groove, it crams a consistently complex signal into an increasingly small expanse of vinyl, setting the stage for a progressive rise in distortion upon playback.

Recognizing this, Löfgren put the innermost of his two null points at the innermost modulated groove of the record, about 60mm from the center of the spindle (but see below!). To some observers, that's small comfort: with Löfgren's alignment, the increases in distortion before and after the outermost null are abrupt, and the rise in distortion as the stylus travels from

the innermost null point toward the spindle is even steeper: for the stylus to continue even a few millimeters beyond that inner groove is to see a drastic jump in LTE-related distortion. And as Keith Howard brought to light in his article “Arc Angles: Optimizing Tonearm Geometry,” in the March 2010 issue of *Stereophile*,<sup>4</sup> records with modulated grooves nearer to the spindle than 60mm are not uncommon.

And here we arrive at the program-specific part of this scenario: In the world of classical recordings, the need to fit an entire three- or four-movement work on a single LP is obvious. Except when it's unavoidable (eg, the first movement of Mahler's Symphony 3), record producers are loath to begin a movement on one side of an LP and continue it on another.) And in the standard repertoire there's no shortage of symphonies and concerti, not to mention individual movements within those works, that end with a climax, often played fortissimo. Thus the most complex, high-amplitude passages wind up being pressed into the parts of the groove that are the hardest to trace.

And here we arrive at a discrepancy that's been hiding in plain sight all

along: In 1938, when Erik Löfgren published his work, there were no such things as LPs.

### Enter the Smartractor

In 1938, there were only monophonic shellac discs that spun at a high-resolution-friendly 78rpm, and whose jumbo grooves—more than twice as wide as an LP's microgroove—were, in some instances, modulated to within a few millimeters of the paper label. Before the microgroove LP, which Columbia Records introduced in 1948, classical record producers had no choice but to stretch a single movement across multiple sides or even multiple discs; in fact, before 1947, during the era when all commercial recordings were made direct-to-disc, producers and engineers got pretty good at it. (The art of *acoustic* orchestral fade-ins and fade-outs is now surely lost to us.)

The discrepancy of using a 78rpm-era phono-alignment scheme to optimize the sound of 33 $\frac{1}{3}$ rpm stereophonic microgroove LPs did not go unnoticed by Dietrich Brakemeier, of the German firm Acoustical Systems.<sup>5</sup> Beginning in 2010, Brakemeier set about creating a new alignment

scheme tailored specifically to stereo microgroove LPs. The result of his work is a curve he calls UNI-DIN, the first three letters of the name being derived from *universal*, the last three standing for Deutsches Institut für Normung (German Institute for Standardization), one of the organizations that establishes, among other things, the standard characteristics of commercial LPs.

As Brakemeier suggests on the Acoustical Systems website, he developed his alignment scheme with some specific goals in mind, not the least being even lower distortion from an LP's innermost groove—for which the UNI-DIN curve trades “slightly higher [deviation] at the beginning of the groove—where the overall working conditions for the stylus are the best.” Arguably more important was Brakemeier's goal of creating a curve in which increases in distortion are less drastic than in any other alignment—something he says is critical because “the human ear . . . is very sensitive to changes.” Brakemeier suggests that the UNI-DIN distortion curve is “actually flatter than the other curves, in the sense that the inevitable dips and peaks

of [deviation] in the tangential curve are smoother—less steep/fast in both directions.”

To achieve these goals, Brakemeier used a design approach that, while it does involve two null points, differs from those employed by H.G. Baerwald, J.K. Stevenson, B.B. Bauer, J.D. Seagrave, M.D. Kessler, and B.V. Pisha—all of whom have proposed alternative phono-alignment schemes—in not being based on Löfgren's alignment. “I did not base UNI-DIN on Euclidean calculations,” he told me via e-mail. “[It] was first planned, then designed, and *then* calculated.” Brakemeier has not published his data, and regards his alignment scheme as both his intellectual property and the commercial property of Acoustical Systems, of which he is the chief design engineer. That choice has led to at least one clash: Not long ago, against Brakemeier's wishes, a competitor published a graph purported to compare the distortion curves of various alignments, including UNI-DIN. But the graph was based on an incorrect guess at UNI-DIN's underlying calculations, and thus misrepresented Brakemeier's curve—to the advantage of the com-

petitor's preferred alignment, of course.

The UNI-DIN curve is available commercially via the Acoustical Systems Smartractor (\$599), a phono-alignment protractor described by the manufacturer as “universal” inasmuch as it can be used with virtually any pivoting tonearm. Like Dennessen's popular Geometric Soundtractor before it, the Smartractor has much in common with a draftsman's beam compass: here, the beam is a 13"-long rod of square cross-section, machined from polyoxymethylene (POM), that slides along a block of POM that has both a locking screw and a vernier scale. Fastened to one end, perpendicular to the beam, is an adjustable steel rod, machined at its lower end to a point that's intended to contact the precise center of a tonearm's lateral bearing; for tonearms whose pivots are difficult to discern, the upper end of this rod is fitted with a clear plastic disc marked with a scale inscribed on a transparent surface.

4 See [www.stereophile.com/reference/arc\\_angles\\_optimizing\\_tonearm\\_geometry/index.html](http://www.stereophile.com/reference/arc_angles_optimizing_tonearm_geometry/index.html).

5 See my review of the Acoustical Systems Arché headshell in my May 2018 column: [www.stereophile.com/content/listening-185-audio-technica-arché](http://www.stereophile.com/content/listening-185-audio-technica-arché).

The block and beam are fastened, through various fittings, to a semicircle-plus-of mirrored plastic, the top of which is engraved with a series of reticles and information. Because the Smartractor can precisely lock on to the tonearm pivot, dual alignment grids aren't required for accurate results: only a single grid is required, just as in the Dennesen Soundtracktor. That said, the generously sized Smartractor is engraved with *five* grids, for five different alignment schemes: UNI-DIN, Löfgren A (IEC), Löfgren A (DIN), Löfgren B (IEC), and Löfgren B (DIN). In brief, Löfgren A is Erik Löfgren's original, 1938 alignment. In its IEC version, the innermost null point is set at 60.325mm from the spindle center, in accordance with the LP-manufacturing standards set by the International Electrotechnical Commission; in its DIN version, the innermost null is at 57.5mm, in accordance with DIN standards. Löfgren B is a variation that Löfgren devised for players in which the offset angle is both nonadjustable and suboptimal—this according to engineer Graeme F. Dennes, in a paper that is a landmark traversal of studies of the subject;<sup>6</sup> the IEC- and DIN-prescribed nulls are consistent with the above.

### I love my cartridge

The Smartractor is ergonomically friendly, and its readings are easier to see and interpret than those of the outwardly simple DB Systems DBP-10 protractor I've relied on in recent years. The user removes a thumbscrew that secures the block-and-beam assembly to the protractor, then rotates the block relative to the beam to choose one of the five alignment schemes, after which the thumbscrew is reapplied to lock the settings in place. A sixth setting, labeled UNI P2S, allows the beam to be used to measure the pivot-to-spindle distance. The vernier scale ends at 315mm—a slight disappointment, given that the P2S distance of my EMT 997 tonearm, when set up for use with a G-style pickup head, is 316.325mm—but the beam seems long enough to accommodate, if not measure with precision, arms with P2S distances of up to 318mm.

After the alignment grid has been chosen, the Smartractor is lowered to the platter. Its 9mm spindle hole is an intentionally loose fit: with the protractor in place, a short nylon tube—it tapers in thickness from bottom to

## I was the shopkeeper's dog: What he said to bite, I bit.

top—is then pressed down onto the spindle, to center the Smartractor and hold it in place. With the protractor thus positioned and its beam's pointer either aimed at or in contact with the center of the tonearm pivot, the user lowers the stylus and adjusts the cartridge position as needed, until the stylus drops neatly into a dimple on the grid, and the cantilever lines up with the appropriate engraved lines. A cutaway in the clear-plastic fitting between the beam-and-block and the protractor holds a magnifying loupe (supplied) in just the right position to aid alignment—a very welcome enhancement.

The Smartractor is a breeze to use, and seems exceptionally well made. But what of the alignment curves it offers? I have yet to use all five, and my experiences with the SmarTractor are limited to a very few cartridges. Most of the cartridges I own, such as my various EMT OFDs and Ortofon SPUs, are pickup heads, whose fixed offset angles *and* overhangs force me to use the DB Systems protractor. The DB is still the only commercial protractor I know of that makes it easy to select and then implement my own (dual) null points, arrived at by using the Arm Geometer software developed by Keith Howard and referenced in “Arc Angles.”<sup>7</sup>

I made a few listening notes during my early experiences with the Smartractor. In fact, this column began as the introduction to a piece about two new and very expensive standard-mount cartridges—but in my efforts to say a few preliminary words about the work that went into setting them up, I found that the SmarTractor deserved more ink: those cartridges will appear in this space in the next issue.

So I reverted to an old friend among standard-mount cartridges, my well-worn Miyabi 47, which hasn't been in production for a number of years. I chose the Miyabi especially for its relatively spare body, and thus its easy-to-see cantilever: always a boon to precise alignment. And its elliptical stylus is, I suppose, closer than the spherical tips of my various pickup heads to the sorts of styli most hobbyists use. Not only that, audible differences among various alignment settings are presumed to be

more apparent with an elliptical (or any of its many variants) than a spherical tip.

I began by setting up the Miyabi 47 with Löfgren A (IEC) alignment, then spun a few LPs, including: Captain Beefheart & His Magic Band's *Strictly Personal* (Blue Thumb BTS 1); the Incredible String Band's *Liquid Acrobat as Regards the Air* (Island ILPS 9172); Elgar's *Sea Pictures*, performed by mezzo-soprano Janet Baker, Sir John Barbirolli, and the London Symphony Orchestra (EMI ASD 655); and Donovan's *Barabajagal* (Epic BN 26481). I made sure to spend at least a little time listening to the first and last tracks on most of those sides. I enjoyed generally good sound with Löfgren A (IEC), and mentioned in my listening notes that Mike Heron's lead vocal in “Painted Chariot,” the last song on side 1 of the ISB album, sounded *very* present and very good.

Then I repositioned the cartridge in its headshell to achieve Löfgren A (DIN) alignment—which, it seemed to me, required just over 1mm *less* overhang, and a hair less offset. As with the initial setting, this alteration took a bit of patience: not infrequently, I found I'd inadvertently moved the cartridge while retightening the mounting bolts—which I'd loosened in order to move the cartridge in its headshell.

From my notes: “With DIN, the beginning of Elgar's ‘The Swimmer’ definitely sounded a little worse—grainier and harsher, especially in the voice and massed strings. But the very end of the song sounded *microscopically* better—in particular, Baker's loud, sustained high A at the end. (Baker's voice is dead center, while the no-less-loud orchestra, which sounded no different, comes at the listener from both sides of the stage—make of that what you will.) In ISB's ‘Painted Chariot,’ Heron's voice didn't sound quite as good—a difference so slight I might have imagined it—but the loud organ at the end sounded worse in DIN—obviously more distorted.” For the record, “The Swimmer” begins at about 90mm from the spindle center and ends at about 70mm; “Painted Chariot” ends

6 Graeme F. Dennes, “An Analysis of Six Major Articles on Tonearm Alignment and Optimisation and a Summary of Optimum Design Equations,” AES/IEEE, 1983/2015: [https://stuff.pentium02.org/Vinyl/ve\\_Tonearm\\_Geometry\\_by\\_Graeme\\_F\\_Dennes\\_20\\_September\\_2015.pdf](https://stuff.pentium02.org/Vinyl/ve_Tonearm_Geometry_by_Graeme_F_Dennes_20_September_2015.pdf).

7 See my column in the June 2010 *Stereophile*: [www.stereophile.com/artdudleylistening/listening\\_90/index.html](http://www.stereophile.com/artdudleylistening/listening_90/index.html).

at 63mm.

I left the Miyabi 47 in its Löfgren A (DIN) position for the rest of that day, listened to a few more records, and the next day resumed listening with Donovan's *Barabajagal*—chosen because I remembered measuring its modulated groove area a few years ago and noting that, on side 1, it goes all the way to a point just 57mm from the spindle center. For that reason, this LP was a useful choice, but it was a poor choice in another respect: *Barabajagal* has not, shall we say, held up very well. Listening to that side 1 closer, "I Love My Shirt," was an exhumation from which a few foul odors escaped, made worse by the fact that, at the time, my college-age daughter and her boyfriend were within listening range: much ribbing ensued. In any event: the side 1 opener (the title track) sounded really quite good, but by the end of "I Love My Shirt" cymbal smashes were a little hot, lead and backing vocals harsh.

I made a few more notes, then repositioned the cartridge for UNI-DIN alignment. "Barabajagal" was now worse than with Löfgren A (DIN)—per my notes, by the end of the track it was "borderline unlistenable." At first,

"I Love My Shirt," which begins at around 77mm, also sounded worse, but not by as much: Donovan's voice was just a little more sibilant. Yet by the end of the song the sibilance was more natural and thus easier to take. With UNI-DIN, his voice at the end of the track sounded better than ever.

But let's be realistic: This was with one cartridge and a total of maybe a dozen LPs, heard over the course of two days. Over such a brief time and with so small a sampling, variables that might otherwise pale into insignificance—cartridge bolts tightened to different degrees, different ambient temperatures, etc.—can influence or even swamp distinctions that might prove more consistent over the long haul.

And the long haul is what I'm in for. With the indulgence of Acoustical Systems, I intend to keep using the Smartractor, which is more pleasant to work with than any other alignment product I've used, regardless of curve(s). For now, because Löfgren A (DIN) has worked for me so well for so long—from a technical point of view, I believe it's closest to what I've used in recent years with the combination of

the DB Systems protractor and Keith Howard's Arm Geometer software—I'm going to keep that as my control. Hopefully, in time, I'll have a better-informed idea of which alignment scheme provides the most listening enjoyment long-term. My mind is open: as Deng Xiaoping famously said, "It doesn't matter whether a cat is black or white, if it catches mice it is a good cat"—a statement that put him at odds with Jiang Qing, whose mistrust of all things Western never dimmed. ■

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