

# The complexities of simplification

## Touraj Moghaddam

THE VERTERE FOUNDER, CEO AND DESIGNER TALKS CARTRIDGES ON CRANES, LISTENING TO MASTER CUTS AND THE SOURCE OF A RECORD PLAYER'S ENERGY

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When we meet at Vertere's north-west London HQ – somewhere around here is the real *Apprentice* boardroom (in a TV studio) and the café to which Lord Sugar banishes the losing team on his 'reality' show – Touraj Moghaddam is putting the finishing touches to the company's newest, and most affordable, turntable to date. Or 'record player', as I'm corrected: that's the whole vinyl replay unit, of which the turntable is very much a part.

The *DG-1*, the initials standing for Dynamic Groove, is set to sell for £2750 complete with *DF-1* interconnect and separate grounding wire, and is very much a record player: it's as near as a Vertere product gets to a 'plug and play' model, coming ready assembled and requiring only minimal set-up. Unlike the company's other turntables, which are distinctly, this one comes with an arm pre-fitted and even a conventional clear acrylic dustcover. When I visited Vertere final listening was underway to decide which cartridge would come pre-installed.

The pressure was on a bit, as there were a few weeks before the annual High End Show in Munich, where the *DG-1* will make its debut, and there's the package to be finalised, the photography to be done, and the brochure to be done. Eventually it was decided that an Audio-Technica *AT-VM520* moving magnet would be available, installed and pre-aligned. This £110 cartridge adds £100 to the bill, making a £2850 *DG-1* 'Plug and Play' package.

But despite this, Moghaddam seemed pretty much unflappable: he offered coffee and cake – 'Every time I go to that deli they give me cake, and pasta – lots of pasta!', and then we sat down, after a little amusement at my use of two recorders – a *Tascam DR-07MkII* and my trusty *iPhone* voice recorder as backup – to talk about the art of designing a turntable (oops, record player). After all, the *DG-1* is designed to bridge the gap between the company's high-end models for those with a deep-seated enthusiasm for LPs, and the new generation with their collections of 'vinyls'.

From the outset, it's clear that Vertere is very much engineering driven: whether in its record players or its substantial range of cables, there's no sense of the dark arts at play, but rather – well, let Touraj explain...

'One of our substantial advantages is that we work closely with mastering engineer Miles Showell at Abbey Road, and so we have gained great insights into how records are mastered and cut, and can go back to listen to acetates and white labels, and even the original source these were cut from. It's very valid to be able to say "Yes, this turntable brings you closest to the master tape" – that definitely helps in verifying where you stand.

I mean, that's especially true when you're working with cartridges and loudspeakers – speakers are the least correct components of any hi-fi. You know, you can get an amplifier with a flat response, but once you get into loudspeakers and transducers – basically, they have a lot of characteristics!

### Back to the master

That happens whenever you're converting from one state to another: mechanical to electrical in a cartridge, or vice versa in a speaker. And it's a problem, too, in mastering: different engineers have their own preferences for amplifiers and speakers, but what you're looking for is when you cut a master and play it back through the same desk, amp and speakers, you're asking yourself whether you're hearing the same thing, or whether there are any losses in terms of the things that we want like musicality?

He explains that knowing how a record is cut can also help his design process: 'Mastering engineers know if they've got a dynamic range that suddenly goes up they can drop the cutting head by few microns and then bring it back up – there are all sorts of gizmos that they do in order to cut that groove, so when you know that then you're thinking "Okay, maybe I need a slightly different geometry for picking this up later" and so on – so it definitely helps.

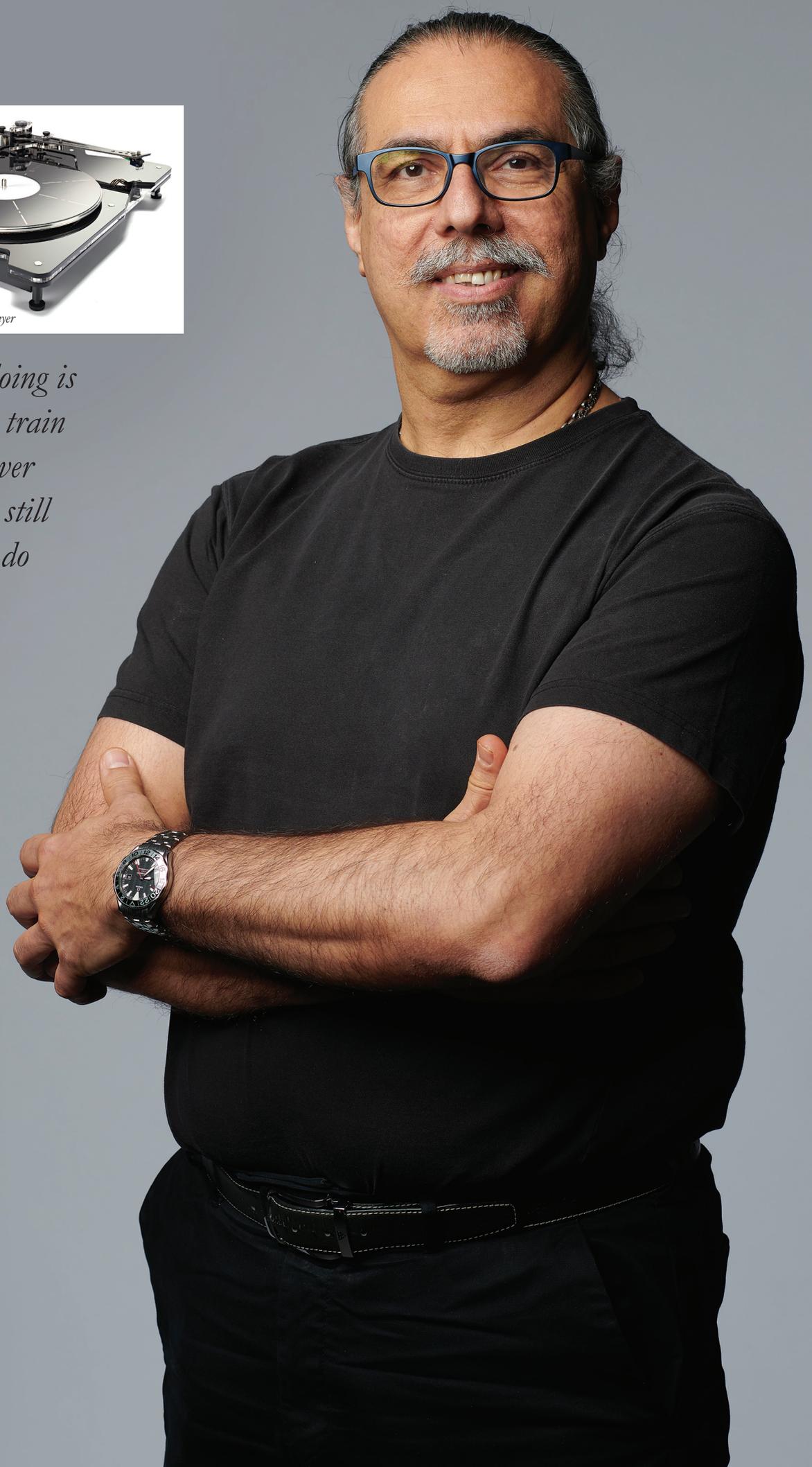
'Then you come back and you think "Well, I can do this a little bit better now that I know what it is, it's not too dissimilar." I mean, imagine you had a car and were going on to a circuit to race, rather find yourself flying off at the corners: you could look at the track and decide on a set-up. But if you actually talked to the guy who designed the circuit and he told you all about where there's a dip, where there's a camber



The new Vertere DG-1 record player

*'What we're doing is like hanging a train from a crane over the track, and still expecting it to do its job'*

Touraj Moghaddam



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change and so on, you’d start thinking “I know what to do now: I can sort of jiggle around and make the set-up better: it needs a little bit of this, and a little bit of that, so...”

He tails off for a moment, and then explains the fundamental of what a record-playing system with striking clarity. ‘Actually, people talk about what we have to do in terms of the handling of a car going down a road, but it’s not really like that: the cartridge doesn’t “see” a record revolving, but rather a straight path it has to follow at some speed, while the sides of the groove are trying to throw it about thousands of times a second.’

**A train on a crane**

Instead, he says we should visualise the cartridge as a train following a track, with all its bends and changes, ‘except what we’re doing is hanging it from a crane over the track and still expect it to do its job.’

‘OK, so the cartridge, and in particular the stylus, is tiny, and so we’re only moving a very small mass along the groove. But if you scaled up the stylus to something like the size of a car, the speeds and forces acting on it would be incredible.’

‘I don’t think, when they first invented this system of a stylus in a groove, they gave too much problem to the scale of this tiny thing – they were too busy going “Hey, I can hear myself speak!”

‘Then it became “Let’s try singing”, then “How about with a piano?”, and then at some point some kind of masochist decided they could fit a whole orchestra into this thing, and they said, “OK, let’s try it”. The fact that it actually worked was kind of amazing – I mean if you’d started from scratch and someone had told you they wanted to use this thing to record and play back an entire rock band you wouldn’t have taken the job.

‘It’s not like digital, where you can have near-silent low-level signals and very loud ones, or at least the loudest signal before the system limits. That’s not a musical dynamic range, but rather just a loudness range, so how can you get close to that with a record? It’s a sliding surface, which generates noise, and the cartridge is mechanically linked, so it acts just like a microphone.

‘So any other ambient noise is to some extent always present in the system, and jacks up your noise floor. But we shouldn’t let that take away from the fact the record player actually does what it does.’

Such clear thinking about the basics of the whole system explains the way Vertere approaches its products, and in particular the new DG-1. Moghaddam believes that in tackling the complexities a record player, it’s all too easy to introduce further complications, putting in place one element to solve

the problems of another, until the whole design becomes both very complex, and very expensive.

Instead, the Vertere way is to sit back, take a long hard look at what a product is trying to do, and then think of ways to simplify that task down to its fundamentals before coming up with the uncluttered, elegant engineering solutions to achieve it. That’s Moghaddam’s way of thinking, and it goes all the way back through his time in a leading role with Roksan to his education and subsequent work at Imperial College London, including the development of engineering solutions for wind turbines.

Only by simplifying the job of the record player can one get the listener closer to the recording being played, he says: ‘That’s why you’ll find our record players look different, both outwardly and in some of the engineering solutions you’ll probably never see. It’s all a matter of stripping down the engineering to those fundamentals by considering the absolute essence of how a record player works – from re-examining the way a cartridge gets its energy to ensuring it extracts maximum information from a groove.’

He stops, and asks me ‘What’s the only energy source in a record player?’ and, suspecting a complex answer, I pause and think for a moment. He clarifies, saying ‘Where does the cartridge get its energy?’, and before I can say ‘From the spinning record?’, he puts me out of my misery. ‘From the motor,’ he says, adding ‘That’s the only energy source in the whole system.’

Immediately I see the way he thinks: what I had considered the main job of the motor, to keep the record spinning at a consistent rate, is transformed: it’s the power source for the signal the cartridge generates, via its tiny magnets and coils.

**Minding the motor**

That’s why such close attention is paid to the motors driving Vertere’s turntables, and the way they’re controlled. In the DG-1 that motor is a 24-pole precision synchronous design, individually tuned to minimise noise, electronically controlled and fed from an offboard plug-top power supply.

Touraj is pretty pleased with the control circuitry used in the DG-1: it’s derived from that in the company’s standalone RG-1 Reference Motor Drive, but has been reduced down to a single microprocessor circuitboard, mounted in the steel chassis of the player, along with the motor, and shielded with copper and more steel. He explains that all sorts of research went into this system, involving several crystal references and the ability to get ever more precise adjustment, and all kinds of transformer.

‘But then we asked why we were spending all this money for little improvement, and thinking there must be a way of doing it better: I mean if you look at the

square wave it's never symmetrical, even though you're filtering dramatically and you're getting a sine wave out of it which doesn't have a lot of harmonic distortion.

'And the feeling was that if we fed the motor with a more symmetrical wave we could get more out of it, so when we looked there was one option: use a microprocessor, generate the wave digitally, and then we feed it through a DAC to create the analogue sine wave.'

Showing me that chassis assembly, which fits between the isolating feet and the main plinth, he points out a blanking plate mounted below the motor control board: 'The board can be addressed directly,' he says. 'You just plug in a computer, and it can be set up during manufacture, or loaded with future firmware upgrades. We can control the sine wave precisely, the noise floor is very low and – well, when we plugged the prototype into the deck it just totally transformed the sound. And it lets us use a much simpler power supply.'

That's a great example of the simplicity here: a drive unit able to be tuned once it is functioning as part of the complete system, and which can be improved if and when the Vertere process of examination of the fundamentals of playing records finds a better way.

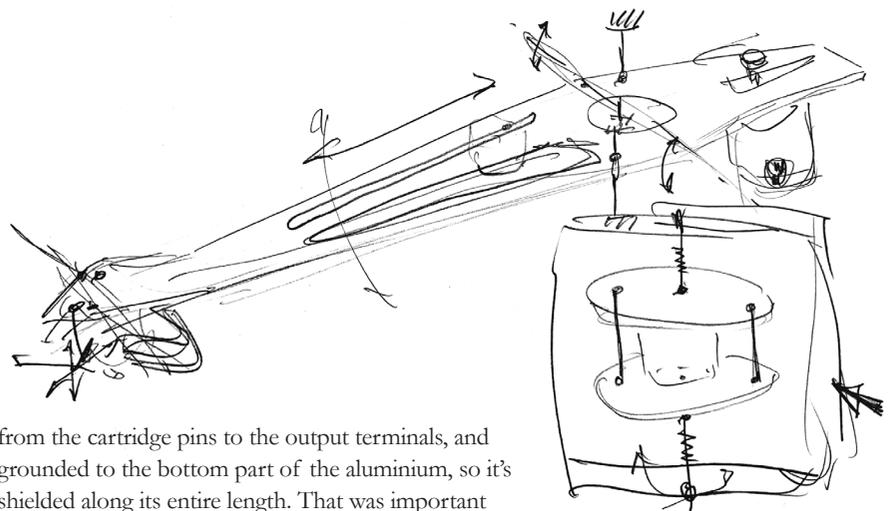
### Internal illumination

The plinth is similarly innovative, being made from three precision-cut layers of acrylic, two self-coloured layers sandwiching a transparent one. Within that 'filling' are also located the silicon suspension between the main plinth and the sub-section carrying the platter and its bearing, the speed-change switch to the left rear of the turntable, internal lighting and even the nut into which the transit screw fits. The lighting switches from a green spot to a red one to show the speed selected, and can also show white 'standby mood lighting'. The plinth also integrates the hinges for the rather conventional-looking dustcover lid fitted to the DG-1.

'Conventional' is something you could never say about the tonearm fitted to the new turntable: in place of the armtube used in just about every other arm on the market, this one is flat, slender, and cut away to give a girder-like look.

'We wanted something able to mimic what our reference tonearm does, but we couldn't just chop that down because you don't get what you want – so it had to be different, to make sure it still performs while fitting within the budget parameters of the deck.'

And different it certainly is: the arm beam is again of a sandwich construction, using two layers of aluminium either side of a layer of polymer, in which is the wiring: 'It's a flexible PCB, running all the way



from the cartridge pins to the output terminals, and grounded to the bottom part of the aluminium, so it's shielded along its entire length. That was important – we're supplying the DG-1 with a moving magnet cartridge, but users will want to switch to a moving coil, so the "wiring" had to be suitable for both.'

But even that's not the cleverest thing about the arm: 'The important thing here was reducing the bearing noise: if you ever dismantled a tonearm bearing and whizzed it, you'd hear it sounds like a bicycle wheel going round: although you can't hear it when the arm is just moving from A to B, the noise is still there in use.'

'So instead' – and here Touraj grabs pad and pen and starts sketching – 'instead I started thinking about using threads, making it almost like a unipivot but also more like a conventional pivoted arm.'

He sketches out the whole arm and the 'bearings', and I see what he means: instead of the normal bearings for vertical and horizontal movement, the DG-1 arm is suspended on one twisted thread in the vertical plane, and two, at angles to each other, in the horizontal. 'So it moves like a conventional arm, but it has no noise, and no stiction – however, the thing it does have is flexibility.'

Even more elegant is that the twist of the threads provides just the right amount of damping and resistance in the movement of the 'bearings', 'And depending on the material you choose, and the weave and the twist, it does your anti-skating for you, too. Yes, the disadvantage of the thread is that flexibility, and if you move it very slowly it will move – but when you get to the wiggling of the cartridge it doesn't. And if you excite a particular point, it isn't transmitted into the beam, so that's another inflow of noise we've avoided.'

'And in order to lighten up the beam we cut a slot ahead of the pivot, which is where we attach the weight to alter the tracking force, so that's another example of solving several problems at once.'

'By taking away the noise and the stiction, we're utilising the masses to allow the stylus to do just what it's supposed to do.'

And that is after all what it's all about.

*Sketching on the fly: a rapid explanation of the innovative thread suspension system used in the DG-1's arm*