Learning and Embodying Algorithmic Music via the Pyramid Tala

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Abstract

The 15-step pyramid tala by mridangam percussionist B C Manjunath is introduced, as a frame for exploring algorithmic music through reciting syllables, without the use of a computer. The authors share their self-reports on learning to clap the tala while reciting patterns of syllables, and transforming them through algorithmic procedures inspired by South Indian, Carnatic rhythms. The experience of taking an embodied approach to learning algorithmic patterns is reflected on, in terms of the relationship between simple rules with complex results, the value of learning to perform algorithms manually, the potential for inspiring new live coding languages, and the relationship between algorithmic musician and audience.

1 Introduction

Learning to be a percussionist can be a life-long journey, a full-body development through learning rudiments and exploring a rich world of rhythm through learning and playing. However, we have not done that; Alex has spent the past quarter century focussed on algorithmic music and live coding practice, generating all his rhythms by writing code, and Dan has ten years casual experience as a beatboxer and livecoder.

On Alex's part, becoming a live coder (Blackwell et al. 2022) has been far from a hands-off practice, they made TidalCycles (McLean 2014) and co-created Strudel (Roos and McLean 2023) to bring their algorithmic music into live improvisation, often working with percussionists to challenge and push their live coding practice further. Although it has been difficult to make the environments needed to live code the music they wanted to make, using them still feels like a shortcut. With a few keypresses, a live coder can make a complex rhythm beyond their imagination, enacted by a computer with absolute precision. This is of course a privilege, but also involves a huge trade-off.

The trade-off at play in this algorithmic shortcut is that rhythm can only be fully understood through the body. This paper's reviewers found this statement controversial, but can be argued in a number of ways. First, if we reject mind-body dualism, the mind and body are inseparable and the statement applies to everything, not just rhythm. This argument is too broad to be of interest, but a more interesting perspective is provided by Agawu (2006), and his conception of 'paper rhythms'. One of his examples is the African Standard Pattern, often analysed in terms of its inter-onset intervals of 2+2+1+2+2+1, but Agawu argues that this 'additive' way of understanding the pattern leads to conclusions not shared with those playing and dancing to the rhythm. He suggests that if African approaches to rhythm were applied in the American academy, patterns "would be taught holistically rather than atomistically; theoretical work would privilege gestalten and larger rhythmic units over pulses akin to the movement of millipedes' feet; and no one would be granted a music degree who could not dance!" This echoes Stockhausen's recommendation that "every student of music go dancing … real social dancing, once a week, as part of the music course, for the whole duration of study" (Stockhausen and Maconie 2000, 170).

If movement is fundamental to musical rhythm, it follows that by not physically developing and playing the rhythm through bodily movements as direct, in-time manipulation, a live coder misses out on some of that process. That's not to say that live coding and algorithmic music is disembodied! Hearing and feeling sound is physical, and we generally do move to the music when we live code, while using our brains which are of course inseparable from our bodies. But still, the shortcut should be acknowledged – instead of exploring patterns through the two-way, coupled, physical interactions between drum skin and hand, we type code as an interaction mediated indirectly by keypresses, and messages sent to algorithmic systems to generate multiple sounds.

One way to address this trade-off is to run algorithms ourselves, without the use of a computer. Then, we can understand the rhythms by directly playing them. This might seem impractical, but actually, this is something that humans have done before the information or even industrial revolution, through heritage practices over millennia; humans have long used algorithm-like recipes to convey and memorise the structure of rhythms, poetry, and other acts. A particularly

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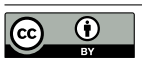

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clear example of this lies in the geometric rhythms of South Indian music. These Carnatic rhythms are primarily shared through oral practice and not notation, often as *solkattu* (performed as *Konnakol*), where rhythms of e.g. the mridangam (the two-headed, principal drum in Carnatic music) are performed using spoken, non-lexical vocable syllables.

The following text does not attempt to introduce the rich, ancient, and yet continually innovating Carnatic rhythmic practices, but does take inspiration from them, and the experience of learning through tuition from and collaboration with accomplished mridangist B C Manjunath. For an introduction to Carnatic rhythms in English we recommend "The Art of Konnakol" by Trichy Sankaran (2010), as well as enjoying the many videos available online.

2 Pyramid tala

In the following we will focus entirely on the fifteen-step 'pyramid' tala, as introduced by B C Manjunath in an informal video shared online in June 2025. The tala is not a traditional one, although the geometric rhythmic structures which Manjunath performs over it do have traditional forms.

The video[1] shows B C Manjunath clapping a rhythm consisting of five inter-onset intervals (IOIs) which successively increase in duration by one beat (1,2,3,4,5), adding up to the fifteen-beat cycle.

```
x x . x . . x . . . x . . . .
```

On this ground, he recites `"hap- py . world . . mu- . sic . day . . . ."`, then `"ta ta . ka . . ta . . . ta . . . ."` and `"tha dhi . gi . . na . . . thom . . . ."`. B C Manjunath then fills in the gaps by counting up, starting at '1' for each clap `"1 1 2 1 2 3 1 2 3 4 1 2 3 4 5"`. Then the same again, but swapping in phrase groupings rather than arabic numbers `"Tha Tha ka Tha ki ta Tha ka dhi mi Tha dhi gi na thom"`.

`Tha`, `Thaka`, `Thakita`, `Thakadhimi` and `Thadhiginathom` are commonly heard South Indian solkattu phrases, with 1, 2, 3, 4 and 5 syllables respectively. As spoken, they closely relate to phrases on the mridangam drum, as well as movements in the bharatanatyam dance tradition, and can be used both in teaching and learning, and in performance.

Next, Manjunath repeats `Tha dhi gi na thom` three times, with the claps indicated here in parenthesis: `(Tha) (dhi) gi (na) thom Tha (dhi) gi na thom (Tha) dhi gi na thom`. Here syncopations are already beginning to appear, as the second, third and fourth claps fall mid-phrase, before resolving on the third repetition. Because 5 times 3 equals 15, so the phrases fit the tala perfectly.

Manjunath then dives into a series of more complex konnakol patterns, including growing structures lasting a multiple of 15 steps, but still beginning and resolving perfectly on the 'sam' (beginning/end) of the tala. For example in this 45 step[2] pattern:

```
(Tha) (dhi) gi (na) thom
Tha (dhi) gi na thom
(Tha) dhi gi na thom
(Dim) (-) -
(Tha) dhi - (gi) na thom
Tha (dhi) - gi na thom
(Tha) (dhi) - (gi) na thom
(Dim) - -
Tha (-) dhi - gi na (thom)
(Tha) - (dhi) - gi (na) thom
Tha - (dhi) - gi na thom
(Tha)
```

This is a growing structure of traditional form, in three parts, each consisting of three repetitions, and with "Dim - -" between the parts. In the second and third parts, an additional gap is added to the `Tha dhi gi na thom` phrase, creating `Tha dhi - gi na thom` and then `Tha - dhi - gi na thom`. Despite this expansion, the parts still together add up to a multiple of 15, making a total of 60 beats. Listening to B. C. Manjunath's recital is fascinating, with all kinds of rhythmic syncopations created against the underlying pyramid tala.

3 Experience reports: Pyramid tala as a New Interface for Musical Expression

Below two self-reported accounts are shared of learning the Pyramid tala. These are rough notes made by the authors, tidied up for this paper. In the spirit of alt.NIME, we bring these accounts into the main body of the paper, as lively reports on the experience of internalising algorithms. With respect to chronology, we start with Alex's report, who began learning and playing within the tala first.

[1] The video is available at youtube.com/shorts/DV3RPS2-iZw

[2] The first Tha is also added at the end, as a 46th step. This indicates the cyclic nature of the pattern, where the end is also considered the beginning.

3.1 Alex learning the pyramid tala

Despite essentially being a process of learning to count up from 1 to 5, I found learning the pyramid tala at times extremely difficult. Each time I found myself able to perform a pattern transformation in the tala, a small change of emphasis or a simple transformation produced a new challenge, requiring days or sometimes weeks to again grasp. The following represent my notes during this time. Unlike Dan's report below, I did not think to keep note of the dates while learning the tala, but can say that this was not a focussed programme of learning, but rather a long-form process over many months, fitting in around other more urgent work pressures.

I begin by learning the tala as its own rhythm, at first by repeatedly reciting solkattu syllable phrases, clapping on the leading 'tha' of each phrase, as marked with parenthesis.

```
(Tha)
(Tha) ka
(Tha) ki ta
(Tha) ka dhi mi
(Tha) dhi gi na thom
```

This feels fairly straightforward – I am already very familiar with the phrases by my previous experience learning konnakol, and they structure the time well. However, I cannot clap the pattern without reciting the phrases. To try to do this, I repeat the cycle while gradually making my recitation quieter – trying to internalise the recitation, while beginning to focus my attention on the claps, rather than the phrases.

At this stage it feels like I am trying (and failing!) to re-learn to count from 1 to 5. The intervals 1+2+3+4+5 *seem* like they should form a coherent rhythm, and they do feel coherent when reciting the syllables. But it is still not possible for me to just 'clap' without the syllables. The problem is that it feels like there is a missing 'step' at the end of the tala, due to my lifetime of listening to 16-step sequences.

I continue to repeat the cycle of claps over and over while reciting, trying to gradually shift attention from the solkattu phrases to the clapping, to try to develop a 'feel' for the tala. This feels like programming my body.

I then try to recite the 5-syllable 'tha dhi gi na thom' three times on top to match the tala (as of course, five multiplied by three equals fifteen) – this feels impossible at first! The succession of 1/2/3/4/5 intervals make it feel like time is 'uncompressing', so it feels impossible to match with straight 5s.

So, I work out numerically where the 'tha' should land. I try tapping 5s with one hand while tapping the 1/2/3/4/5 with the other. I can do it by learning the sequence, but this feels like only a step towards *feeling the actual pattern*. The normal 'western' approach is to take a scribal technique – to work the sequence out on paper, writing out the claps and tha di gi na thoms, and then reading them. That would feel very different from internalising them with respect to the vocal relationships between them, and so I really want to avoid this approach. Instead, I code it, but then listen to the result, without reading.

After a while of listening, I try reciting the 1+2+3+4+5 solkattu on top, and it suddenly sounds very different. It feels there are three things going on - the 1+2+3+4+5 'tha' rhythm, the filled-in solkattu, and the repeating fives. I can watch the highlights, and tweak the sounds to explore my own perception of these different layers. This is an example of the 'programmer being part of the program' (McLean et al. 2023), where first I code myself, then code the computer, then code them together.

To try to get more of a feel for the tala I try clapping the 1+2+3+4+5 intervals while listening to a simple repeating rhythm of 5 beats. From this I realise I'm *trying* to clap a cycle of 15, but in practice I keep falling into a pattern of 14 (1+2+3+4+4), whereas I *thought* I was falling into 16 (1+2+3+4+6). It appears that it is difficult to be aware of where I am in the count while not yet feeling the count. When I hear the 5s, the end of the cycle feels like it falls between two beats, and feels untethered. I feel like I'm feeling the syncopations relative to a 16-step sequence rather than a 15-step one, which means the second cycle feels very syncopated, and very difficult to get right.

With more practice, the four beats between the 5s come into focus, and help me find the end of the cycle. I start to wonder if I can become aware of the preceding groups of 0, 1, 2, 3 'in between' beats as well. There is a general confusion I have with sequences here; with an inter-onset interval of 5, if you clap every five beats, there are four beats where you don't clap. This can play havoc with my counting, because periods of five feel like they produce gaps of four between them! To be honest, this is the kind of confusion that I've had with numbers since I have been a child, and it feels funny to be revisiting them aged fifty.

As I try these different experiments, I am also starting to feel the rhythm slowly grow in strength, just through repetition and experiencing it from these very different perspectives.

Next, I learn the places of the claps in the three times thadiginathom (5 / 5 / 5), and begin to repeat it over and over, reciting and clapping. Excitingly, I begin to feel the additive structure of the rhythm, beginning to separate from the

imposing feeling of metrical common time. My head is starting to feel the warm, tired glow familiar from learning a new konnakol structure. However, is the meter now the repeating 5 step sequence, with the 1+2+3+4+5 on top? I realise that the figure and ground are the wrong way round!

With more repetitions I feel the rhythm more in my fingers clicking the tala, freeing up my head to try to repeat 'tha' every 5 steps. The second 'tha' falls on the step before a click. I make a quick strudel pattern to check I'm on track, my second 'tha' moving around until it finds the right place and settles there. It feels a bit like a polyrhythm but there's no phasing – two 'tha's match with clicks, and one doesn't. The 'tha's fall on the first and final fifth click, and on the beat before the fourth one. It feels like a movement away and back.

With more repetitions, the 'tha's now feel evenly spaced, and I can concentrate less on the clicking/clapping as it moves into the background. I feel like I've succeeded in switching the figure and ground, and can start to focus more on the polymetric interplay between them.

I switch back to repeating 'thadiginathom' rather than just 'tha' followed by four gaps (karve), and again, the rhythm feels very different from before. I no longer feel the pull of 16 beat common time at all. I wonder, will learning this rhythm change how I hear other rhythms? Is this how music works?

Returning after some hours, I can no longer do what I did before, and have to relearn everything. But, it's quicker this time.

I realise that I have a problem with the first 'group' in 1+2+3+4+5 - the single step. Can a single step really be a group? I find it really difficult to perceive it as one – a clap on the '1' attaches itself to the clap on the '2' that follows. There's nothing between them. Worse, the first six steps have a symmetry - 'clap clap - clap - -'. This symmetry is particularly strong when I tap my left and right knee according to the 'claps' and gaps 'left left right left right right' - indeed, this pattern is well known to drummers as a 'paradiddle' rudiment.

So, although the pyramid tala has the clear 1+2+3+4+5 structure, unexpected shapes appear within it, as a creative function of perception (Stiny 2006). This is a core benefit of the pattern-based approach to rhythm, that algorithms can be worked with as a creative material, where we continually respond to these unexpected features. Here it feels frustrating though, this unexpected feature has strong enough presence that it makes it difficult to feel the growth, from 1 to 5, that I want to. Perhaps with practice I will be able to see past it, but what about the audience? Perhaps this is what Manjunath means when he says "the audience should experience complexity, but for the musician it should be simple". Seeing and feeling the underlying simplicity behind a complex rhythm is very difficult.

I try to focus on that first 'tha'. My intonation is bad, but I try to use it to accentuate the 1, and give it identity separate from the following 'tha ka'. This seems to help with feeling the rest of the tala.

I listen to the video again and can clap along, it sounds a bit .. funkier than before? I think partly because Manju is faster than me, and a great percussionist, so that the rhythm feels more fluid. But on a first listen through, I still feel a missing beat sometimes, which throws me. However, it feels better on repeated listens.

Back to strudel, I have some fun with playing the pyramid tala backwards and forwards at the same time.

Next I try clapping the pyramid tala while switching between `1 2 3 4 5` and `5 5 5` syllables. This is difficult to start with, but then becomes effortless, helping me focus on the tala as fixed, while the rhythm on top changes.

Then, I try reciting 4 4 4 3 on top.

```
tha ka dhi mi tha ka dhi mi tha ka dhi mi tha ki ta
x   x      x         x             x
```

The claps on the 'dhi' helps orient this, although this creates a repetition that again diverts from the growth pattern of the tala.

Some months later, I return to the tala. Remembering my earlier strudel experiment, I try reciting a reversal of the pyramid to `5 4 3 2 1`. If we are building the pyramid 'up', maybe it is more like a pyramid this way? It feels very different – the end of the sequence feels nicely anchored on the '1', which makes it easier in a way, but this anchoring makes it feel like a kind of tensile structure, which is a bit disorienting.

Further months later, with occasional practice I find I'm getting there with the rhythm, but am feeling the start of the cycle in the 'wrong' place, at first I *thought* I was feeling `2 3 4 5 1`, but after a prolonged introspection eventually worked out that I was feeling `4 5 1 2 3`: feeling that the cycle started *after* that initial `1 2 3` 'paradiddle'. I think that this could still be due to struggling with my overfamiliarity with 4/4 common time, so starting with a solid '4' and finishing with the clear paradiddle helps ground the cycle, and distract me from what can feel like a missing beat. In any case, it is interesting that I again found it difficult to introspect on the very basics of what I was feeling, despite that feeling being the very basis of my own movements. This is how tacit knowledge works - the closer it is to you, the harder it is to express in words (Polanyi and Sen 2009).

After further practice, I sense that I can finally reliably clap and feel `1 2 3 4 5`. Being able to feel the `5` interval in particular felt like the challenge I needed to overcome – being able to do that without relying on 'tha dhi gi na thom', either spoken or as an internal voice, enabled me to more fully feel the structure as a +1 growth pattern.

A new end-goal then emerged with this pattern - to learn to clap the 15 step tala, while vocalising a version where each phrase is repeated. This was an idea by my collaborator Matt Davies, and became an element in our performance together with B C Manjunath in the Crucible Playhouse Sheffield, in November 2025. Following this performance, I wanted to be able to perform it myself without using my computer. For example, with a repetition of two:

```
(Tha) (Tha)
Tha (ka) Tha ka
(Tha) ki ta Tha (ki) ta
Tha ka dhi (mi) (Tha) ka (dhi) mi
Tha (dhi) gi na thom (Tha) dhi gi na thom
(Tha)
```

As with all the above it felt important to learn this without notating and reading it – rather than learning a sequence, I wanted to embody the algorithm structuring it. It took some weeks, but eventually I managed to internalise the rhythm, and am now able to freely switch between one, two and three repetitions of each phrase in turn.

```
(Tha) (Tha) Tha
(Tha) ka Tha (ka) Tha ka
Tha (ki) ta Tha ki ta (Tha) (ki) ta
(Tha) ka dhi (mi) Tha ka dhi (mi) Tha ka dhi mi
(Tha) (dhi) gi (na) thom Tha (dhi) gi na thom (Tha) dhi gi na thom
(Tha)
```

I was surprised to find this version with three repetitions easier to learn than with two. There are some clear orientation points, in particular the final repetitions of both the 3-beat `Tha ki ta` and 4-beat `Tha ka dhi mi` phrase 'framed' by claps, and a clap falling on the 'mi' of `Tha ka dhi mi` twice in a row. Furthermore, I had already learned the final three repetitions of `Tha dhi gi na thom` earlier in this journey.

One thing that strikes me as I switch between these three different variations, is even though the second and third one take twice and three times longer to recite in 'clock' time respectively, in a way they still *feel* like they have the same duration. I might clap the tala once, twice or three times to fit the different repetitions, but nonetheless, in each case I am performing a single cycle of the rhythm, just with different transformations. This fits with my experience of learning South Indian rhythms via Konnakol practice – as the rhythmic transformations expand and compress, and my focus moves around the rhythm and tala as I learn them, I am left with a strange feeling of bending time. In any case, I feel that next time I perform this structure with Matt Davies and B C Manjunath, I will have a better feel for it and contribute more to the performance, even as the live coder in the trio.

I am also left with a feeling that there is always one more twist that can be added, to make a rhythm that I've learned feel impossible to grasp once more. For example, taking the previous two variations, we can replace all syllables apart from the leading `Tha` from each phrase with gaps. Rather than just repeat `Tha` twice for each repetition in the first variation, we can then repeat the solkattu phrase `Tha ka`:

```
(Tha) (ka)
Tha (-) ka -
(Tha) - - ka (-) -
Tha - - (-) (ka) - (-) -
Tha (-) - - - (ka) - - - -
(Tha)
```

Then for the variation with three repetitions, we use `Tha ki ta`:

```
(Tha) (ki) ta
(Tha) - ki (-) ta -
Tha (-) - ki - - (ta) (-) -
(Tha) - - (-) ki - - (-) ta - - -
(Tha) (-) - (-) - ki (-) - - - (ta) - - - -
(Tha)
```

Replacing syllables with gaps (karve) is on the face of it a simple pattern transformation, but completely changes the character of the rhythm, and the result again feels impossible to recite while clapping. The isolation of phrase onsets

transforms the rhythm from polymeter to polyrhythm, creating a completely new rhythm from a simple, systematic process of removing syllables. With further weeks of practice, I manage to recite it while clapping, although often stumble when switching between this and other patterns in the pyramid tala.

3.2 Dan learning the pyramid tala

Dan's journey began while Alex was some months into his. However, after an initial read, Dan decided not to refer back to Alex's notes, leading to a fairly independent account as follows.

2025-12-18 The pyramid tala is pleasing on first listen, not mysterious. Since I've been brought up on 4-4, I'm surprised to realise it has 15 units, given how neat it sounds.

I can recite it to myself pretty easily by saying the numbers. It's like counting from 1 to 5, with the FINAL number in each phrase being the thing that catches my attention, allowing me to keep track of where I am simply by allowing some part of my brain to count from 1 to 5 triggered by the "reset" triggered by noticing the final number in each phrase.

I realise that there's a "triplet"-like logic available: the first 6 measures fit perfectly well with a standard tripletty rhythm, and the remaining 9 measures line up OK after it. This may have been contributing to the feeling of naturalness.

Alex commented that the first "1 1 2" has a "problem" that he didn't find it easy to perceive the first "1" as a phrase in itself. I see that. I don't find it so hard given the way I'm feeling the emphasis, but I do indeed feel those first 3 beats as if they were a phrase, often.

2026-01-10 (Three weeks later) I'm getting a bit more confident at repeating it verbally to myself now WITHOUT numbers, just with simple "cha - shi - shi" vocalisations. I notice that the final 5 measures remain occasionally confusing for me: what seems to sit neatly is to treat it as 2 then 3, and trying to suppress the extra accent I'm injecting. However, it often falls into either 2+2 or 3+3 when I lose concentration.

2026-01-11 The next day: I find that I've got much better at it, through this "cha - shi - shi" verbalisation which works well, and the "2 then 3" way of handling the final five definitely part of what I'm internalising, though I'm able to keep the pattern steady and put those other aspects out of my mind. It's still not totally stable. But I can find it an enjoyable rhythm to repeat to myself even without necessarily focusing on it now, while mostly getting it right.

..I now find it quite easy to play along to the tala video (with a drumstick) without any counting or anything on the off-notes. I notice that sometimes I'm "secretly" using a "2" tactus throughout - e.g. when nodding along to what I'm doing - and the way it fits with 15 is by sitting polyrhythmically alongside, so that the repeated phrase overall is of length 30.

By now, my early heuristics (such as "counting from 1 to 5, with the FINAL number in each phrase being the thing") are irrelevant and would even be distractions if I tried to make those explicit.

I listened to a new example, a recording of Alex performing with B C Manjunath and Matt Davies, and it's different from how I've been doing it, because it very explicitly emphasises a 3 pattern alongside the tala, which fits neatly into 15 of course but is not at all how I've been rehearsing it so far. At first it's hard for me intuitively to confirm that the pattern is correct, nor to clap along to it. After thinking it through a bit I find I can do it, and the heavy slow 3 version of it is quite easy to maintain. But when I listen to this version I'm definitely feeling it as 5 x 3-measures with a syncopation as decoration. I'll see whether I can achieve a more natural hearing of this with the tala strong against the 3.

(I had forgotten, by the way, that I had already commented on the "triplet logic" on the first day. Although I noticed that on day one, I didn't use it in my recitations.)

2026-01-18 I'm able to recite the tala (as basic accents and gaps) intuitively at will. I can also recite it with the words "tha dhi gi na thom" on the accents, with no hesitation or rehearsal. Naming the beats in this way adds a pleasing way to make each one of them unique and recognisable to me.

Today while reciting, I noticed that without realising it I also tapped my foot along but in a 4-4 beat with the final sixteenth note deleted. It was intuitive enough to be unconscious.

On the other hand, I still really struggle to perform the tala while also marking a 5 x 3 pattern behind it. I tried doing it very slowly and explicitly, but I still kept failing while also not feeling the tala at all. It felt so strenuous. This is strange, especially as my default way to recite the tala includes a semi-accented beat near the end "TA mm MM mm mm" which formally would fit perfectly with the 5-triplet way.

Throughout all this, I have indeed been feeling those first two accents (which have no gap between) pretty much as a single phrase, I think.

2026-01-22 I tried reciting "tha dhi gi na thom" while playing other things on the guitar, and that goes pretty smoothly. Two things I noticed from this. Firstly, because plucking/strumming the guitar often has a physical down-up alternation, I had to watch out that this physical aspect didn't lull me into an even-numbered measure. Secondly, playing along on the guitar makes quite audible that I'm mentally chunking this into measures of 3-3-4-5. I call that a moderate success,

since doing two things at once (playing guitar while verbally reciting) must involve at least some level of inattention, and yet I have no habit of falling into 4-4-4-3 or 3-3-3-3-3.

4 Discussion

Reflecting on the above reports, what have we learned, and what is its significance for the NIME conference? By learning the tala, we have gained insight into the fundamental relationship between live coders and their algorithms, and how that relationship might be enriched, and assumptions challenged.

From a computational perspective, each step in the algorithms that we have described are straightforward, for example: take inter-onset intervals from 1-5 as a 'new tala', set phrases to those intervals, repeat each phrase a set number of times while maintaining the tala, keep just the first syllable of each phrase, then map phrases across those syllables. Each step in this algorithmic development is straightforward, but the end result is complex, and fascinating – this is the joy of algorithmic music.

The process has also revealed value in learning to perform algorithmic music without a computer. It might take a moment to code up an algorithm in a programming language, and then the results can be immediately heard. But to learn to clap and perform the algorithm is to know it in a different, much closer way, exploring patterns from different perspectives over days and weeks. As the pattern becomes tacit, we are ready to learn a further transformation, gradually building up a variety of patterns that can then be woven together in improvised performance.

Learning and performing algorithms in this way also allows us to reconsider the assumptions and affordances of live coding systems. Does how we measure time in live coding fit well with how it is really 'felt'? Such interfaces are often constrained by the dominant assumptions of staff notation, and particular notions of tempo, time signatures, tuplets and so on. This experience with the pyramid tala, as well as learning more traditional Carnatic rhythmic structures, are directly informing Alex's ongoing work on a new live coding environment based on temporal assumptions that are different from those of Tidalcycles and other Uzu languages.

In the end though, this approach is a way to make music, presumably for an audience. While we have focussed on what learning the pyramid tala and algorithmic transformations of rhythms around it means for a musician, a question remains open around what it means to members of the audience. We have already seen how Alex and Dan have quite different experiences of the tala – Alex focussing on the 15, but Dan at times feeling every other beat, creating a polyrhythm of length 30, or at other times feeling every fourth beat, skipping a beat at the end. Presumably then there are many ways to explore the musical results as an active listener and audience member too.

5 Ethical Standards

We have not used high-carbon transport or computation in the production of this paper. All words, when not clearly cited, are our own, and we have not used LLMs or similar 'AI' technologies in writing it.

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7 References

Agawu, Kofi. 2006. "Structural Analysis or Cultural Analysis? Competing Perspectives on the 'Standard Pattern' of West African Rhythm." *Journal of the American Musicological Society* 59 (1): 1–46. https://doi.org/10.1525/jams.2006.59.1.1.

Blackwell, Alan, Emma Cocker, Geoff Cox, Alex McLean, and Thor Magnusson. 2022. *Live Coding: A User's Manual.* MIT Press. https://doi.org/10.5281/zenodo.7383848.

McLean, Alex. 2014. "Making Programming Languages to Dance to: Live Coding with Tidal." *Proceedings of the 2nd ACM SIGPLAN International Workshop on Functional Art, Music, Modelling and Design.* https://doi.org/10.1145/2633638.2633647.

McLean, Alex, Julian Rohrhuber, and Renate Weiser. 2023. "The Meaning of Live: From Art Without Audience to Programs Without Users." (Utrecht, Netherlands), April. https://doi.org/10.5281/zenodo.7843567.

Polanyi, Michael, and Amartya Sen. 2009. *The Tacit Dimension.* University of Chicago Press.

Roos, Felix, and Alex McLean. 2023. "Strudel: Live Coding Patterns on the Web." *Proceedings of the 7th International Conference on Live Coding* (Utrecht, Netherlands), April. https://doi.org/10.5281/zenodo.7842142.

Sankaran, Trichy S. 2010. *The Art of Konnakkol (Solkattu): Spoken Rhythms of South Indian Music.* Lalith Publishers.

Stiny, George. 2006. *Shape: Talking about Seeing and Doing.* MIT Press.

Stockhausen, Karlheinz, and Robin Maconie. 2000. *Stockhausen on Music: Lectures and Interviews.* Marion Boyars.