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DASTGAH: ALGORITHMIC EXPLORATIONS OF PERSIAN MICROTONALITY AND SERIALISM

Abstract: This article presents *Dastgah*, an original composition that integrates the Iranian microtonal modal system with algorithmic and serialist methodologies. By extending traditional 12-tone serialism into a 17-tone pitch matrix derived from the Dastgah system, the work engages with microtonal nuances central to Persian classical music. Utilizing the SuperCollider programming environment, the composition applies serial operations—Prime, Retrograde, Inversion, and Retrograde-Inversion—to microtonally-defined pitch sets, while algorithmically managing rhythm, dynamics, and spatialization. This fusion of tradition and technology results in a generative, real-time musical system that challenges Western tuning paradigms and offers a new model for culturally-inclusive algorithmic composition. The project is both a theoretical and artistic exploration of how computational tools can mediate between his-

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torical depth and contemporary innovation, highlighting issues of identity, authorship, and cross-cultural aesthetics in 21st-century music.
Keywords: Iranian Dastgah System, Microtonality, Algorithmic Composition, Serialism, SuperCollider.

1. Introduction

The composition *Dastgah: Algorithmic Explorations of Persian Microtonality and Serialism*[1] emerges from an ongoing investigation into the integration of Iranian microtonal modal systems within contemporary algorithmic and serialist compositional frameworks. This work builds upon prior compositions such as *Walking in the Darkness for solo santur*,[2] in which algorithmic logic governs melodic development based on constrained pitch sets reflecting Iranian modal traits, and *Daramad for tar and fixed media*,[3] which merges live performance with electroacoustic tracks. These earlier explorations established foundational strategies for embedding Iranian modal structures into contemporary compositional practice.

Dastgah advances this trajectory by embedding the modal, microtonal language of Iranian classical music directly within an algorithmic system designed in SuperCollider. Central to this integration is the extension of the conventional 12-tone serial matrix into a 17-tone system that reflects the intervallic structure of the Dastgah system tradition. Rather than juxtaposing disparate musical systems, the work incorporates Iranian microtonal intervals into the structural logic of serialism, applying operations such as Prime, Retrograde, Inversion, and Retrograde-Inversion to a culturally-informed pitch set.

SuperCollider plays a critical role in realizing this synthesis, offering real-time control over pitch, rhythm, dynamics, and spatialization. Through custom algorithmic processes, the composition becomes a generative system capable of producing infinite non-repetitive variations. These procedures not

[1] Ali Balighi, *Dastgah: Algorithmic Explorations of Persian Microtonality and Serialism*, Berlin, Post-Orientalism, 2025. https://alibalighi.bandcamp.com/album/dastgah-algorithmic-explorations-of-persian-microtonality-and-serialism

[2] Ali Balighi, *Walking in the Darkness for Solo Santur*, 2016. https://www.youtube.com/watch?v=PX1lZ56oyc0

[3] Ali Balighi, *Daramad for Tar and Fixed Media*, 2020. https://www.youtube.com/watch?v=pnoZhKhfdnM

only preserve the expressive subtleties of Iranian music, particularly its nuanced microtonal inflections, but also reflect serialism's emphasis on formal rigor and systematic development.

Algorithmic composition serves not merely as a tool of automation, but as a creative paradigm through which tradition and innovation can interact dynamically. It enables the exploration of a microtonal pitch space that lies outside the Western equal temperament system, while also facilitating real-time transformations that simulate aspects of improvisation—a central component of Iranian musical aesthetics.

This composition thus challenges the hegemony of Western tuning paradigms and expands the expressive and structural potential of serialism. It does so by treating Iranian musical heritage not as a static artifact but as a living framework adaptable to contemporary technological tools. *Dastgah* reflects a commitment to cross-cultural composition, highlighting the role of digital media in preserving, transforming, and reimagining cultural identity within the context of contemporary art music.

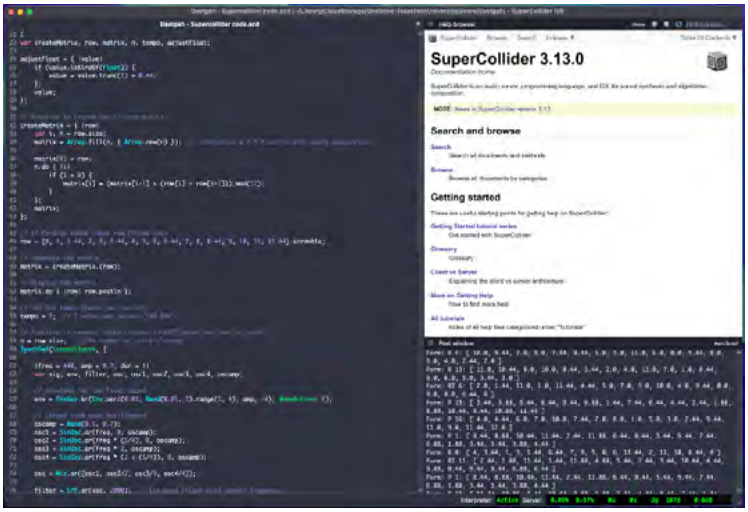

Figure 1: Screenshot of the SuperCollider IDE showing code for the algorithmic composition Dastgah, which implements a 17-tone Iranian microtonal matrix using serial operations. On the left, the code defines functions to generate the tone matrix and map pitch classes to a custom synthesizer. The right side displays the SuperCollider help browser and the real-time output window, illustrating the program's execution and matrix transformations. This visual represents the synthesis of Iranian musical modes with algorithmic composition in a live coding environment.

2. Background and Context

2.1. The Iranian Dastgah System and Modal Logic

The Dastgah system constitutes the core of Persian classical music. Each Dastgah comprises a collection of short melodic prototypes called gūshe that musicians shape into extended, semi-improvised performances.[4] Melodic development follows seyir—a concept of directional contour rather than goal-oriented functional harmony—while shahed (a pitch of gravitational focus) supplies local tonal centricity.[5] Because the tradition is transmitted orally, performers internalize these structural cues and flexibly reconfigure them in real time, privileging expression over fixed form.

2.2. Microtonality as Expressive Foundation

Persian modes rely on microtonal inflections that lie between the semitones of Western equal temperament, including neutral seconds (≈ 144 ¢) and three-quarter-tone intervals (≈ 44 ¢). These precise pitch shades are indispensable to conveying affect and poetic nuance. [6] Psychophysical studies confirm that musicians and listeners can reliably perceive—and, with exposure, prefer—such microtonal deviations.[7] In compositional terms, microtonality establishes a vocabulary that is simultaneously scalar and timbral, because slight detunings generate distinctive beating patterns and spectral color.[8]

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[4] Sahar Arshi, and Darryl N. Davis, "Capturing the Dynamics of Cellular Automata, for the Generation of Synthetic Persian Music, Using Conditional Restricted Boltzmann Machines". Paper presented at the Artificial Intelligence XXXIV: 37th SGAI International Conference on Artificial Intelligence, AI 2017, Cambridge, UK, December 12–14, 2017, Proceedings 37, 2017.

[5] Sina Sanayei, "The Concept of Melodic Progression (Seyir) in Persian Classical Music", *Rast Müzikoloji Dergisi*, 11, 2023, 213–30.

[6] Bamdad Khoshghadami Hosseini, and Soroosh Ghahramanloo, *Deciphering Persian Music: A Systematic Approach through Modal Classification and Synthesis*, Research Catalogue, 2024. https://doi.org/10.22501/rc.2547124

[7] Freya Bailes, Roger T. Dean, and Mary C. Broughton, "How Different Are Our Perceptions of Equal-Tempered and Microtonal Intervals? A Behavioural and Eeg Survey", *PloS ONE*, 10(8), 2015, e0135082. https://doi.org/10.1371/journal.pone.0135082

[8] Eline Adrianne Smit, Andrew J. Milne, Roger T. Dean, and Gabrielle Weidemann, "Perception of Affect in Unfamiliar Musical Chords", *PLoS ONE*, 14(6), 2019, e0218570. https://doi.org/10.1371/journal.pone.0218570

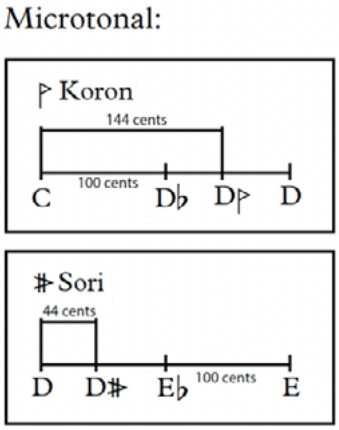

Figure 2: Diagram showing Persian microtonal symbols Koron and Sori and their pitch positions. In the image, D Koron lies between D ♭ and D, creating a neutral second interval of 144 cents from C to D Koron, compared to the 100 cents from C to D♭. Sori also raises a note by 44 cents. In the image, D Sori lies between D and E ♭ , forming a three-quarter-tone interval (44 cents) from D to D Sori, in contrast to the 100-cent semitone from D to E ♭ . These microtonal steps are used in Persian music to articulate nuanced scalar and emotional expression. The image is from Daramad for tar and fixed media by Ali Balighi.

2.3. Serialism and Western Formalism

In contrast, Western serialism—codified by Schoenberg and later expanded by composers such as Messiaen—organizes the twelve chromatic pitch classes into an ordered row subjected to transformations of Prime, Retrograde, Inversion, and Retrograde-Inversion.[9] By treating every pitch as structurally equal, serialism displaces tonal hierarchy and foregrounds combinatorial organization.[10] Although philosophically distant from modal improvisation, serialism offers a rigorously systematic approach to pitch that can be adapted algorithmically—particularly within software environments that handle non-standard tuning data.

2.4. Bridging Modal and Serial Systems

Uniting these traditions raises both aesthetic and technical challenges. Iranian practice prizes ornamented, cyclic time and spontaneous elaboration, whereas serialism privileges pre-composed order and linear traversal[11]. Moreover, the fixed 12-tone grid cannot directly encode Persian micro-inter-

[9] Allen Forte, "Olivier Messiaen as Serialist", *Music Analysis*, 21, 2002, 3–34.

[10] Roger T. Dean, "The Serial Collaborator: A Meta-Pianist for Real-Time Tonal and Non-Tonal Music Generation", *Leonardo*, 47, 2014, 260–61.

[11] Simon Gorin, Benjamin Kowialiewski, and Steve Majerus, "Domain-Generality of Timing-Based Serial Order Processes in Short-Term Memory: New Insights from Musical and Verbal Domains", *PLoS ONE*, 11(12), 2016, e0168699. https://doi.org/10.1371/journal.pone.0168699

vals. Nevertheless, extending the serial matrix to seventeen tones—thereby embedding culturally-specific intervals—enables a reconciliation that respects modal nuance while preserving serialist transformational logic. Algorithmic environments such as SuperCollider facilitate this hybridization by permitting custom frequency ratios, stochastic selection, and real-time spatialization, effectively converting the score into a generative system that mirrors the improvisatory spirit of Dastgah system performance.

By framing Iranian microtonality and Western serialism as complementary rather than oppositional, the present project positions algorithmic composition as a mediator of cross-cultural exchange. It demonstrates how computational tools can sustain the expressive priorities of Iranian music while engaging the formal experimentation prized in post-tonal Western art music—a synthesis that underpins the creative aims of Dastgah.

3. Methodology

3.1. Algorithmic Framework and Conceptual Goals

The composition Dastgah is built on a custom-designed algorithmic system implemented in SuperCollider, aiming to reconcile the expressive microtonality of the Iranian Dastgah system with the structural rigor of Western serialism. Central to this methodology is the creation of a 17-tone serial matrix—a deliberate expansion of the traditional 12-tone row—designed to incorporate culturally-specific intervals that define Iranian modal.

This system does not merely automate compositional tasks; it functions as a creative framework that enables real-time musical evolution, shaped by both formal logic and algorithmic chance. As Fieldsteel notes, SuperCollider's hybrid architecture—combining a real-time synthesis server with an expressive coding language—makes it uniquely suited for exploratory, microtonal, and generative music systems[12].

3.2. Constructing the 17-Tone Serial Matrix

At the core of the composition lies a 17-tone prime row, derived from Iranian modal intervals, including neutral seconds (≈ 144 ¢), three-quarter tones (≈ 44 ¢), and other microtonal variants. These were encoded numerically in MIDI pitch values, such as:

[12] Eli Fieldsteel, *Supercollider for the Creative Musician: A Practical Guide*, Oxford University Press, 2024.

```
row = [0, 1, 1.44, 2, 3, 3.44, 4, 5, 6, 6.44, 7, 8,
8.44, 9, 10, 11, 11.44].scramble;
```

Using a custom createMatrix function, the matrix was constructed to support the four traditional serial transformations—Prime (P), Retrograde (R), Inversion (I), and Retrograde-Inversion (RI)—applied to the expanded pitch set. These transformations were recalculated to preserve microtonal spacing and interval directionality, allowing for systematic pitch manipulation while maintaining culturally-embedded tonal subtleties.

3.3. Dynamic Selection and Real-Time Variability

To reflect the improvisational ethos of Persian music, the algorithm incorporates stochastic and non-linear decision-making processes. A selection mechanism randomly chooses a transformation (P, R, I, RI) and its index in real time:

```
selectFormAndIndex = {
   var forms = [\P, \R, \I, \RI];
   [forms.choose, (0..(row.size-1)).choose];
};
```

This dynamic structure enables the piece to generate endless variations without repeating, mirroring the organic unfolding of seyir (melodic progression) in traditional performance. Such use of randomness echoes aleatoric practices while staying embedded within a rigorously- defined system.

3.4. Timbre, Rhythm, and Spatialization

Each matrix-generated pitch is converted into frequency via `midicps`, and then mapped to a custom synthesizer. Registers are assigned through an algorithmic mapping to different pitch ranges (low, mid, high, post-high), and rhythm is governed by stochastic timing functions, e.g.:

```
(exprand(0.1, 4)/ tempo).wait;
```

Amplitude and dynamic contours are shaped by randomized envelope generators (`EnvGen.kr`) and modulated by values drawn from a bounded random range. SuperCollider's `PanAz.ar` function facilitates spatial diffusion across four speakers, creating immersive, multichannel textures that recall the spatial complexity of Iranian architecture and musical design.

This real-time diffusion supports listener immersion while reinforcing the structural logic of the piece. The use of spatialization and stochastic

dynamics adds layers of perceptual variability that align with contemporary theories of embodied and affective listening.

3.5. A Hybrid Model of Musical Intelligence

Rather than forcing Iranian modal music into a fixed grid, this methodology embeds its essential features—modal gravities, microtonal inflection, improvisational form—into an algorithmic architecture that enables perpetual variation. This hybrid model treats the computer as a co-composer, one that performs transformations both deterministic and probabilistic, thus enabling a generative structure that remains culturally grounded and sonically unpredictable.

This model reflects a broader redefinition of compositional authorship. As discussed by Dean and Fieldsteel, algorithmic music requires the composer to become a system designer—curating possibilities rather than prescribing fixed outcomes. In this sense, *Dastgah* aligns with emerging views of composition as a dynamic, collaborative process between human intention and machine behavior.

4. Results and Analysis

4.1. Structural Outcomes of the 17-Tone Matrix

The application of serialist operations to a 17-tone pitch matrix informed by Iranian microtonal vocabularies results in a highly differentiated and evolving musical structure. Unlike traditional 12-tone serialism, which depends on symmetrical and equidistant pitch relationships, this expanded system incorporates culturally-specific specific microtones—such as neutral seconds (≈ 144 ¢) and three-quarter tones (≈ 44 ¢)—that diverge from harmonic regularity and challenge the structural assumptions of Western pitch organization. Rather than forming a fixed scalar system, these intervals reflect the expressive flexibility and modal logic found in Iranian musical practice.[13]

Each transformation—Prime (P), Retrograde (R), Inversion (I), and Retrograde-Inversion (RI)—operates on a row that embeds these non-Western intervals, producing asymmetrical and non-repeating contours. This system ensures structural rigor while preserving pitch identities essential to Iranian

[13] Idin Samimi Mofakham, *Holographic Composition Technique: Revisiting the Medieval Treatises on Iranian Music,* Norwegian Academy of Music, 2023; Dariush Talai, *A New Perspective on Iranian Music Theory*, Tehran, Mahoor Institute of Culture and Art, 1993.

Dastgah expression. As observed in matrix-based traversal, the formal architecture remains serially grounded but perceptually fluid, generating nonlinear, mosaic-like musical narratives that eschew goal-directed harmonic progression.

Furthermore, the randomized traversal of the matrix—driven by stochastic selection functions—enables emergent forms. The composition does not follow a pre-determined linear arc but evolves dynamically, creating an open-ended structure that simulates improvisation, a hallmark of Iranian classical performance.[14]

4.2. Perceptual and Emotional Implications

The incorporation of microtonality significantly expands the expressive range of the composition. While serialism has historically been critiqued for its emotional detachment and abstract formality, the infusion of Iranian modal material introduces pitch nuances that convey affective states such as longing, tension, or spiritual introspection—qualities deeply embedded in Dastgah aesthetics.[15]

Empirical studies confirm that listeners can distinguish microtonal intervals from equal-tempered ones, and with repeated exposure tend to develop preferences and deeper perceptual acuity for microtonalities[16]. This capacity is critical to the Dastgah system, which relies on subtle inflections and expressive deviations to signal emotional shifts. Thus, microtonality in this composition is not merely a stylistic addition but a cognitive and emotive dimension that redefines the listening experience.

4.3. Texture, Timbre, and Spatial Design

Timbre and spatialization are integral to the composition's aesthetic identity. SuperCollider's synthesis engine facilitates the precise tuning of sine oscilla-

[14] Sina Sanayei, op. cit.

[15] Shahram Amiri, Aliakbar Parvizi Fard, Behnam Khaledi-Paveh, Aliakbar Foroughi, Amir Bavafa, Meysam Bazani, Youkhabeh Mohammadian, and Kheirollah Sadeghi, "The Effectiveness of Music Therapy on Insomnia Using Persian Traditional Music", *Journal of Kermanshah University of Medical Sciences*, 23, 2019.

[16] Yvonne Leung, and Roger Thornton Dean, "Learning Unfamiliar Pitch Intervals: A Novel Paradigm for Demonstrating the Learning of Statistical Associations between Musical Pitches", *PLoS ONE*, 13(8), 2018, e0203026. https://doi.org/10.1371/journal.pone.0203026

tors to microtonal frequencies, resulting in glistening, glassy tones with non-harmonic overtones. These tones, slightly detuned and filtered, emulate the breathy texture of traditional Iranian instruments such as the tār and ney. The result is a sonic environment that blends acoustic memory with digital abstraction.

Envelope generators and amplitude modulators shape each sound's dynamic arc, while multichannel spatialization (via PanAz.ar) diffuses sound in four channels, producing a shifting and immersive auditory field.[17] This spatial fluidity mirrors the architectural aesthetics of Iranian domes and courtyards, where sonic reflections are integral to spiritual and perceptual experience.

Research in auditory perception confirms that textural complexity—especially when driven by microtonal variation—elicits heightened sensory engagement and emotional depth[18]. Thus, texture in *Dastgah* is not ornamental but essential to its expressive power.

4.4. Algorithmic Improvisation and System Agency

The algorithmic design enables continuous transformation of pitch material in real time, granting the system a quasi-improvisational agency. By employing stochastic methods such as rrand, exprand, and .choose, the system mimics the variability and spontaneity of human performance, reinforcing the improvisatory ethos of Iranian music.[19]

Each performance of *Dastgah* unfolds uniquely, determined by algorithmic decisions governed by the matrix. In this sense, the computer functions not merely as a tool but as a co-performer. These dynamics challenge traditional conceptions of compositional authorship, aligning with contemporary views that regard the composer as a system designer and curator of potentialities.

The generative structure also undermines the fixity associated with classical serialism. Instead of a closed-form, repeatable artifact, the piece becomes a living system—constantly reinterpreting its source material and offering new emotional and formal landscapes in each iteration.

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[17] Eli Fieldsteel, *Supercollider for the Creative Musician: A Practical Guide*, Oxford University Press, 2024.

[18] Eline Adrianne Smit et al., "Perception of Affect in Unfamiliar Musical Chords", op. cit.

[19] Roger T. Dean, op. cit., 260–61.

5. Aesthetic and Cultural Reflections

5.1. Reimagining Tradition Through Technology

Dastgah represents an aesthetic proposition in which tradition and technology converge to reconfigure cultural identity in sound. Rather than treating the Iranian Dastgah system as a static historical artifact, the composition frames it as a living, adaptable framework that is capable of transformation through contemporary algorithmic processes. This aligns with broader shifts in ethnomusicological discourse, which emphasize the dynamic, evolving nature of tradition in globalized contexts.[20]

Through its SuperCollider implementation, the composition enables precise articulation of Iranian microtonal intervals—an achievement often unattainable with conventional Western instruments. Technology here is not simply a Western tool applied to a non-Western tradition; it is reconfigured as an expressive medium for Iranian musical heritage. In doing so, the work reflects the notion that software environments can become culturally-situated spaces for artistic production[21].

5.2. Hybridity as Structural, Not Stylistic

The hybridity in *Dastgah* is not superficial. It is structurally embedded at every level of the composition—from the algorithmic logic to the pitch architecture. The work does not juxtapose Iranian and Western elements; rather, it fuses them at the level of compositional grammar. This contrasts with earlier models of cross-cultural composition that often relied on quotation or fusion aesthetics. Instead, this piece presents a *hybridity*, where the Dastgah's microtonality becomes foundational to the serialist structure itself.

Such an approach resonates with Bhabha and Rutherford's notion of the *third space*, wherein cultural identity is not simply inherited but produced through negotiation, translation, and transformation.[22] The algorithmic matrix becomes a site of intercultural encounter, where Iranian modal sensibilities are not subsumed by Western frameworks but co-construct the compositional language.

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[20] Sina Sanayei, op. cit.

[21] Ali Balighi, "The Art and Science of Multichannel Audio in Electroacoustic Music: A Review", *Emille*, 2024, 12.

[22] Homi K. Bhabha, and Jonathan Rutherford, "Third Space", *Multitudes*, 26, 2006, 95–107.

5.3. Challenging Authorship and Algorithmic Creativity

By embedding indeterminacy and randomness in the system, the work decentralizes the role of the composer. Rather than functioning as a sole author, the composer designs a system of possibilities—curating conditions under which music emerges. This reflects a broader trend in post-digital aesthetics, where creativity is distributed between human intention and machine agency.

Each performance of *Dastgah* differs based on real-time algorithmic decisions, blurring the line between composition and performance. This challenges the Romantic ideal of the composer as a masterful originator, instead positioning the composer as a collaborator with code—an architect of generative systems. The system itself becomes a co-performer, producing a dialogic relationship between structure and emergence.

5.4. Expressive Ambiguity and Cultural Resonance

Aesthetically, the piece resists categorization. Its microtonal palette, stochastic rhythm, and spatial diffusion create a sound world that is neither strictly Iranian nor strictly Western. Instead, it cultivates a space of expressive ambiguity—a sonic third space—that invites listeners to engage without relying on familiar tonal or formal cues.

This ambiguity is not a weakness but an aesthetic strategy. As listeners navigate non-tempered intervals and emergent textures, they experience unfamiliarity as a site of meaning. For audiences familiar with Persian music, the modal echoes of Shur, Mahur, or Segah may activate cultural memory. For others, the piece becomes a gateway into alternative tuning systems and compositional logics.

Moreover, the use of algorithmic form challenges expectations of teleological development. The piece unfolds cyclically and unpredictably, echoing the temporal aesthetics of Persian music, which privileges emotional immediacy and spiritual contemplation over narrative closure.

5.5. Ethical Dimensions of Cross-Cultural Composition

The integration of Iranian musical elements within a Western-derived computational framework raises ethical questions regarding representation, ownership, and power dynamics. While algorithmic systems are often assumed to be culturally neutral, they are in fact shaped by the epistemologies and aesthetic priorities of their creators.[23]

[23] Kamer Ali Yuksel, Batuhan Bozkurt, and Hamed Ketabdar, "A Software Platform for Genetic Algorithms Based Parameter Estimation on Digital Sound Synthesizers". Paper

In this work, care is taken to embed Iranian musical logic authentically, drawing from lived experience and internal knowledge of the tradition. This approach avoids the risk of appropriation and instead engages in what Born terms *reflexive musical hybridity*, wherein cultural materials are treated with critical respect, not simply as aesthetic resources but as repositories of knowledge.[24]

By framing the Dastgah system as structurally-generative and algorithmically-viable, the composition advocates for a rethinking of whose musical systems are considered *composable* in algorithmic contexts. It positions non-Western systems not as exotic alternatives but as co-equal frameworks capable of reshaping the future of compositional practice.

6. Conclusion

The composition *Dastgah* exemplifies an advancement in algorithmic and microtonal music, offering a new model for structurally-embedded cross-cultural composition. By expanding the 12-tone serial system into a 17-tone matrix derived from Iranian Dastgah intervals, the work challenges the dominance of Western equal temperament and redefines serialism as a culturally-adaptive framework. Rather than imposing a rigid 12-tone structure, the composition incorporates culturally-specific microtonal intervals—such as neutral seconds and three-quarter tones—into the core generative logic of its pitch organization.

The use of SuperCollider as both compositional environment and performance engine enables a level of precision and real-time variability that mirrors the improvisational sensibilities central to Persian classical music. Through stochastic processes and matrix-based transformations, the composition becomes a generative system in which form, rhythm, and pitch continually evolve—producing an ever-shifting soundscape that resists formal closure.

At a broader level, *Dastgah* contributes to a rethinking of cultural hybridity in algorithmic music. Unlike superficial stylistic fusion, this work operates through what Georgina Born describes as reflexive musical hybridity—a deep, self-aware integration of musical systems that acknowledges

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presented at the Proceedings of the 2011 ACM Symposium on Applied Computing, 2011.

[24] Georgina Born, "Music and the Materialization of Identities", *Journal of Material Culture*, 16, 2011, 376–88.

their historical, institutional, and affective dimensions. The composition does not merely combine Persian and Western elements; it re-engineers their compositional grammars at a structural level, allowing for mutual transformation and dialogic exchange.

This project also invites a critical reexamination of authorship and system design in contemporary composition. By treating the algorithm as a co-creative agent, the composer relinquishes control and repositions themselves as a curator of dynamic potential rather than a prescriptive author. This decentralization opens space for emergent musical behavior that honors the interpretive, flexible spirit of Dastgah while engaging with the formal rigor of serialism.

Ethically, the work foregrounds the importance of respectful cultural integration. By drawing upon insider knowledge of Iranian music and embedding it structurally within a new compositional model, the piece resists appropriation and instead demonstrates how algorithmic systems can serve as tools for cultural continuity, not erasure.

Ultimately, *Dastgah* offers a vision for the future of composition in which technology is not a neutral tool, but a culturally-situated medium. It affirms that non-Western systems—when engaged with critically and creatively—can reshape algorithmic music at its foundational levels. This composition is not only an artistic statement, but also a theoretical intervention – one that proposes hybridity as a structural practice, serialism as an open and culturally-inclusive form, and algorithmic design as a space for negotiating identity in sound.

7. Code

```
(
var createMatrix, row, matrix, n, tempo, adjustFloat;

adjustFloat = { |value|
     if (value.isKindOf(Float)) {
          value = value.trunc(1) + 0.44;
     };
     value;
};

// Function to create the 17-tone matrix
createMatrix = { |row|
     var i, n = row.size;
```

```
    matrix = Array.fill(n, { Array.new(n) });  // Ini-
tialize a N * N matrix with empty sub-arrays

    matrix[0] = row;
    n.do { |i|
        if (i > 0) {
            matrix[i] = (matrix[i-1] + (row[i] - row[i-
1])).mod(12);
        }
    };
    matrix;
};

// 17 Persian tones input row (Prime row)
row = [0, 1, 1.44, 2, 3, 3.44, 4, 5, 6, 6.44, 7, 8,
8.44, 9, 10, 11, 11.44].scramble;

// Generate the matrix
matrix = createMatrix.(row);

// Display the matrix
matrix.do { |row| row.postln };

// Set the tempo (beats per second)
tempo = 2;  // 2 notes per second (120 BPM)

// Function to convert pitch classes to MIDI notes and
send to synth
n = row.size;  // The number of pitch classes
SynthDef(\atonalSynth, {

      |freq = 440, amp = 0.3, dur = 1|
    var sig, env, filter, osc, osc1, osc2, osc3, osc4,
oscamp;

    // Envelope for the flute sound
      env = EnvGen.kr(Env.perc(0.01, Rand(0.01,
1).range(1, 4), amp, -4), doneAction: 2);

    // Create sine wave oscillators
      oscamp = Rand(0.1, 0.7);
      osc1 = SinOsc.ar(freq, 0, oscamp);
      osc2 = SinOsc.ar(freq * (5/4), 0, oscamp);
      osc3 = SinOsc.ar(freq * 2, oscamp);
```

```
      osc4 = SinOsc.ar(freq * (2 + (5/4)), 0, oscamp);

      osc = Mix.ar([osc1, osc2/2, osc3/3, osc4/4]);

    filter = LPF.ar(osc, 2000);  // Low-pass filter with
cutoff frequency
    filter = HPF.ar(filter, 20);  // High-pass filter
with cutoff frequency

    // Apply the envelope to the filtered signal
    sig = filter * env;

      //Panning the signals across 4 channels.
      sig = PanAz.ar(4, sig, Rand(0, 1.0), 0.8, 2, 0.5);

    // Output the signal
    Out.ar(0, sig);

}).add;

{
    var usedForms = List.new;
    var playNote, printForm, selectFormAndIndex, get-
PitchClassRange;

    // Function to randomly select a pitch class within
a specified wide range
    getPitchClassRange = { |pitchClass|
        var baseNote;

        if (pitchClass.isNil) { pitchClass = 0; }; //
Avoid nil values

        // Randomly choose a register: low, mid, or high
        switch(4.rand,
            0, { baseNote = (24 + 12.rand).clip(24,
36); },  // Low register
            1, { baseNote = (48 + 12.rand).clip(48,
60); },  // Mid register
            2, { baseNote = (72 + 12.rand).clip(72,
84); },   // High register
            3, { baseNote = (84 + 12.rand).clip(84,
96); }   // Post-High register
        );
```

```
          (baseNote + pitchClass).mod(127);  // Ensure it
stays within MIDI range
     };

     // Function to play a note with a random register
     playNote = { |pitchClass|
          var midiNote = getPitchClassRange.(pitchClass);
          var freq = midiNote.midicps;
          Synth(\atonalSynth, [\freq, freq]);
             (exprand(0.1, 4)/ tempo).wait;  // Adjust
wait time according to tempo
     };

     // Function to print the form used
     printForm = { |form, index, rowOrCol|
          ("Form: " ++ form ++ " " ++ index ++ ": " ++
rowOrCol).postln;
     };

     // Function to randomly select a form and index
     selectFormAndIndex = {
          var forms = [\P, \R, \I, \RI];
          var form, index;

          // Randomly select a form and index
          form = forms.choose;
          index = (0..(row.size-1)).choose;  // Ensure the
index is within bounds

          [form, index];
     };

     // Continuous loop to play the matrix using random
forms and indices
     inf.do {
          var formAndIndex = selectFormAndIndex.();
          var form = formAndIndex[0];
          var index = formAndIndex[1];
          var rowOrCol;

          switch(form,
               \P, { rowOrCol = matrix[index]; },
               \R, { rowOrCol = matrix[index].reverse; },
```

```
                \I, { rowOrCol = matrix.collect { |row|
row[index] }; },
                \RI, { rowOrCol = matrix.collect { |row|
row[index] }.reverse; }
            );

            printForm.(form.asString, index, rowOrCol);
            rowOrCol.do { |pitchClass| playNote.(pitchClass);
};
        };

}.fork;
)
```

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Summary

This article presents *Dastgah*, an original composition that merges Iranian microtonal modal systems with Western serialist and algorithmic compositional methods. The piece is realized through SuperCollider and structured around a 17-tone pitch matrix, derived from Persian modal intervals such as neutral seconds and three-quarter tones. These microtonal elements are embedded into the formal logic of serial operations—Prime, Retrograde, Inversion, and Retrograde-Inversion—producing a hybrid structure that is both culturally grounded and formally rigorous.

By algorithmically transforming this microtonal pitch set, *Dastgah* becomes a generative musical system capable of infinite variation. Stochastic processes govern the real-time selection of matrix transformations, rhythmic values, amplitude envelopes, and spatial distribution. This dynamic and emergent behavior reflects the im-

provisational nature of Persian music, while simultaneously engaging the systemic discipline of Western serialism.

The integration of Iranian *Dastgah* elements into an algorithmic framework challenges the dominance of Western equal temperament and proposes a culturally- inclusive model for compositional design. Rather than relying on stylistic fusion, *Dastgah* re-engineers the grammar of serialism to accommodate culturally- specific tuning systems, enabling a deeper structural hybridity.

Beyond its technical innovations, the work raises aesthetic and ethical questions about authorship, representation, and cultural agency in algorithmic music. The composer's role shifts from that of a prescriptive creator to a system architect, curating conditions under which music unfolds in real time. Each performance is unique, embodying a collaborative dialogue between human intention and machine behavior.

Ultimately, *Dastgah* demonstrates how contemporary technologies can be harnessed to honor and transform traditional musical practices. It affirms the creative potential of cross-cultural composition by treating non-Western musical systems not as exotic adjuncts, but as foundational sources of compositional logic. Through this project, algorithmic music becomes a space for negotiating identity, structure, and expressive ambiguity in a globalized artistic landscape.