Revised Selected Papers

Accademia Musicale Studio Musica
Michele Della Ventura, *editor*

2024

Proceedings of the International Conference on New Music Concepts

Vol. 11

Accademia Musicale Studio Musica

Accademia Musicale Studio Musica

International Conference on New Music Concepts

Proceedings Book
Vol. 11

Accademia Musicale Studio Musica
Michele Della Ventura
Editor

Published in Italy
First edition: April 2024

www.studiomusicatreviso.it
Accademia Musicale Studio Musica – Treviso (Italy)
ISBN: 978-88-944350-5-4

The Interactive Digital Transcription and Analysis Platform (IDTAP): Enabling the Computational and Heuristic Analysis of Sound, Music, and the Social

Dard Neuman, Jonathan B. Myers

University of California, Santa Cruz
DNeuman@ucsc.edu, JBMyers@ucsc.edu

Abstract. This paper outlines the historical background, motivation, development process, and potential impact of a new interactive digital transcription and analysis platform (IDTAP): The IDTAP is a web-based application that enables users to digitally transcribe, archive, share, and analyze audio recordings of oral melodic traditions. In 2023, authors and principal investigators Dard Neuman and Jon Myers launched version 1.0 of the platform, disseminated it globally, and cultivated an initial base of users. Whereas the platform has been built around Hindustani music (i.e., North Indian classical music), the principles, melodic contour archetypes, technologies, and methodologies behind the platform are designed to expand to other traditions where continuous melodic contour movements are accentuated. This expansion of the IDTAP, in turn, opens multiple recorded sound collections and archives to digital preservation, musical creation, as well as statistical, quantitative, and interpretive analysis, equipping scholars from a range of disciplinary backgrounds to apply the power of twenty-first-century computational methodologies and large datasets to humanistic endeavors.

Keywords. Digital Archive, Hindustani Music, Non-Western Music, Notation, Software, Transcription.

1 Introduction

The IDTAP is an interactive digital archive for oral melodic expressive traditions. Specifically, it is an open-source and open-access, multi-layered and interactive platform that allows users to upload audio recordings, transcribe melodic sound intuitively, efficiently, and accurately from those recordings; test the accuracy of their transcription through synthesized audio playback; and analyze the transcriptions qualitatively, quantitatively, and computationally. The larger goal of the IDTAP is to de-center music scholarship and composition from a western theory and notational framework while centering the place of music (or melodic expressive traditions) in humanistic and social scientific studies. Staff notation is the primary, predominant, if not hegemonic, tool for graphically representing music in academia world-wide.

Whereas staff notation has a number of advantages—i.e. a spatially efficient method of representing rhythmic sequences; relative ubiquity among musical practitioners throughout the world; easy transferability to extant notation software and data analysis tools—it does not accurately represent various aspects of musical information, particularly those that are found in many non-western music traditions. Some musicologists and ethnomusicologists have, since the 1950s, argued against the utilization of staff notation for the transcription, composition, and analysis of non-European art music traditions [1]-[4]. Even so, many researchers and artists continue to use it when engaging with non-western repertoires. This presents problems that are ethical, empirical, and epistemological. Ethically, staff notation imposes a Eurocentric representational understanding of musical form. Empirically, staff notation flattens out important aspects of many oral-melodic idioms. Epistemologically, it discourages scholars without knowledge of staff notation, let alone other methodological tools to include melody and rhythm in their research. This effectively removes from humanistic and social scientific inquiry a central aspect of everyday life—the relationship of organized sound to a range of communities, be they small scale proximate communities or large-scale religious, dynastic, or national imagined communities. These relationships are even more elusive in oral cultures and their secular and spiritual expressive traditions. Lastly, extant alternative forms of musical representation, including those that are digital, exist within a two-dimensional framework.

By contrast, the IDTAP provides a multi-layered and interactive platform and corresponding store of knowledge: it is a transdisciplinary research archive that bridges computational media, linguistics, comparative literature, statistics, history, folklore, religious studies, cultural and comparative musicology, ethnomusicology, and music composition. The goal of the IDTAP research team is to grow and develop the platform so that recorded music from a diversity of oral cultures can be both preserved and made available for music making and research in empirically analyzable and comparable data formats.

The IDTAP software is able to represent a diversity of melodic contours due to a unique rethinking of a widely held music-theoretical tenet. Instead of taking a fixed-pitch note as the only basic unit of structure, the IDTAP is organized around a succession of "trajectories": formally/mathematically specified archetypal paths from one pitch to another, among a series of pitches, or on a fixed-pitch. These trajectories are able to represent a range of finely calibrated glissandi that appear in many musical traditions outside of the keyboard and staff-oriented Eurocentric musical paradigm.

2 Disciplinary Interventions

The fundamental principle of the IDTAP is to diversify music research, representation, creation, criticism and theory through more expansive transcription forms and corresponding analytics. This principle represents a commitment to empirical and comparative research that is untethered to 19th-century colonial investments in taxonomic schemas that plot European racial and cultural measures as the apex around which other human and cultural creations are assessed and judged. We believe the IDTAP and the resultant notations and datasets will be pertinent to many areas of research/scholarship and teaching/learning.

First, the IDTAP is organized to diversify humanistic inquiry and to help professionalize the next generation of researchers. The dual roles of music transcription and the empirical analysis of music, once distinctive methodological features in the fields of musicology and ethnomusicology, are currently in a state of flux. The musicological turn in U.S. music departments in the 1980s and '90s decentered the role of music theory and other empirical approaches in favor of critical and cultural theoretical approaches [5]-[8]. This shift occurred, in part, because music transcription and analysis relied on staff notation, regardless of whether the music in question resembled the European classical music tradition within which staff notation was originally developed.

There have been two broad correctives to this situation: the abandonment of transcription and empirical methods altogether, and the creation of custom notation systems. These solutions, however, raise additional challenges. The turn away from transcription-based research moves the domain of melodic/rhythmic sound analysis away from quantitatively measurable evidence-based research, as well as cutting edge computational technologies based on digital audio research. This effectively removes a central part of everyday life from humanistic and social scientific inquiry: the interconnected relationship between melodic expressive traditions and affective and emotional communities [9]. The second corrective, custom transcription methods, lack commensurate fields of data for quantitative and/or computational analysis, let alone a common language for scholars to engage a broader community of readers and researchers with music analysis.

Scholars of Hindustani music based in India and the UK have worked to address some of these issues. Music in Motion is a web archive that contains videos that display melodic contour plots with textual annotations of lyrical content scrolling in real time with audio playback [10]. A research group at Durham University has been conducting empirical research into rhythmic-event micro-timing differences in Hindustani music [11] and has published a dataset for rhythmic events that is openly available for researchers to use in timing- and rhythm-focused empirical studies [12]. The growing interest in this empirical vein is also evinced by the recent appearance of a new journal, *Analytical Approaches to Music of South Asia*. These projects, however, are close-ended: They do not provide an interactive platform that allows others to upload, transcribe, query, and analyze the data beyond the melodic contour graphs or the already produced datasets. The IDTAP web app, by contrast, is an interactive platform—in a sense, a kind of scholarly crowdsourcing.

The IDTAP is intended, then, as a research tool for scholars of oral melodic traditions and expressive cultures. Statistically oriented researchers can use the data that undergirds this visual representation to ask new, quantitative kinds of research questions. Ethnomusicologists can use “big data” computational approaches to query this archive at a large scale across a range of performances (diachronically or synchronically), or at a small scale through specific measurements within a single performance, or even a single phrase. Music theorists can use the data as a platform for the discovery/construction of new kinds of theoretical knowledge regarding melodic contour, macro- and micro-rhythm, and performer style. Social historians, folklorists, religious studies scholars, and musicologists can supplement their research of (affective) communities, classes, castes, or individuals through the treatment of recorded melodic sound as historical evidence.

Second, the IDTAP is intended as a pedagogical tool for undergraduate and graduate students, as well as independent musicians and music students who want to teach themselves. Whereas generations of practitioners have learned in the “traditional” way, i.e. under the direct tutelage of a hereditary or discipular forebear, the IDTAP has the potential to engender a more diverse community of practitioners, including those who weren’t born into a musical family and who may not have privileged access to a master-teacher, due to socio-cultural, economic, and/or geographical factors.

Lasly, the IDTAP is intended as a diversifying corrective to a current bias in Music Information Retrieval (MIR), Music Artificial Intelligence (MAI) research, and corpus studies, all of which are focused on western musical corpora [13]. These epistemological and data-borne biases may have far-reaching consequences over the coming decades, as AI systems play an exponentially increasing role in the processes by which music is generated, disseminated, and consumed. To incorporate the important bodies of non-western / non-notated musical knowledge, their unique forms and structures must first be made computationally legible by projects such as the IDTAP.

3 IDTAP Framework and Theoretical Foundation

The IDTAP has been designed, developed, and implemented with the following components: 1) the archive of recordings, including tools for users to upload, document, and listen to the recordings; 2) the editor interface, which includes a suite of tools for users to compose or transcribe melodic contours and instrumental, syllabic, and/or textual articulations, as well as to segment and annotate the transcriptions; 3) the archive of transcriptions/notations; 4) data-visualization and data-query functions; and

5) the collections of different users, organized by function: research, pedagogy, appreciation, and creative production. The IDTAP user interface and analysis suite are meant to enable and make available digital transcriptions for scholars and students who have archival, language, linguistic, musical, or literary research skills found in humanities-based disciplines but are not necessarily trained in programming or computational methodologies.

The IDTAP framework is organized around two core concepts, articulations and trajectories: Articulations are instrumental and vocal onsets while trajectories are formally/mathematically specified archetypal straight or curved paths on one pitch, from one pitch to another, or among a series of pitches. The articulation structure distinguishes vocal from instrumental music, with further hierarchical groupings that draw on two transferrable and generalizable systems: the International Phonetic Alphabet (IPA) for vocal expressions and a modification of Bharata's system of instrument classification based on articulation types (i.e., whether the instrument attack is plucked, bowed, blown, pressed, or hammered) for instrumental expressions. For vocal transcriptions, the IDTAP editor allows for the inclusion of syllabic articulations: for every trajectory, the user can mark a starting consonant, vowel, and ending consonant. The synthesizer for the vocal transcriptions is rendered via an implementation of the Klatt Synthesizer, a powerful dual cascade and parallel formant model of human speech production [14]. The synthesizer for plucked string instrumental transcriptions is rendered via an implementation of the Karplus-Strong string synthesis algorithm [15]. The articulation framework for vocal and instrumental music is organized for the expansion of the IDTAP to other traditions. At present, the user can select between the following alphabets: IPA, Latin, and Devanagari. As the IDTAP develops to other traditions and languages it will add corresponding alphabets. Similarly, while the instrumental trajectories are currently modeled on a plucked string instrument, they will be expanded to include other instrument types.

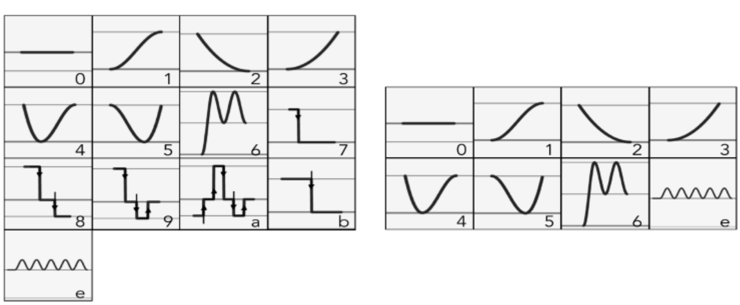

Fig. 1. The thirteen trajectories used in the plucked instrument tradition of the sitar and the eight trajectories used in vocal music.

To transcribe, users trace trajectories on top of the spectrogram and/or melograph. For certain trajectories, the slope of the curve can be adjusted to match the melodic contour being transcribed. Trajectories can also be "offset" to represent microtones (*shrutis*)—or spaces between scale tones—and movements between scale tones and microtones (*andolans*). Fig. 2 shows two transcriptions of a section of a Hindustani composition, "Babul Mora," performed by the artist Begum Akhtar. Note how the IDTAP is as empirically attuned to the nuances of movements between scale tones as on them.

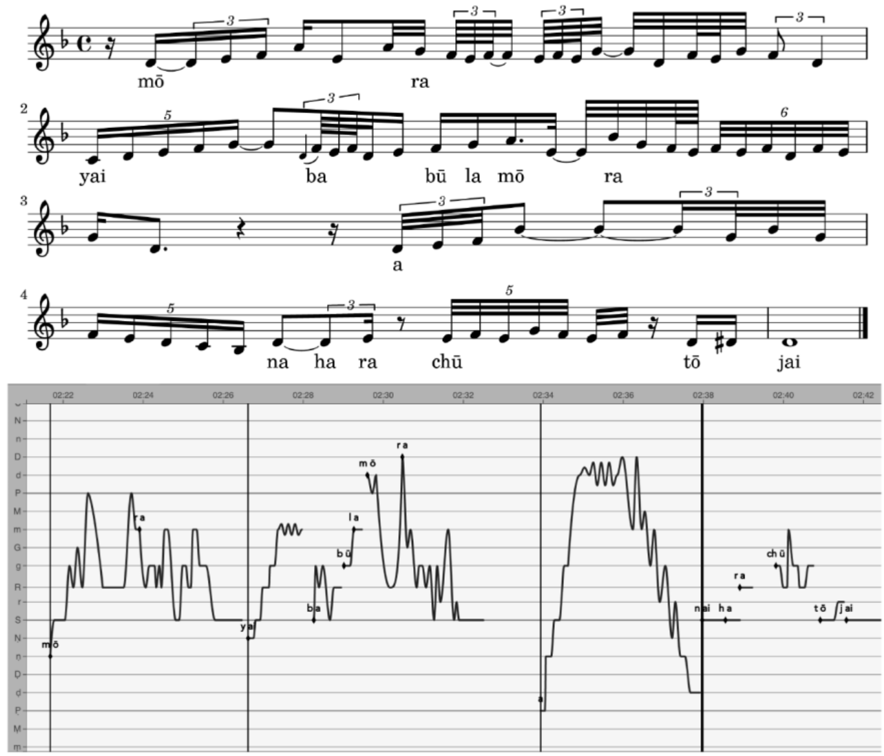

Fig. 2. Transcription of the same selection of the song, *Babul Mora*, using staff and IDTAP notations.

4 IDTAP Upload and Set Up Process

The set-up process for the transcription files includes five actions. The first involves specifying general and idiomatically specific metadata. The next two actions involve 1) adjusting the tonic to that which is used in the performance; and 2) establishing which scale tones are used in the performance. The final two actions involve music information retrieval to aid the transcription process: the generation of a constant Q spectrogram [16] and a “melograph” [17], two-dimensional graphical representations of audio information that map frequency on the Y axis against time on the X axis. Fig. 3 shows three representations of the same section of a performance: the first pane shows an algorithmically generated melograph; the second pane a logarithmically scaled spectrogram, and the third pane a manually engraved IDTAP transcription that can be plotted/traced on top of the spectrogram and/or melograph.

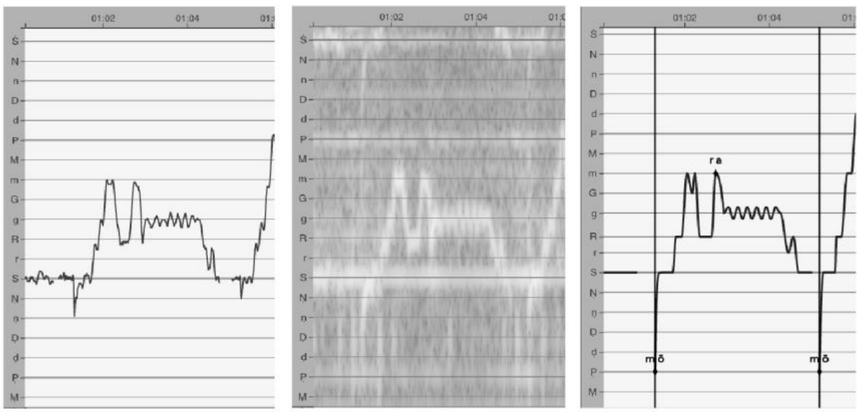

Fig. 3. (Left) Algorithmically generated “Melograph” / pitch trace of excerpted performance by Begum Akhtar. (Middle) Logarithmically scaled Spectrogram (specifically, a Constant Q Transform) of the same excerpt. (Right) IDTAP transcription of the same excerpt, by D. Neuman.

5 IDTAP Transcription Process

The “Editor” interface allows users to transcribe a particular recording (or compose/make notations unrelated to any particular recording) by inserting trajectories onto a two-dimensional time-by-pitch graph. The transcription process is facilitated by: the user-controlled overlay of a spectrogram and/or melograph; custom synthesis software that sonifies data fed from user-generated transcriptions; affordances that allow for the adjustment of tuning at both the macro-scale (adjusting the tuning system associated with the entire transcription) and the micro-scale (adjusting the frequency of individual pivot points associated with particular trajectories); the ability to select a certain region of audio, loop it, and/or adjust its playback speed; a flexible interface for assigning, displaying, and adjusting hierarchically nested systems of temporal division (that is, *meter*); and the ability to shift the pitch of the entire recording and synthesis to match the user’s physical instrument or vocal range.

This process is simplified by tools for 1) adjusting the proportions of the editor's tuning-system to the pitches in the performance; 2) pitch shifting the recording and synthesis in tandem to match a user's voice or physical instrument tuning and register; 3) transcribing melodic contours; 4) transcribing articulations (vocal vowel and consonant syllable/syllable clusters, and instrumental articulations—plucked, hammered, bowed, blown, etc; 5) segmenting a transcription into hierarchically-nested collections of sections, phrases, and groups; 6) specifying metrical templates, adding them at the appropriate time in a transcription, and adjusting their micro-rhythmic placement to match the natural temporal fluctuation of performance practice (i.e. rubato); 7) playing back the synthesis of the transcription in relation to the recording; 8) looping specified regions and adjusting playback speed; 9) annotating the transcriptions at different levels of form and content, choosing from a set of IDTAP-provided options.

6 IDTAP Analysis, Data Visualization, and Query Process

The "Analysis" interface includes interactive tools for users to engage with transcription data heuristically. These include 1) a query system for users to isolate and view particular sequences from a transcription according to an unlimited number of filtering criteria; 2) a pitch occurrence data-visualization tool that displays the relative proportion of time spent on particular pitches, and segmented by section, phrase, or durational window; 3) a "pitch pattern" visualization tool that shows the relative frequencies of particular patterns of pitches that appear throughout a transcription. This interface includes parameters for emic and etic inquiries, the first enabling the analyst to annotate and analyze according to "insider" sensibilities, categories and concepts, and the latter enabling the analyst to analyze according to "neutral" parameters.

Pitch Prevalence

This tool allows users to generate visualizations that represent the prevalence of particular pitches over the course of a transcription. This is achieved by splitting the transcription into durational windows according to one of three user-selected segmentation schemes. One segmentation scheme—by duration—is considered etic, as it splits the transcription into windows of particular user-defined duration. This approach aims to overcome various biases: both insider knowledge of traditional conceptions of phrase structure as well as outsider intuitive perceptions of phrase structure. Two of the segmentation schemes—by section and by phrase—are considered emic, relying on an analyst's insider knowledge of the musical tradition and their analytical intentions in explicitly entering phrase and section divisions throughout the process of transcription. For the emic segmentation approaches, the user is also able to filter the segments to include or exclude particular section or phrase types, as specified by the user during transcription. With the section segmentation, a user may choose to include or exclude section types: in the case of Hindustani music, different forms of composition and improvisation. The *phrase* segmentations are subdivided into: phrase-types (compositional forms); elaboration-types (improvisational forms); articulation-types (e.g, if a vocalist is singing lyrics (*bols*), solfege (*sargam*), non-lexical syllables (*aakar*, *nom-tom*); and incidentals (e.g., if the musician speaks, tunes an instrument, etc.).

For example, fig. 4 displays the pitch prevalence and duration of the first six sections and eleven phrases of the *thumri* song, "Babul Mora," performed by Begum Akhtar. It also shows the coded description of each section and phrase type so that a user can see at a glance the formal sections and pitch structure of an entire performance.

Pitch Range and Percentage of Duration on each Fixed Pitch, Segmented by Phrase												
Begum Akhtar - Babul Mora Naihar Chhooto Jaaye												
Section #		1		2	3			4	5			6
Section		Pre-Chiz Alap		Composition	Improvisation			Composition	Improvisation			Composition
Phrase #		1	2	3	4	5	6	7	8	9	10	11
Start		0:00	0:06	0:26	0:37	0:44	0:47	0:50	0:57	1:01	1:05	1:09
Duration		0:06	0:20	0:11	0:07	0:03	0:03	0:07	0:05	0:04	0:04	0:06
Phrase Type				Mukra	Mukra	Asthai	Asthai	Mukra				Antara
Elaboration			Bol Banao	Bol Banao	Bol Banao	Bol Banao	Bol Banao		Bol Banao	Bol Banao	Bol Banao	
Articulation		Aakar	Bol	Bol	Bol	Bol	Bol	Bol	Bol	Bol	Bol	Bol
Incidental												
0	d											
	P											
	M											
	m						9%				24%	
	G											
	g		3%	6%			14%		39%	58%		12%
	R		14%	5%			21%	4%	11%	18%	10%	
	r		7%	10%	6%	6%		12%			18%	9%
	S	83%	60%	80%	73%	5%	56%	71%	50%	24%	48%	80%
-1	N		2%		6%							
	n		6%		7%	15%						
	D		1%									
	d	17%	1%		6%	5%						
	P		5%		3%	70%		13%				

Fig. 4. Pitch Prevalence Data Visualization.

In addition to the type of segmentation, users may also toggle a) for their visualization to tabulate the prevalence of each pitch chroma (also known as pitch class: the quality of a pitch abstracted from its octave registration) instead of the pitch; b) for the display to be vertically condensed, leaving out the empty vertical space representing pitches not included in the transcription; or c) for the visualization to display the relative prevalence of elements as a "heatmap" grayscale gradient, as opposed to just the most common (mode) element in dark gray and the rest in light gray.

Query Display

This tool enables users to construct a multi-part query that filters a transcription, displaying only those segments that match the user's specifications. Fig. 5 shows the query function and query output for every time the vocalist, Begum Akhtar, sings the word "*babul*" (father). The query function in this case is threefold: looking for a phrase with starting consonant "ba," the vowel "u" and the ending consonant "l." This particular query would allow for either a pedagogical or analytical investigation on how an artist expresses a composition—where word and melody are fixed—in multiple ways, allowing one to examine the dialectic of composition and improvisation visually.

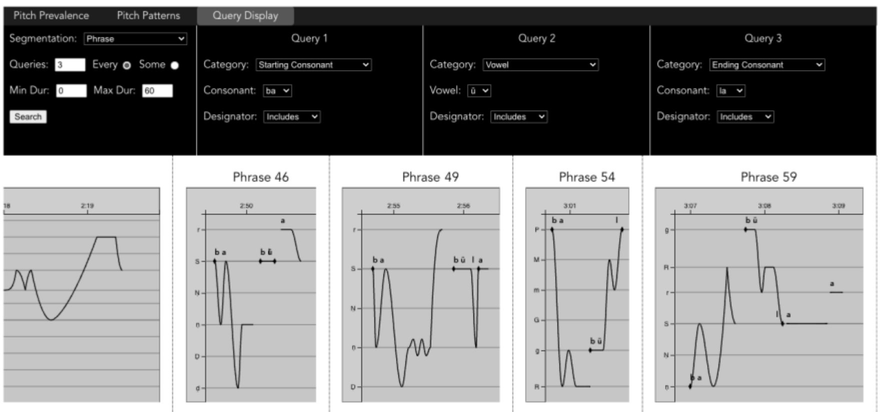

Fig. 5. Query functions and display example.

The following categories are available for users to construct queries: Pitch, Strict Pitch Sequence (pitches must appear in this exact order without any gaps between them), Loose Pitch Sequence (pitches must appear in this order, but may have gaps between them), Trajectory, Strict Trajectory Sequence, Loose Trajectory Sequence, Section Type, Alap Type, Composition Type, Tempo, Tala (descriptor of metric structure and hierarchy, something like a Time Signature in western music), Phrase Type, Elaboration Type, Incidental Type, or Articulation Type.

For each of these categories, users can select a designator: "includes," "excludes," and, if applicable, "starts with," or "ends with." For example, a user might construct a query that includes all phrases that contain the pitch "Sa" in octave 0, or another query that excludes all phrases that contain a particular trajectory, i.e. a "krintin-slide." This querying system is especially powerful when the user combines multiple of them in order to hone in on a particular analytical idea or hypothesis. Users can also choose to display those segments that satisfy all of the queries, or just at least one of the queries. With the desired phrases now displaying, the analyst can make discoveries based on observing the filtered results.

Pitch Patterns

This tool enables users to select a specific type of segmentation and pattern size. It then counts and records the number of occurrences of every unique pitch sequence within each segment, based on the chosen pattern size, and displays this information along with a graphical depiction of the contours of each sequence. This kind of display allows the analyst to intuitively search for common patterns of various sizes in different segments throughout a performance, thus revealing some essence of the style of the melodic elaboration: See fig. 6.

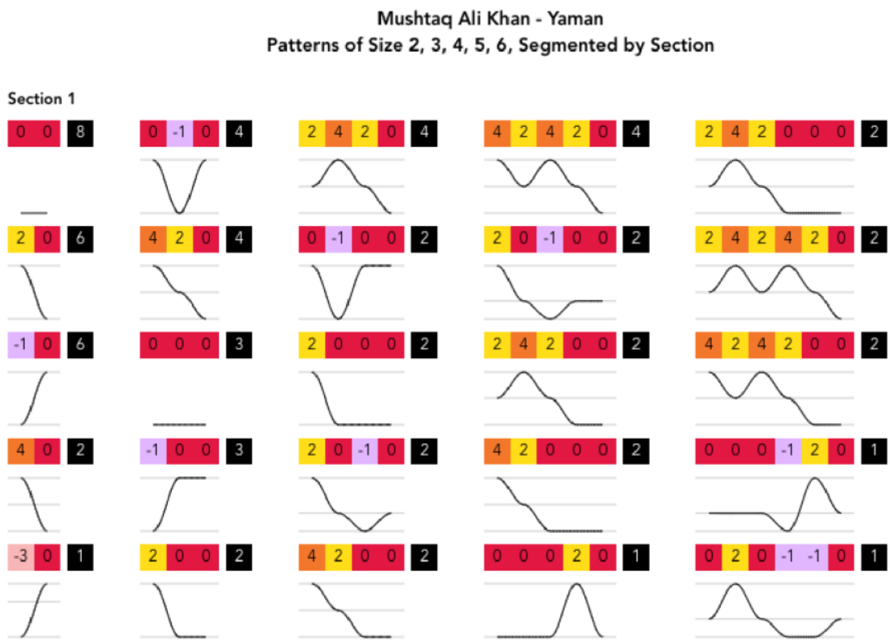

Fig. 6. Pitch Patterns analysis tool

Finally, the IDTAP allows users to generate datasets to conduct quantitative statistical analysis: see fig. 7.

The types of analysis enabled by these queries, data visualizations, and datasets are multiple. To name just a few, users can examine a particular recording, section from a recording, or body of recordings associated with an individual or group of musicians from a range of traditions. Research topics could include: relationships between lyric-text and melody, or syllable and melodic movement; empirically measurable changes of a musician's performance style over time: throughout an individual performance or across many performances; analysis across instruments, venues, styles, performance sections, time-periods, geographic areas, recording media, or other clearly specified method of slicing a corpus. These three analysis tools will be enhanced and added to as our project team continues to engage with and respond to the needs of our research colleagues.

Phrases																	
	Start Time	Duration	Trajectories														Chikaris
			Num	Id	Id Name	Duration	Start Time*	Slope	Articulations			Pitches			Proportional Duration Within Phrase	Proportional Duration within Trajectory	Timing within Phrase
									time**	type	stroke	swara	raised	octave			
0	0	10.1	0	6	Bend: Simple Multiple	0.41	0		0	pluck	d	0	TRUE	0	0.04	0.53	2.39
												6	TRUE	-1		0.47	5.2
												0	TRUE	0			8.38
			1	0	Fixed	2.36	0.41					0	TRUE	0	0.23	1	9.6
			2	0	Fixed	2.88	2.77		0	pluck	d	0	TRUE	0	0.29	1	
			3	0	Fixed	4.44	5.66		0	pluck	d	0	TRUE	0	0.44	1	
	Start Time	Duration	Trajectories														Chikaris
			Num	Id	Id Name	Duration	Start Time*	Slope	Articulations			Pitches			Proportional Duration Within Phrase	Proportional Duration within Trajectory	Timing within Phrase
									time**	type	stroke	swara	raised	octave			
1	10.1	10.32	0	8	Krintin Slide	0.31	0		0	pluck	d	1	TRUE	0	0.03	0.32	2.22
									0.32	hammer-off		0	TRUE	0		0.32	7.54
									0.64	slide		6	TRUE	-1		0.36	9.84
												6	TRUE	-1			
			1	0	Fixed	2.4	0.31					6	TRUE	-1	0.23	1	
			2	0	Fixed	1.21	2.71		0	pluck	d	6	TRUE	-1	0.12	1	
			3	12	Silent	0.11	3.92								0.01	1	
			4	2	Bend: Sloped Start	0.3	4.04	2	0	pluck	d	0	TRUE	0	0.03	1	
												6	TRUE	-1			
			5	0	Fixed	0.46	4.34					6	TRUE	-1	0.04	1	
			6	4	Bend: Ladle	0.97	4.8	2	0	pluck	d	2	TRUE	0	0.09	0.51	
												1	TRUE	0		0.49	
												2	TRUE	0			
			7	0	Fixed	2.09	5.77		1	dampen		2	TRUE	0	0.2	1	
			8	12	Silent	0.17	7.86								0.02	1	
			9	0	Fixed	2.28	8.03		0	pluck	d	2	TRUE	0	0.22	1	

Fig. 7. Excel sheet representation of transcription data.

Next Steps

We have identified the following five components of research as next steps in the upcoming two years.

1) Enhancing the current version of the notation/ transcription web application. These include: developing synthesis engines for bowed-string, reed, wind, hammered, and percussion instruments; attending to timbre and non-melodic parameters such as amplitude and dynamics for appropriate instruments; and expanding the query functions to produce datasets and data visualizations across transcriptions (intra in addition to inter performance analysis). The percussion components require the development of a novel visual representation scheme that will exist alongside the two-dimensional pitch-by-time graphic strategy of our melodic instrumental representations.

2) Expanding the representational capacities to Carnatic music (South Indian classical music) and traditional Korean court music. We have already beta-tested the IDTAP with a variety of vocal and instrumental traditions and will work with scholars, musicians, and doctoral students on the advisory board who specialize in Korean and Carnatic traditions.

3) Conducting video, audio, and ultrasound recording sessions with visiting musicians from South Asia and Korea at the electronic music studio lab at UCSC. These data-collection events will provide important materials for the development of audio-synthesis algorithms and machine-learning approaches to auto-transcription, and for the understanding of the organological/ phonological particularities of sound traditions and their related spoken languages.

4) Transcribing recordings, which serve two purposes: 1) building the digital archive for users for their research, pedagogical, and music composition, and 2) serving as training data for machine-learning models.

5) Developing a methodology for automating some of the transcription process. Under the guidance of our advisory board, we draw on the work of Google Magenta researchers who have demonstrated that a well-curated dataset of approximately two hundred hours of audio recordings can be used to train a sequence-to-sequence Transformer neural network model to make accurate transcriptions [18].

7 Conclusion

There are many possible encoding schemes and graphical models for representing musical information. Different representations are more or less suitable for different kinds of tasks, be they descriptive or prescriptive, exacting (along a particular subset of parameters of discernibility) or ambiguous, archival or generative, textual or graphic, abstract or concrete. Extant visual representations are socio-historical artifacts, outgrowths of complex social feedback systems with particular historically-informed quirks and affordances. Each such schema stratifies around and is constitutive of particular social practices (artistic, scientific, commercial, spiritual). Like languages, they persist as long as a *fluent* community continues to engage with and develop corresponding activities. Practitioners conversant in any of these systems will have molded themselves into a bodily/psychological configuration with such symbol systems, and with the acts of reading, interpreting, engraving, and sonifying. Just as this training extends their ability to affect and perceive the sonic, it also necessarily establishes a limit, confining them within circumscribed habits of thought and activity. Indeed, experience with any such engraving technology cultivates a conceptual world and a corresponding technological apparatus for exploring it, but there are many possible worlds. The IDTAP aims to engender one such world for a 21st century community of practitioners and researchers to engage with oral traditions and their corresponding archives, and to allow these traditions to flourish among the hybrid AI artistic praxes to come.

References

[1] C. Seeger, "Toward a Universal Music Sound-Writing for Musicology," *Journal of the International Folk Music Council*, vol. 9, pp. 63-66, Jan. 1957.

[2] N. M. England et al., "Symposium on Transcription and Analysis: A Hukwe Song with Musical Bow," *Ethnomusicology*, vol. 8, no. 3, pp. 223-233, Sep. 1964.

[3] M. Hood, *The Ethnomusicologist*. New York, 1971.

[4] T. Ellingson, "Transcription," in *Ethnomusicology: An Introduction*, H. Myers, Ed. Basingstoke, 1992, pp. 153-164.

[5] S. Mclary, *Feminine Endings: Music, Gender, and Sexuality*. Minneapolis: Univ. Minn. Press, 1991.

[6] J. Kerman, *Contemplating Music: Challenges to Musicology*. Cambridge, MA: Harvard University Press, 1985.

[7] L. Goehr, *The Imaginary Museum of Musical Works: An Essay in the Philosophy of Music*. Oxford: Clarendon Press, 1992.

[8] M. Citron, *Gender and the Musical Canon*. Cambridge: Cambridge University Press, 1993.

[9] L. Gandhi, *Affective Communities: Anticolonial Thought, Fin-de-siècle Radicalism, and the Politics of Friendship*. Durham: Duke University Press, 2006.

[10] S. Rao and W. van der Meer, "Music in Motion: The automated transcription for Indian music (AUTRIM) project by NCPA and UvA," 2017. [Online]. Available: https://autrimncpa.wordpress.com/. [Accessed Jan. 16, 2024].

[11] M. Clayton et al., "Interpersonal Entrainment in Indian Instrumental Music Performance: Synchronization and Movement Coordination Relate to Tempo, Dynamics, Metrical and Cadential Structure," *Musicae Scientiae*, vol. 23, no. 3, pp. 304-331, 2019.

[12] M. Clayton, L. Leante, and S. Tarsitani, "IEMP North Indian Raga," Database of annotated audiovisual recordings, 2018. [Online]. Available: https://doi.org/10.17605/OSF.IO/KS325

[13] P. E. Savage, "An overview of cross-cultural music corpus studies," in *Oxford Handbook of Music and Corpus Studies*, D. Shanahan, A. Burgoyne, and I. Quinn, Eds. New York: Oxford University Press, [In press]. Available: http://doi.org/10.31235/osf.io/nxtbg

[14] D. H. Klatt, "Software for a cascade/parallel formant synthesizer," in *J. Acoust. Soc. Am.*, vol. 67, no. 3, pp. 971-995, 1980.

[15] K. Karplus and A. Strong, "Digital synthesis of plucked-string and drum timbres," *Comput. Music J.*, vol. 7, no. 2, pp. 43-55, 1983.

[16] C. Schörkhuber, A. Klapuri, N. Holighaus, and M. Dörfler, "A MATLAB toolbox for efficient perfect reconstruction time-frequency transforms with log-frequency resolution," in *Proc. 53rd International Conference: Semantic Audio*, Audio Engineering Societ*y*, Jan. 2014.

[17] J. Salamon and E. Gómez, "Melody extraction from polyphonic music signals using pitch contour characteristics," *IEEE Transactions on Audio, Speech, and Language Processing*, vol. 20, no. 6, pp. 1759–1770, 2012.

[18] C. Hawthorne et al., "Enabling Factorized Piano Music Modeling and Generation with the MAESTRO dataset," in Proc. International Conference on Learning Representations, 2019. [Online]. Available: https://openreview.net/forum?id=r1lYRjC9F7

This book presents a collection of selected papers that present the current variety of all aspect of music research, development and education, at a high level. The respective chapters address a diverse range of theoretical, empirical and practical aspects underpinning the music science and teaching and learning, as well as their pedagogical implications. The book meets the growing demand of practitioners, researchers, scientists, educators and students for a comprehensive introduction to key topics in these fields. The volume focuses on easy-to-understand examples and a guide to additional literature.

Michele Della Ventura, editor

New Music Concepts and Inspired Education

Revised Selected Papers

ISBN: 978-88-944350-9-2

www.studiomusicatreviso.it