

**Notating and analyzing the context, sounds, and images of an  
improvised DMI (digital musical instrument) performance:  
Everyone to the Power of One” for T-Stick, by D. Andrew Stewart**

“New horizons demand new descriptions...”

(composer, conductor, and teacher Theodor Antoniou; in Cage’s “Notations,” 1969, p.260)

“Everything from a siren to a set of tuned sheep-bells...”

(composer, playwright, pianist, and teacher James Drew; in Cage’s “Notations,” 1969, p.261)

**Eixo temático específico 3: O impacto da tecnologia na teoria e análise musical**

**Keywords:** Improvisação em DMI. Análise de performance de DMI. Notação musical. T-Stick. Composer-performer D. Andrew Stewart.

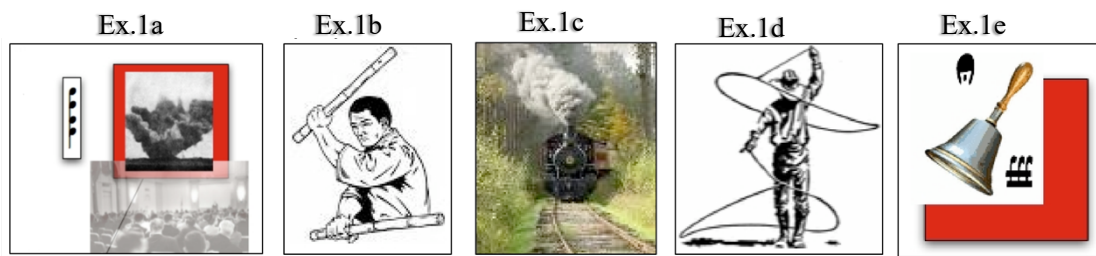
**Abstract:**

The motivation for this case study is to develop notational and analytical tools to transcribe and understand performances of DMIs (digital musical instruments) recorded in audio and/or video. Moreover, there is the need to communicate analysis to larger audiences, commonly distanced from the technological and quantitative aspects of sound, and the so-called “non-muso” musicians, commonly distanced from the traditional notation of music (Tagg, 2011). Our primary source is the improvisational performance of “Everyone to the Power of One,” a work for solo T-Stick, by a specialist on this instrument, composer-performer D. Andrew Stewart (2010, p.22) in a video recording from 2008, lasting 9 minutes and 14 seconds. The T-Stick is a DMI developed 15 + years ago by Joseph Malloch in his Master’s (2008)

Differently from most DMIs created in academic environments, the T-Stick endured almost two decades of existence due to its simplicity of construction, low cost, variety of sensors, relatively easy maintenance and continuous effort to maintain and create up-to-date versions of the instrument at

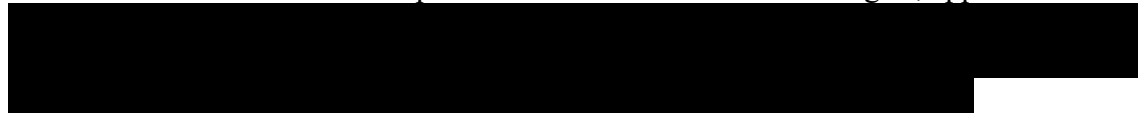
Also distinctive of the T-Stick is its elementary nature. It is basically an ABS tube with internal and external sensors activated by limb gestures in space, giving it inherent theatrical possibilities on stage (Stewart & Malloch, 2010, p.3094-3096).

A review of referential literature about music notation from *musique concrète* onwards (Shaeffer, 1966; Cage, 1969; Smalley, 1997; Thoresen, 2004; Sauer, 2009; Magnusson, 2019) shows that the advent of sound recording with magnetic means in 1945, and digital means in 1975, greatly expanded the sonic world of music and, therefore, its notation. In the repertory he composed for the T-Stick, D. Andrew Stewart exhibits a notational style that follows the main trends of post-World War II music scores as it keeps up with tradition but assimilates the transgressive, poetic, and imagistic influence of the other arts, such as photography, drawings, collage, poetry, and even dance (Ex.1).



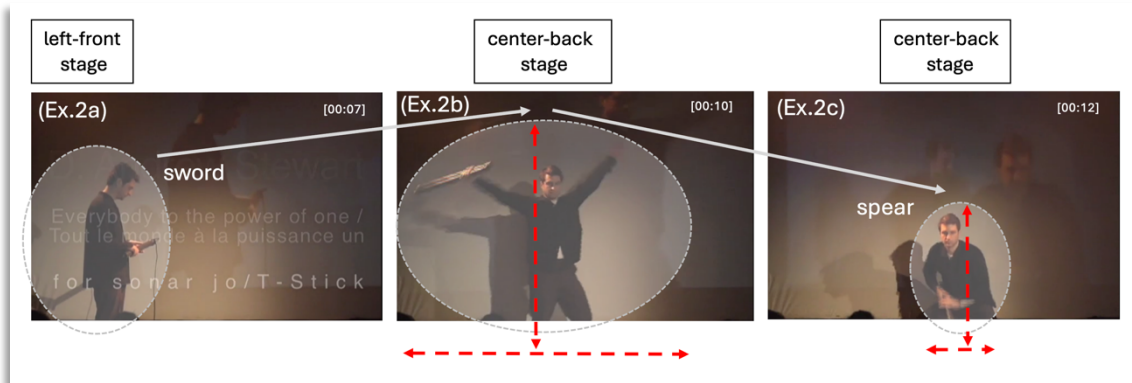
Ex.1 – Contextual images from the prompt score of “Everyone to the Power of One” by Stewart: (Ex.1a) explosion and audience, (Ex.1b) oriental martial-art fighter with bamboo sticks, (Ex.1c) steam locomotive, (Ex.1d) cowboy’s *lasso*, and (Ex.1e) handbell with *fff* and *fermata*.

At first sight, Thorsen’s meticulous spectro-morphological notation, which includes qualitative and quantitative data, seemed to be the most appropriate for transcribing a multi-layer timber-complex DMI piece, such as “Everyone to the power of one.” However, the steep-learning curve for even professional musicians<sup>1</sup> to familiarize themselves with its abstract symbols, signs, and icons pointed to a different solution, which combines traditional and post-World War II notational strategies, approached with



To discuss musical events from local to overall levels, we borrowed Schenker’s analytical concepts of foreground, middle-ground and background (Forte and Gilbert, 1982). The first steps of the analysis process involved the recognition of elements and the timing of their occurrences. The complex interaction of sounds and images called for initial sketches focused on a few categories of events, generating different timelines: one for phrasing formed by punctual events and their sound envelopes, one to annotate pitches and timbers described qualitatively, and one for metaphorical gestures and structural trigger points. The superimposition of imagistic, sounding and textual/contextual contents revealed either the reinforcement or contradiction of explicit and subliminal meanings. Ex.2 and Ex.3 show, in foreground levels, the theatrical possibilities of the T-Stick explored on stage by the performer, which gestures, although may vary on each performance, seem not to be improvised but results of honed motor skills and deliberate practice, which can be learned and taught (Lavastre & Wanderley, 2024, p.143-149-150).

<sup>1</sup> Smalley notices that “Although the detail of spectro-morphological description may sometimes not be easy to follow, particularly without an extensive experience of electroacoustic music repertory, it is far from being an esoteric activity” (1997, p.125).



Ex.2 - D. A. Stewart's kinesphere with the T-Stick on stage in "Everyone to the Power of One:" moving from left to right (Ex.2a), expanding with a "sword" (Ex.2b) and contracting with a "spear" (Ex.2c).



Ex.3 - The T-Stick used as martial-art cold-arm props in "Everyone to the Power of One:" a "spear" (Ex.3a), a "sword" (Ex.3b), and a "shield" (Ex.3c).

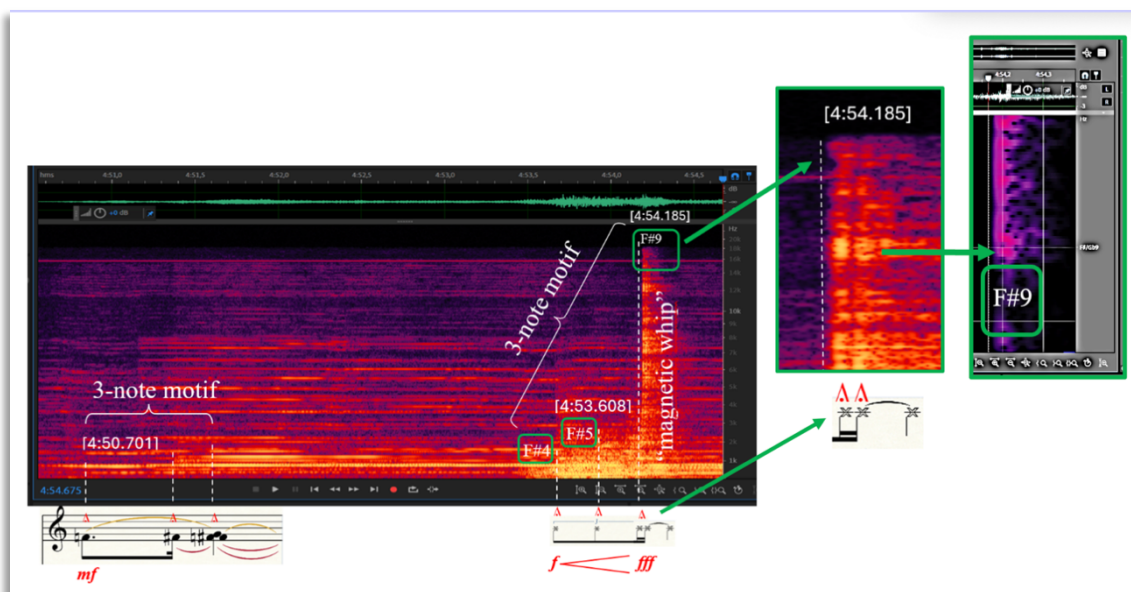
Ex.4 shows the collection of the most relevant sounds from Stewart's mapping<sup>2</sup> for the T-Stick used in the video performance, selected based on articulation (*legato* or *staccato*), dynamics (with maximum and minimum values in dB), formal structural relevance (in the *A*, *B* and *A'B'* Sections), and labeling with non-muso descriptions.

<sup>2</sup> "Mapping in the context of DMI design is the process by which control signals from sensors or gestures are associated with parameters of a sound synthesizer or other output medium". (Stewart & Malloch, 2010, p.3094).

intensity / articulation	<i>Section A</i>			<i>Section B</i>			<i>Section A'B'</i>		
maximum intensity in <i>staccato</i>	[0:19.665]	[1:04.896]	[1:52.464]	-----	[3:36.035]	[4:54.208]	[5:46.997]	[6:51.462]	[7:28.485]
	<b>-7,2 dB</b>	<b>-7,1 dB</b>	<b>-7,3 dB</b>		<b>-9,7 dB</b>	<b>-6,5 dB</b>	<b>-6,5 dB</b>	<b>-7,0 dB</b>	<b>-7,5 dB</b>
	3rd non-pitched note of the 3-note motif	F5 "breaking glass"	low non-pitched "thud"		non-pitched "slap bass"	F# "magnetic whip"	Es "bell"	appoggiatura B4-C5 with "wood strike"	F5 "thud"
maximum intensity in <i>legato</i>	[0:20.327]	[1:13.244]	[1:20.142]	[3:44.870]	[3:33.37]	[4:17.030]	[5:28.247]	[6:40.095]	[7:30.797]
	<b>-14,0 dB</b>	<b>-10,0 dB</b>	<b>-11,0 dB</b>	<b>-9,6 dB</b>	<b>-9,1 dB</b>	<b>-11,0 dB</b>	<b>-17,0 dB</b>	<b>-13,5 dB</b>	<b>-7,0 dB</b>
	non-pitched "airy pipeline"	B4 bend (wave/frequency modulation?)	G5 bend + "metal sanding"	G3 "airy pipeline"	D5 "airy pipeline" + "metal sanding"	reverb of E4 "bell" + "gong"	G5 "airy pipeline" + "dripping water"	F4-Ab4 bichord "alarm siren"	rotating "metal sanding"
minimum intensity in <i>staccato</i>	[1:04.469]	[1:39.459]	[2:12.034]	[3:16.870]	-----	[4:40.337]	[5:09.494]	[5:21.899]	[7:09.865]
	<b>-21,0 dB</b>	<b>-20,0 dB</b>	<b>-26,0 dB</b>	<b>-22,0 dB</b>		<b>-21,5 dB</b>	<b>-26,0 dB</b>	<b>-22,0 dB</b>	<b>-29,0 dB</b>
	F4 "thud"	non-pitched "thud"	Eb4 "thud echo"	chromatic (E4, F4, F#4, G4) "airy pipeline"		"thud" + F#5	C4 muted "thud"	C#4 "thud"	chromatic (Ab5-G5) "eerie vocal"
minimum intensity in <i>legato</i>	[0:24.318]	[2:03.336]	[2:14.683]	[2:53.227]	[3:11.137]	[4:37.101]	[5:03.021]	[6:35.655]	[6:32.891]
	<b>-30,0 dB</b>	<b>-32,0 dB</b>	<b>-36,8 dB</b>	<b>-35,0 dB</b>	<b>-39,0 dB</b>	<b>-51,0 dB</b>	<b>-54,5 dB</b>	<b>-48,0 dB</b>	<b>-66,5 dB</b>
	"airy pipeline" + "dripping water"	Bb4 to A4 "airy pipeline" to "lightsaber" + "metal sanding"	non-pitched "airy pipeline" + "dripping water"	descending major triad (G4-E4-C4) "airy pipeline"	C4 to B4 <i>glissando</i> "airy pipeline"	F#5 "metal sanding"	F5-E5-F5 "airy pipeline" bend + "metal sanding"	<i>ppp</i> non-pitched "hiss"	"cranking gear" <i>molto crescendo</i>
dynamics	Min = -36,8 dB Max = -7,1 dB			Min = -51,0 dB Max = -6,5 dB			Min = -65,6 dB Max = -6,5 dB		

Ex.4 - Table with the structural sound collection from Stewart's mapping for the T-Stick used in *Sections A, B, and A'B'* of "Everyone to the power of one" with articulation, dynamics and timing.

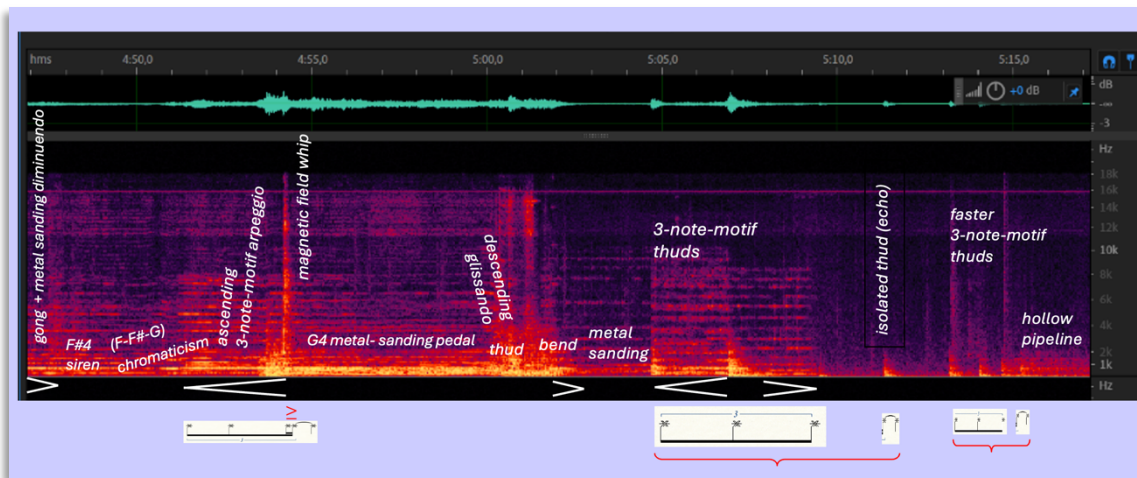
Ex.5 shows two transformed recurrences of the 3-note motif in *Section A'B'* of "Everyone to the power of one." First, an accumulation of sounds results in a two-semitone cluster (F5, F#5 and G5). Then, it follows a climatic arpeggiation of the pitch F#, encompassing 5 octaves (F#4, F#5 and F#9) within a very distinctive *crescendo*. A spectrographic zoom of this event, which surpasses the standard pitch range of musical events, shows two very close attacks in the last note of the motif, a feature also observed in the first appearance of this motif at the very beginning of the video recording and also in several other instances of the performance.



Ex.5 – There are two striking recurrences of the 3-note motif in the *Section A'B'* of "Everyone to the power of one:" a semitonal cluster and a large-span arpeggiation.

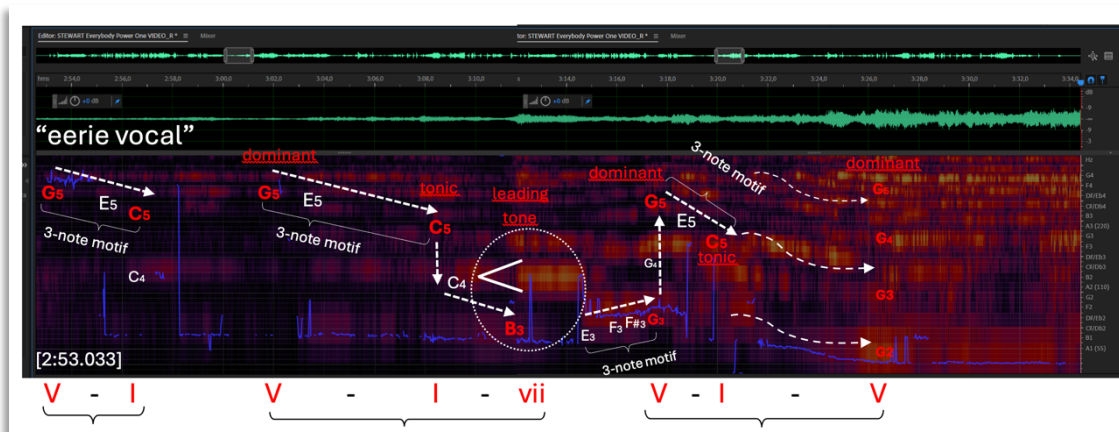


Still, at foreground levels, we observed that local events form phrases, many of which have as a unifying factor the recurrence and transformation of the 3-note motif, which organizes the entire performance (Ex.6).



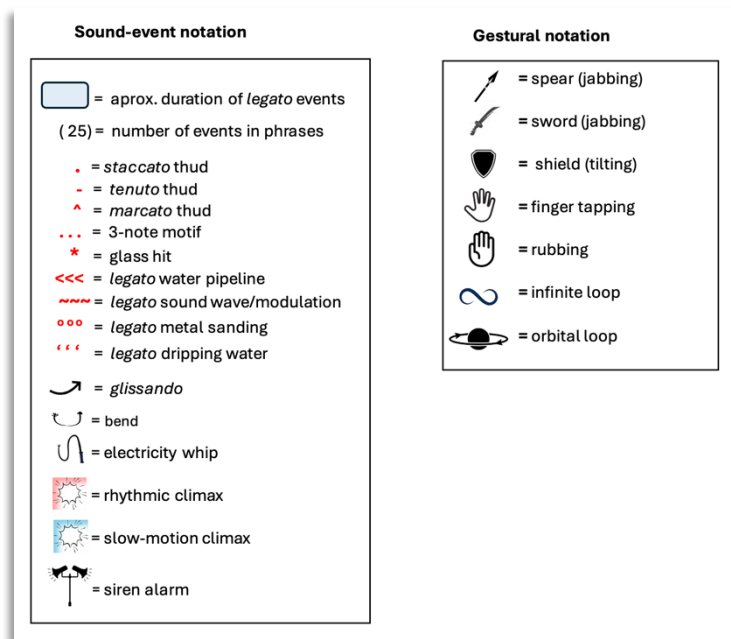
Ex.6 - Musical phrase containing several contrasting events and three recurrences of the unifying 3-note motif of “Everyone to the power of one”.

Stewart’s eclectic style sometimes required us to pair the spectrogram with traditional harmonic analysis during the transcription and analysis processes of these foreground-level phrases. Ex.7 shows an eerie tonal passage that marks the beginning of *Section B* and makes explicit four tonal harmonic progressions and an increase of the dynamics into the leading tone of C major (the pitch B3), revealed by the brighter red-orange colors in the sound spectrogram and marked with a *crescendo* sign.



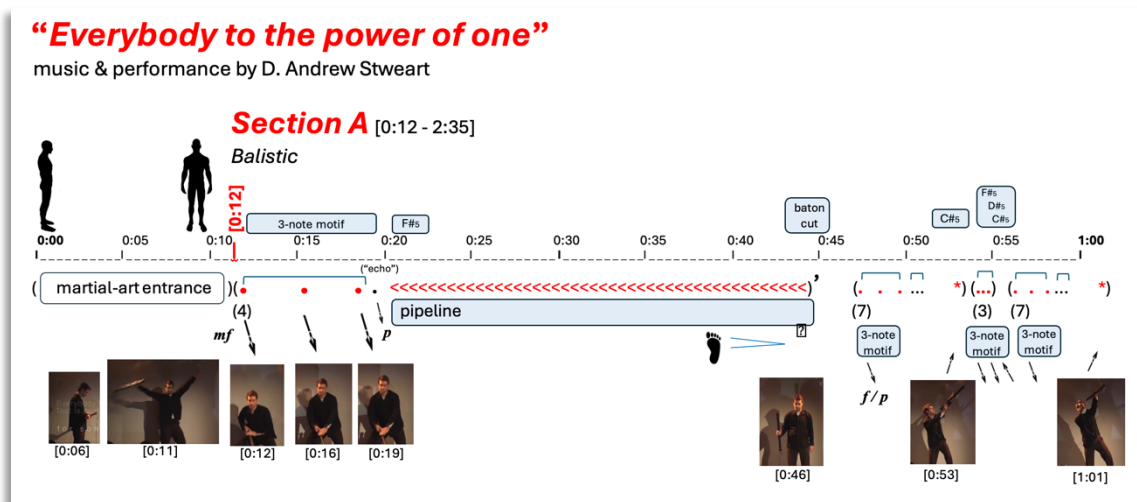
Ex.7 – C major harmonic progressions in four recurrences of the 3-note motif at the beginning of *Section B* of “Everyone to the power of one,” with a *crescendo* into the leading-tone B3.

To represent significant portions of the performance at middle-ground levels, we proposed a notation to make explicit the dialoguing layers. This notation combines musical signs for articulations and sound effects, icons of objects and gestures, numbers and durations of small events forming phrases, and climaxes (Ex.8).



Ex.8 – Glossary of signs and icons to notate musical events, dialog of layers, and gestures for the T-Stick in “Everyone to the power of one,” by D. Andrew Stewart.

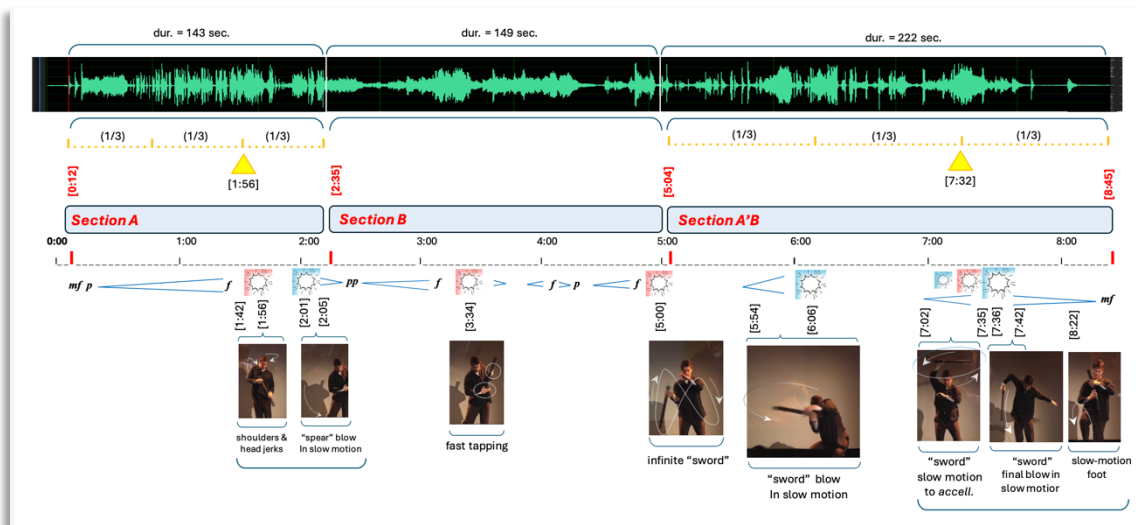
Ex.9 shows a middle-ground representation of the beginning of *Section A*, organized around a timeline with photograms from the video recording, layers and number of events, phrasing, traditional music notation, and respective descriptive keywords.



Ex.9 – Middle-ground representation of the analysis of the beginning of *Section A* from “Everyone to the Power of One.”

Finally, the background level gives a concise view of the performance. Ex.10 compiles the main findings of the analysis in a single image containing the sound wave to which are associated durations, dynamics, climaxes, two golden sections (2/3 of *Section A* and

2/3 of *Section A'B'*) and pictures of main structural gestures with the T-Stick in the three formal sections (*Sections A, B and A'B'*).



Ex.10 - Background formal analysis of D. Andrew Stewart's performance of "Everyone to the Power of One" showing: sound wave, timeline, duration of main sections (*A - B - A'B'*), dynamics, climaxes, two golden sections (in *Sections A* and *A'B'*), and main gestural actions at structural points.

## References:

CAGE, John. (1969) **Notations**. New York: Something Else. 312p.

FORTE, Allen; GILBERT, Steven E. (1987) **Introduction to Schenkerian Analysis: Form and Content in Tonal Music**. New York: W. W. Norton.

JAVASTRE, Benjamin; WANDERLEY, Marcelo M. (2024) Studying performances with Digital Musical Instruments: A case study of "Ritual," a piece for solo Karlox. Ed. by A. R. Jensenius. In: *ICRSM 2022* ( ) Series, v.12, p.138-154. In: *Proceedings from ICRSM 2022* ; available at [https://doi.org/10.1007/978-3-031-57892-2\\_8](https://doi.org/10.1007/978-3-031-57892-2_8)

MAGNUSSON, Thor. (2019) **Sonic writing: technologies of material, symbolic & signal inscriptions**. New York: Bloomsbury Academic.

MALLOCH, Joseph W. (2008) **A Consort of Gestural Musical Controllers: Design, Construction, and Performance**. Montreal: Schulich School of Music, McGill University. 66 pages (Master's Thesis in Music Technology).

MALLOCH, Joseph; WANDERLEY, Marcelo M. (2007) The T-Stick: From Musical Interface to Musical Instrument. *Proceedings of the 2007 International Conference on New Interfaces for Musical Expression (NIME07)*. New York City, USA, pp. 66-69.

MIRANDA, Eduardo Reck; WANDERLEY, Marcelo M. (2006) *Digital Musical Instruments: Control and Interaction Beyond the Keyboard*. Middlton, WI: A-R Editions.

PEIRCE, Charles Sanders. (1991) **Peirce on Signs: Writings on Semiotics by Charles Sanders Peirce**. Edited and organized by James Hoopes. Chapell Hill: North Carolina Press.

PLAZA, Julio. (2003) **Tradução intersemiótica**. Coleção Estudos, nº 93. São Paulo: Editora Perspectiva.

SAUER, Theresa (2009) **Notations 21**. Design and art direction by Michael Perry. New York: Mark Batty Publisher. 328p.

SHAEFFER, Pierre. (1966) **Traité des objets musicaux: essai interdisciplines**. Paris: Seuil. (published in English in 2017 as “Treatise on Musical Objects: An Essay Across Disciplines” by University of California Press with translation by Christine North and John Dack).

SMALLEY, Denis. (1997) **Spectromorphology: explaining sound-shapes**. Organized Sound, v.2, n.2, p.107-126. Cambridge: Cambridge University Press (published online in 2001; DOI: 10.1017/S1355771897009059).

STEWART, D. Andrew. (2010) **Catching Air and the Superman**. Montreal: Schulich School of Music, McGill University. 137 pages (Doctor of Music Thesis).

STEWART, D. Andrew. (2008) **Everyone to the Power of One**. Montreal: Université du Montréal. Available at: <https://vimeo.com/showcase/3109087/video/914222011>. (video recording of 9 minutes and 14 seconds extracted from the inaugural concert of the group Le Vivier).

STEWART, D. Andrew. (2009) **Everyone to the Power of One**. Montreal: Edition of the composer. 12 pages (prompt score for music improvisation).

STEWART, D. Andrew; MALLOCH, Joseph W. (2010) **Everybody to the power of one for soprano T-Stick**. CHI 2010, Media Showcase Session 4 April 10–15, 2010, Atlanta, Georgia, USA. ACM 978-1-60558-930-5/10/04.

TAGG, Philip. (2011) **Análise musical para “não-musos:” a percepção popular como base para a compreensão de estruturas e significados musicais**. Translation and glossary by Fausto Borém. Per Musi, n.23, p.7-18. Belo Horizonte: UFMG. (in Portuguese; a previous and shorter version in English was presented, but not published, in a 2001 Conference on Analysis of Popular Music in Cardiff, England, as “Musical analysis for “non-musos”: popular perception as a basis for understanding musical structure and meaning”).

THORESEN, Lasse (2004) **Spectromorphological analysis of sound objects: an adaptation of Pierre Schaeffer’s typomorphology**. With the assistance of Andreas Hedman Lasse Thoresen. Oslo: The Norwegian Academy of Music.