

Microtonal Tuning Systems Dataset: m17EDO variants and 51-Tone Asymmetric System

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Abstract

This dataset presents three original microtonal tuning systems developed by Hiroki Naito. Based on 17-tone equal temperament (17-EDO), these systems introduce specific asymmetric modifications utilizing just intonation ratios and intentional deviations. The dataset includes two 17-tone variants (m17EDO-2306 and m17EDO-2311) and a highly complex 51-tone asymmetric system designed for three interconnected pianos. These tunings are provided to explore novel harmonic functions, precise control of acoustic beating, and the theoretical limits of equal temperaments.

1. Introduction

While standard 17-EDO provides a highly symmetrical pitch space (approx. 70.588 cents per step), it lacks the purity of specific harmonic intervals. The modified systems documented in this dataset intentionally break this symmetry at structural nodes. By integrating just intonation ratios (such as 11/8 and 8/5) and shifting specific steps, these tunings generate unique dissonance curves and localized harmonic tensions. This report details the numerical structure of each tuning system.

2. Tuning Systems

2.1. m17EDO-2306

A modified 17-EDO tuning system (June 2023 revision). Three steps are replaced with just-intonation-derived or alternative intervals. It was first implemented in the composition *Prelude X* (2023).

Step 9: Modified from 564.7¢ to 551.3¢ (Ratio 11/8)

Step 10: Modified from 635.3¢ to 600.0¢

Step 12: Modified from 776.5¢ to 813.6¢ (Ratio 8/5)

Step	Cents	Ratio	17-EDO ref	Deviation
1	0.0	1/1	0.0	0.0
2	70.6		70.6	0.0
3	141.2		141.2	0.0
4	211.8		211.8	0.0

Step	Cents	Ratio	17-EDO ref	Deviation
5	282.4		282.4	0.0
6	352.9		352.9	0.0
7	423.5		423.5	0.0
8	494.1		494.1	0.0
9	551.3	11/8	564.7	-13.4
10	600.0		635.3	-35.3
11	705.9		705.9	0.0
12	813.6	8/5	776.5	+37.1
13	847.1		847.1	0.0
14	917.6		917.6	0.0
15	988.2		988.2	0.0
16	1058.8		1058.8	0.0
17	1129.4		1129.4	0.0
1 (8va)	1200.0	2/1	1200.0	0.0

2.2. m17EDO-2311

A further modification (November 2023 revision). Five steps deviate from standard 17-EDO, introducing more complex beating patterns compared to the 2306 variant. It was first utilized in *Lunar Fantasia* (2023).

Differences from 2306: Step 6 (+24.1¢), Step 9 (-14.4¢), Step 10 (+3.0¢), Step 16 (+29.4¢).

Step	Cents	Deviation from 17-EDO	Note
1	0.0	0.0	
2	70.6	0.0	
3	141.2	0.0	
4	211.8	0.0	
5	282.4	0.0	
6	377.0	+24.1	Modified
7	423.5	0.0	
8	494.1	0.0	

Step	Cents	Deviation from 17-EDO	Note
9	536.9	-27.8	Modified
10	603.0	-32.3	Modified
11	705.9	0.0	
12	813.6	+37.1	Modified
13	847.1	0.0	
14	917.6	0.0	
15	988.2	0.0	
16	1088.2	+29.4	Modified
17	1129.4	0.0	

2.3. Piano Opera 51-Note Tuning

Developed for *Piano Opera in 4 Acts — The Asteroidal Sequence of Metaphysical Ulysses* (2024–2025). This system requires three separate microtonal pianos, each tuned to a unique 17-note scale, yielding 51 distinct pitches per octave. Piano 1 (P1) acts as the anchor, utilizing the m17EDO-2306 tuning with a base pitch of 312 Hz. Pianos 2 and 3 are tuned asymmetrically to interleave with P1, creating precise interference patterns (beating) rather than equidistant subdivisions.

Total #	Cents	Piano Inst.	Step Size (¢)
1	0.0	P1	-
2	12.5	P3	12.5
3	50.0	P2	37.5
4	70.6	P1	20.6
5	83.1	P3	12.5
6	120.6	P2	37.5
7	141.2	P1	20.6
8	153.7	P3	12.5
9	191.2	P2	37.5
10	211.8	P1	20.6
11	224.3	P3	12.5
12	261.8	P2	37.5

Total #	Cents	Piano Inst.	Step Size (¢)
13	282.4	P1	20.6
14	294.9	P3	12.5
15	332.4	P2	37.5
16	352.9	P1	20.5
17	386.5	P3	33.6
18	403.0	P2	16.5
19	423.5	P1	20.5
20	436.0	P3	12.5
21	473.6	P2	37.6
22	494.1	P1	20.5
23	506.6	P3	12.5
24	544.1	P2	37.5
25	547.5	P3	3.4
26	551.3	P1	3.8
27	600.0	P1	48.7
28	612.5	P3	12.5
29	614.7	P2	2.2
30	674.5	P3	59.8
31	685.3	P2	10.8
32	705.9	P1	20.6
33	743.0	P3	37.1
34	755.9	P2	12.9
35	813.6	P1	57.7
36	826.5	P2	12.9
37	847.1	P1	20.6
38	870.5	P3	23.4
39	897.1	P2	26.6
40	917.6	P1	20.5

Total #	Cents	Piano Inst.	Step Size (¢)
41	920.5	P3	2.9
42	967.7	P2	47.2
43	988.2	P1	20.5
44	999.0	P3	10.8
45	1033.5	P3	34.5
46	1038.3	P2	4.8
47	1058.8	P1	20.5
48	1108.9	P2	50.1
49	1129.4	P1	20.5
50	1142.9	P3	13.5
51	1179.5	P2	36.6

3. Implementation Notes

The raw data for these tuning systems is available in Scala format (.scl) within this dataset. The file piano-opera-51note.scl is provided primarily for reference and analytical purposes. For practical performance and digital realization, this system must be implemented across 3 separate synthesizer/piano instances, rather than loading all 51 pitches into a single instrument scale mapping.