DOI: 10.71568/daga2026.094

SInES Tools, Helpers, Visualizers as your Scientific Realizers

Christoph Reuter[1], Isabella Czedik-Eysenberg[1], Anja-Xioaxing Cui[1], Sarah Ambros[1], Felix Klooss[1], Gabriel Feller[1], Ingrid Schachner[1], Marik Roos[1], Helene Lindenbauer[1], Hao Li[2], Matthias Bertsch[3]

[1] *SInES, Musicological Department, University of Vienna, 1090 Vienna, Austria, E-Mail: christoph.reuter@univie.ac.at*

[2] *Northwestern Polytechnical University (NWPU), XI'an, China*

[3] *Motion-Emotion Lab, University of Music and Performing Arts, Vienna, Austria*

SInES Tools – Status Quo 2026

The online tools of the Space for Interdisciplinary Experiments on Sound (SInES), available since 2023 at [1], have been expanded to include more than 80 tools in recent months. They are organized on a web page, which can be searched by keywords and functions, into the following categories:

- Audio Signal Analysis
- AI/Machine Learning
- Sound Synthesis
- Tracking Tools
- Visualizers
- Helpers (Statistics & Co)

Based on modern web libraries such as Essentia.js [2], Meyda.js [3], JS-Xtract.js [4], P5.js [5], Plotly.js [6], and many others, these tools follow two simple principles to make professional software accessible to researchers, students, and interested laypeople alike:

- It's online, it's free, it's one click away
- Upload Data → Analyze → Download Results.

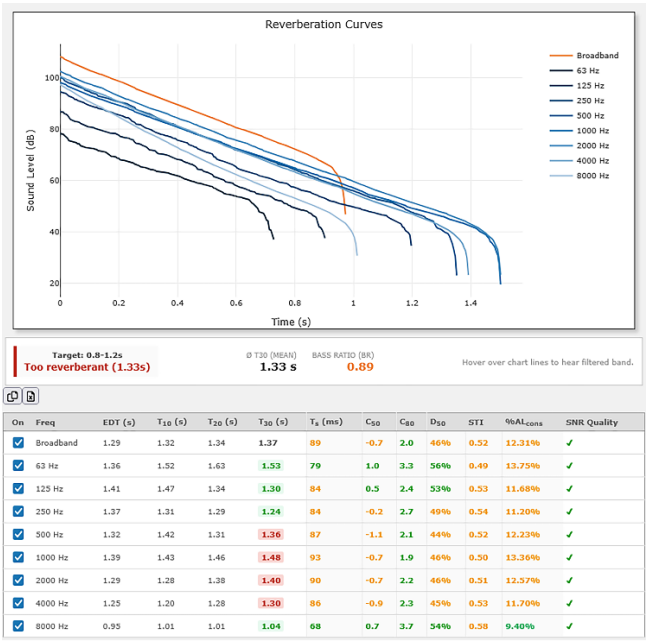
New Audio Signal Analysis Tools

New SInES Tools include the **dB Analyzer** [7], a tool for sound pressure level and loudness analysis. From recordings with calibrated microphones, the actual sound pressure level (dB_{SPL}) can be calculated from the dB_{FS} of the audio track, as well as weighted levels (dB_A, dB_B, dB_C), LA_{eq}, and integrated loudness (LUFS), loudness in sone and Phon, and even sound pressure (Pa) and intensity (W/m²). Of course, as with nearly all SInES tools, the results can be exported as CSV and Excel files.

The **Room Acoustics Tool** [8] allows reverberation calculation based on recorded impulse responses (similar to [9]). From these, typical acoustic properties according to ISO 3382 are calculated, such as $RT_{10\text{-}30}$, EDT, D_{50}, C_{50}, C_{80}, G_{Theo}, STI, $ALcons_{Theo}$, and A_{eq}. Features include octave band filtering (63 Hz – 8 kHz), target room profiles for evaluation, and an integrated auralization engine for real-time convolution (see Figure 1).

The **Clubbernaut** [10] uses the JavaScript library clubber.js to perform a harmonic tension analysis on musical works: To do this, the spectrum of the audio file is mapped to a 128-note MIDI range, enabling real-time automatic key and chord detection, which is used to calculate the composition's harmonic tension curve.

The **Masking Score Estimator** [11] calculates the most likely masking effect between two audio signals. By comparing a target file against a masker file, it calculates a comparative masking score based on spectral and temporal descriptors using Meyda.js. It analyzes RMS, spectral features, MFCCs, and 24 Bark bands to determine signal transparency and timbral blend. This is useful both for orchestration and for assessing the effectiveness of masking unwanted noise with more pleasant sounds [e.g. 12].



On	Freq	EDT (s)	T_{10} (s)	T_{20} (s)	T_{30} (s)	T_s (ms)	C_{50}	C_{80}	D_{50}	STI	%AL_{cons}	SNR Quality
☑	Broadband	1.29	1.32	1.34	1.37	89	-0.7	2.0	46%	0.52	12.31%	✓
☑	63 Hz	1.36	1.52	1.63	1.53	79	1.0	3.3	56%	0.49	13.75%	✓
☑	125 Hz	1.41	1.47	1.34	1.30	84	0.5	2.4	53%	0.53	11.68%	✓
☑	250 Hz	1.37	1.31	1.29	1.24	84	-0.2	2.7	49%	0.54	11.20%	✓
☑	500 Hz	1.32	1.42	1.31	1.36	87	-1.1	2.1	44%	0.52	12.23%	✓
☑	1000 Hz	1.39	1.43	1.46	1.48	93	-0.7	1.9	46%	0.50	13.36%	✓
☑	2000 Hz	1.29	1.28	1.38	1.40	90	-0.7	2.2	46%	0.51	12.57%	✓
☑	4000 Hz	1.25	1.20	1.28	1.30	86	-0.9	2.3	45%	0.53	11.70%	✓
☑	8000 Hz	0.95	1.01	1.01	1.04	68	0.7	3.7	54%	0.58	9.40%	✓

Figure 1: Reverberation curves and measurement results of a lecture hall displayed in the SInES Room Acoustics Tool.

The **Modulation Power House** [13] gives a 2D Modulation Power Spectrum (MPS) analysis of audio files. It decomposes sound signals into their temporal (Hz) and spectral (Cycles/Mel) modulation components, allowing users to visualize and quantify characteristics like vibrato, rhythm, roughness, and Syllable rate, while featuring an interactive sonogram/MPS, customizable STFT settings, and a peak-tracking table with audio resynthesis of specific detected modulations.

The **Roughness Estimator** [14] serves as psychoacoustic tool for calculating spectral roughness (according to Plomp & Levelt [15], Sethares [16], and Vassilakis [17]) and for estimating modulation-based roughness (according to Zwicker [18], Aures [19] and Daniel & Weber [20]).

As a signal processing tool for Laplace transformation and LPC-based formant estimation the **Laplace-Transformator** [21] visualizes audio in the complex s-plane (σ and ω) and tracks formants F1–F4 using Linear Predictive Coding (LPC). With LPC order number estimation, a pole density map, formant frequency tracking and auralization it is a useful tool for calculating vocal and instrumental formants.

The **MIDI Analysis Tool** [22] explores multi-track MIDI files through interactive piano roll timelines, detailed event lists, tempo and key signatures, and statistical distributions of pitch, velocity, and duration as well as pitch class distribution and harmonic tension analysis.

Sound Synthesis and Transformation

In 2025 and the first months of 2026, the SInES Tools were expanded to include a **synthesis section** [23] featuring primarily spectral manipulation tools that are otherwise difficult or nearly impossible to find: This section offers a range of tools that allow high-quality transfer of timbral characteristics from one sound to another. These include tools such as a **Bark Band Vocoder** [24] (with 24 bark band filters, for aurally accurate adaptation of one sound to another), a **Spectral Cross Synthesizer** [25] (in which the spectrum of one sound can be superimposed onto the temporal envelope of a target sound), **Modulation Transfer** [26] (for analyzing vibrato, tremolo, jitter, and shimmer, which can be transferred to any other sounds), a **Spectral Stamper** [27] (where a spectrum is applied to another sound as a 3D filter, effectively used like a stamp to imprint a timbral structure), a **Spectral Morpher** [28] (which offers various algorithms for morphing static and dynamic sounds, including pitch tracking, phase vocoding, and formant correction), etc.

Additional tools are available for spectral filtering, such as the **Formant Shifter** [29] (a tool for shifting and reshaping the spectral envelope of voices and instruments independently of pitch, including contrast enhancement, gap filling, and spectral tilt), the **Formant & Pitch Shifter** [30] (for independent pitch and formant shifting while maintaining audio duration), and the **Spectral Gator** [31] (a tool for isolating or removing spectral frequencies based on their amplitude levels). This class of tools also includes new developments for separating harmonic components from noisy components in the spectrum, such as the **Harmonic/Percussive Separator** [32] (a tool for Harmonic/Percussive Separation (HPS) using the FitzGerald (2010) algorithm [33] to isolate tonal and transient components of any audio signal through median filtering in the spectral domain, see Figure 2), the **Harmonic Frequency Extractor** [34] (a tool for extracting or suppressing specific frequencies and their harmonics from audio signals), and the **Harmonicity Analyzer** [35] (a tool for separating periodic and noisy signal components and calculating the Harmonic-to-Noise Ratio (HNR) in dB).

Furthermore, there are time and spectral warping tools such as the **Time Stretcher** [36] (a high-quality time-stretching tool enabling artifact-free time scaling from 0.1x to 50x using phase-coherent spectral processing, without affecting the original pitch), and the **Spectral Warper** [37] (a tool for transforming harmonic overtone series into stretched or compressed inharmonic spectral structures. Based on the principles of William A. Sethares [38], it shifts partials to explore the relationship between spectral content and consonance/dissonance perception) as well as tools like the **Tempodrom** [39] (a tool for perceptual BPM analysis and groove extraction, which decomposes audio into 12 frequency bands to identify rhythmic spikes and calculate a global tempo consensus, including groove resynthesis to WAV and MIDI export for DAW integration).

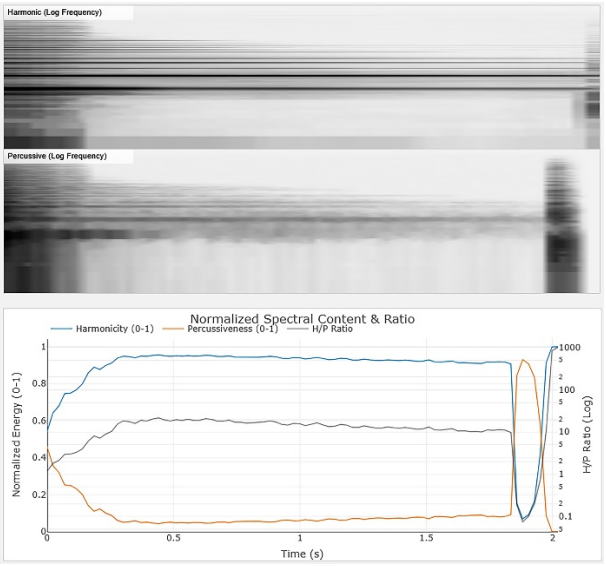


Figure 2: Result of spectral separation of the harmonic and percussive components of a guitar sound displayed in the SInES Harmonic/Percussive Separator.

Helpers and Visualizers

For the already existing SInES pose and hand **tracking tools** [40], visualizers have been set up to track and analyze movements [41], such as the **3D Pose Tracking Visualizer (Avatar)** [42]. This 3D visualization tool allows users to animate virtual avatars and stick figures based on recorded pose data. It synchronizes 3D skeletal movements with original video footage and acoustic features. The tool includes customizable bone mapping, rotation offset adjustments for precise alignment, calculation of joint angles, velocity, acceleration, and distance traveled for each body part, as well as integrated correlation analysis between movement trajectories and audio parameters (see Figure 3).

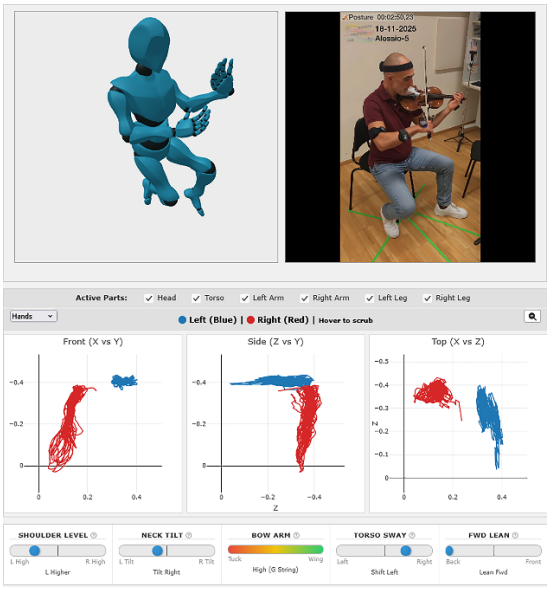


Figure 3: Movements of a violinist matched to those of a 3D avatar, including trajectories of the right and left hands as well as various posture parameters, displayed in the SInES 3D Pose Tracking Visualizer (Avatar Version).

The new **SInES Helpers [43]** section has been added. It is designed to prepare/pre-process, statistically analyze, and visualize the data collected by using the SInES (or any other) Tools. As part of data pre-processing, these new tools make it extremely easy to search for and sort by similarities in large tables [44], calculate moving averages with adjustable window sizes across table columns [45], perform z-transformations on tables [46], or synchronize/merge tables with different sampling rates to one large, unified table [47].

For statistical analysis, the SInES Helpers offer a broad range of basic tools, such as correlation analysis with the **Column Correlator** [48] (for easily calculating Pearson's r and Spearman's rho, including Bonferroni correction, Shapiro-Wilk normality checks, Grubbs' outlier detection, and Breusch-Pagan tests for heteroscedasticity), the **Time Series Analyzer** [49] (for detecting correlations in temporal data such as audio or motion sequences, including automated lag analysis to identify delayed relationships, autocorrelation, as well as moving average smoothing or trend differencing to reduce noise and artifacts), the **t-Tester** [50] (for effortless calculation of t-values, p-values, and Cohen's d effect sizes directly from your Excel files, including the Shapiro-Wilk test for normality and Levene's test for equality of variances), and the **Interrater Calculator** [51] (a specialized tool for assessing rater agreement and consistency: It performs robust calculations for Fleiss' Kappa, Krippendorff's Alpha (nominal), and Cronbach's Alpha, providing full statistical reporting including p-values, Z-scores, and 95% confidence intervals, including automated subgroup comparisons). For more complex statistical analyses that also enable pattern recognition in multidimensional datasets, a range of tools is available, such as cluster analysis using the **Gaussian Mixture Model** [52] (a tool for independent Gaussian Mixture Model (GMM) clustering that automatically estimates key model parameters, including weights, means, and variances), the **ClusterBuster** [53] (clustering using k-means analysis, including the Elbow Method to identify the optimal number of clusters including built-in Z-score outlier detection), and **SupANOVA** [54] (a tool that combines an ANOVA with Principal Component Analysis (PCA) to automatically identify the most significant features using F-values and to visualize group differences via PCA in interactive 2D plots or 3D space, see Figure 4).

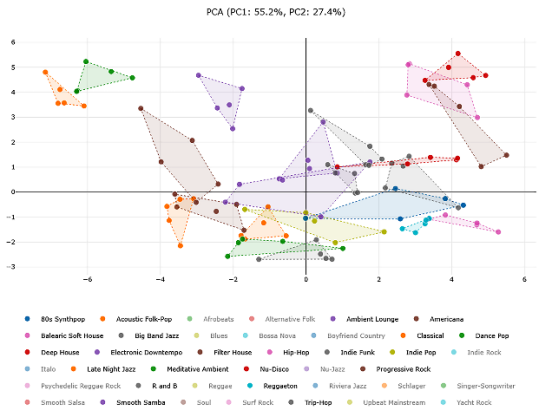


Figure 4: ANOVA across 15 audio features with subsequent PCA for the genre separation of AI-generated musical works, displayed in the SInES SupANOVA.

Thanks to the new SInES Helpers, such as the **Excel Visualizer** [55], **Boxplotter** [56], **Categorizer** [57], and **Heatmapper** [58], collected data and results can be visualized in a wide variety of ways, including 2D/3D scatter plots, bar charts, bubble charts, box or violin plots, radar charts, progression charts, density maps, and more. Visualizations can be exported as PNG, PDF, or interactive HTML, which presents the data including audio samples when hovering over the corresponding data points.

Summary and Outlook

With more than 80 apps for audio signal analysis, AI-powered assessments, sound synthesis, body, hand, point, and emotion tracking/visualization, as well as statistical analysis of collected data, the SInES Tools in their current form offer a comprehensive and completely free online environment for professional work with audio and video data that is accessible to researchers, students, and laypeople alike.

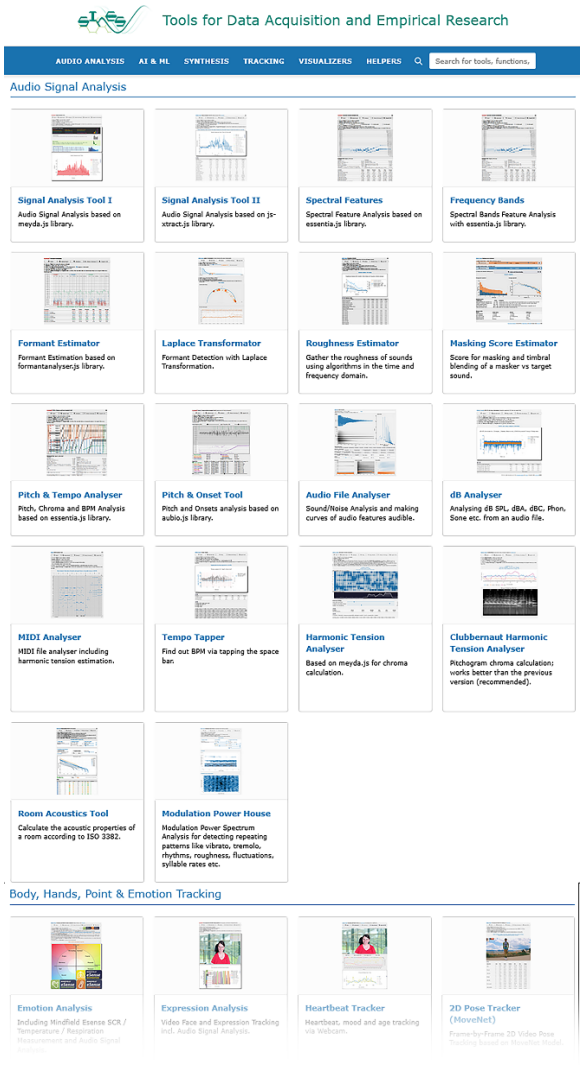


Figure 5: SInES Tools at https://sinestools.univie.ac.at
It's online, it's free, it's one click away.

Plans for 2026/27 include the translation of the SInES Tools into Chinese, an expansion of the 3D Avatar visualizers for the already existing SInES Tools for body, hand, and face tracking, as well as automation and batch functions for doing audio and video analysis at a larger scale.

Literature

[1] SInES Tools: https://sinestools.univie.ac.at

[2] Correya, A. et al. 2021. Audio and Music Analysis on the Web using Essentia.js. Transactions of the International Society for Music Information Retrieval, 4(1), 167–181.

[3] Rawlinson, H. et al. 2015. Meyda: an audio feature extraction library for the Web Audio API. Proceedings of the 1st Web Audio Conference (WAC), Paris, France.

[4] Jillings, N. et al. 2016. JS-Xtract: a realtime audio feature extraction library for the web. 17th International Society for Music Information Retrieval Conference, 2016.

[5] McCarthy, L., Reas, C., Fry, B. 2015. Getting Started with p5.js. Santa Rosa, CA: Make Community, LLC.

[6] Plotly.js: https://plotly.com/javascript/

[7] SInES Tools: dB Analyzer: https://sinestools.univie.ac.at/dbcalculator.htm

[8] SInES Tools: Room Acoustics Tool: https://sinestools.univie.ac.at/roomacousticstool.htm

[9] OPRA: Online tool for the prediction of room acoustical qualities: https://opra.isave.hs-duesseldorf.de/

[10] SInES Tools: Clubbernaut: https://sinestools.univie.ac.at/clubbernaut.htm

[11] SInES Tools: Masking Score Estimator: https://sinestools.univie.ac.at/maskingestimator.htm

[12] Hao, L. et al. 2026. Audio injection based combined noises annoyance suppression: Quantification and modeling. Applied Acoustics 241, 111016.

[13] SInES Tools: Modulation Power House: https://sinestools.univie.ac.at/mps.htm

[14] SInES Tools: Roughness Estimator:https://sinestools.univie.ac.at/roughness_estimator.htm

[15] Plomp, R. & Levelt, W.J.M. 1965. Tonal consonance and critical bandwidth. JASA 38(4), 548–60

[16] Sethares, W.A. 1993. Local consonance and the relationship between timbre and scale. JASA 94(3), 1218–1228.

[17] Vassilakis, P. N. 2005. Auditory roughness as means of musical expression. Sel. Rep. in Ethnomusicology 12, 119–144.

[18] Fastl, H., & Zwicker, E. 2007. Psychoacoustics: Facts and Models. Springer.

[19] Aures, W. 1958. Ein Berechnungsverfahren der Rauigkeit. Acta Acustica United with Acustica 58, 268–281.

[20] Daniel, P., & Weber, R. 1997. Psychoacoustical Roughness: Implementation of an Optimized Model.Acustica 83,113–123.

[21] SInES Tools: Laplace-Transformator: https://sinestools.univie.ac.at/laplace_transformator.htm

[22] SInES Tools: MIDI Analyser: https://sinestools.univie.ac.at/midiparser.htm

[23] SInES Tools: Synthesis Tools: https://sinestools.univie.ac.at/#synthesis

[24] SInES Tools: Bark Band Vocoder: https://sinestools.univie.ac.at/vocoder.htm

[25] SInES Tools: Spectral Cross Synthesizer: https://sinestools.univie.ac.at/crosssynthesizer.htm

[26] SInES Tools: Modulation Transfer: https://sinestools.univie.ac.at/modulationanalyser.htm

[27] SInES Tools: Spectral Stamper: https://sinestools.univie.ac.at/spectralstamper.htm

[28] SInES Tools: Spectral Morpher: https://sinestools.univie.ac.at/spectralmorpher.htm

[29] SInES Tools: Formant Shifter: https://sinestools.univie.ac.at/formantshifter.htm

[30] SInES Tools: Formant & Pitch Shifter https://sinestools.univie.ac.at/pitchformantshifter.htm

[31] SInES Tools: Spectral Gator: https://sinestools.univie.ac.at/spectralgate.htm

[32] SInES Tools: Harmonic/Percussive Separator: https://sinestools.univie.ac.at/harmonic_percussive_separator.htm

[33] FitzGerald, D. 2010. Harmonic/Percussive Separation using Median Filtering. 13th DAFx. Graz.

[34] SInES Tools: Harmonic Frequency Extractor: https://sinestools.univie.ac.at/harmonic_frequency_extractor.htm

[35] SInES Tools: Harmonicity Analyser: https://sinestools.univie.ac.at/harmonicnoiseratio.htm

[36] SInES Tools: Time Stretcher: https://sinestools.univie.ac.at/timestretcher.htm

[37] SInES Tools: Spectral Warper: https://sinestools.univie.ac.at/spectral_warper.htm

[38] Sethares, W.A. 2015. Tuning, Timbre, Spectrum, Scale. London: Springer

[39] SInES Tools: Tempodrom: https://sinestools.univie.ac.at/tempodrom.htm

[40] SInES Tools: Tracking Tools: https://sinestools.univie.ac.at/#tracking

[41] SInES Tools: Visualizers: https://sinestools.univie.ac.at/#visualizers

[42] SInES Tools: 3D PoseTracking Visualizer: https://sinestools.univie.ac.at/pt3Dvisualiser.htm

[43] SInES Tools: Helpers: https://sinestools.univie.ac.at/#helpers

[44] SInES Tools: Similarity Sorter: https://sinestools.univie.ac.at/excelsimilaritysearcher.htm

[45] SInES Tools: Moving Averager: https://sinestools.univie.ac.at/excelmovingaverager.htm

[46] SInES Tools: Z-Transformer: https://sinestools.univie.ac.at/excelztransfomer.htm

[47] SInES Tools: Excel Synchronizer: https://sinestools.univie.ac.at/excelsynchroniser.htm

[48] SInES Tools: Excel Column Correlator: https://sinestools.univie.ac.at/excelcorrelator.htm

[49] SInES Tools: Time Series Analyser:https://sinestools.univie.ac.at/time_series_analyser.htm

[50] SInES Tools: t-Tester: https://sinestools.univie.ac.at/excelttester.htm

[51] SInES Tools: Interrater Calculator: https://sinestools.univie.ac.at/irrcalculator.htm

[52] SInES Tools: Gaussian Mixture Model: https://sinestools.univie.ac.at/gmmanalyser.htm

[53] SInES Tools: ClusterBuster: https://sinestools.univie.ac.at/excelcluster.htm

[54] SInES Tools: SupANOVA https://sinestools.univie.ac.at/supanova.htm

[55] SInES Tools: Excel Visualiser: https://sinestools.univie.ac.at/excelvisualiser.htm

[56] SInES Tools: Boxplotter: https://sinestools.univie.ac.at/excelboxplotter.htm

[57] SInES Tools: Categorizer: https://sinestools.univie.ac.at/excelcategorizer.htm

[58] SInES Tools: Heatmapper: https://sinestools.univie.ac.at/excelheatmapper.htm