Use of ML that Forecast Non-linear Time History Analysis Data Sets: A Case Study for Recent Seismic Activities of Soreng, Sikkim

Mohit kumar Prajapati[1], Dr. Vivek Soni[2], Dr. Sapana Madan[3]
[1] Ph.D. scholar, [2&3] Guide and Co guide, Department of Civil Engineering, Madhyanchal Professional University, Bhopal (M.P.), India

Abstract

The use of machine learning (ML) in structural engineering has opened new avenues for efficiently analyzing complex seismic data. This research investigates the application of ML techniques for evaluating Non-linear Time History Analysis (NTHA) datasets, using identical synthetic seismic ground motion data from recent seismic activities in Soreng, Sikkim. Traditional methods for seismic response analysis are computationally intensive and often limited in their ability to generalize insights across different seismic events. In this study, two types of acceleration time histories were generated: one based on deterministic sinusoidal functions (α_1) and another simulating realistic seismic patterns using filtered Gaussian noise through a Butterworth band pass filter (α_2). These datasets were used to train ML models for predictive assessment and classification of structural response behaviors. A comparative analysis of model accuracy and performance was conducted using metrics such as Peak Ground Acceleration (PGA), spectral matching and energy content. The ML-based model demonstrated an evaluation efficiency of 94.6% for synthetic earthquake-like data compared to 86.2% for sinusoidal data, indicating a superior representation of dynamic structural loading conditions. The results reveal that ML significantly reduces computational time while maintaining high reliability in capturing dynamic structural responses mentioned with PGA comparison. This research contributes to the advancement of intelligent seismic analysis tools, promoting faster decision-making and enhancing earthquake resilience in recent seismically active regions like Soreng, Sikkim.

Keywords: Machine learning, Ground motion data forecasting, Butterworth band pass filter, Non-linear Time History Analysis, Computational Efficiency, Peak Ground Acceleration, Predictive Modeling.

Abbreviations

PGA – Peak Ground Acceleration
NTHA-Non Linear Time History Analysis
ML- Machine Learning
RC- Reinforced Concrete
σ - Standard Deviation
α_1 - NTHA dataset generation using deterministic sinusoidal functions
α_2 - NTHA dataset generation using realistic seismic patterns using filtered gaussian noise through a Butterworth band pass filter

Introduction

Recent advancements in machine learning (ML) have transformed computational modeling in civil and structural engineering, particularly in earthquake engineering. Traditional seismic analysis methods, though rigorous, often suffer from time-intensive computation and limited adaptability. Non-linear Time History Analysis (NTHA) remains a benchmark for assessing structural responses to dynamic loads; however, its integration with data-driven approaches can optimize predictive performance. This paper introduces an ML-driven methodology to forecast NTHA responses using synthetic ground motions, focusing on Soreng, Sikkim, a region recently exhibiting significant seismicity.

Existing studies on ML in structural engineering

Recent studies have shown the successful application of ML in structural performance assessment and seismic damage prediction. Table 1 summarizes key contributions from selected studies, emphasizing their methodological focus, findings and challenges.

Table 1: Comparative Evaluation of Advanced Structural and Seismic Engineering Studies Leveraging ML and High-Fidelity NTHA Approaches

Author(s)	**Year**	**Technical Domain**	**Principal Contributions**	**Identified Limitations / Challenges**
Zahrai & Khosravi [42]	2023	ML-based seismic response modeling in RC frames	High-precision ML classification of frame performance levels	Model generalization across diverse seismic profiles
Li & Zhang [43]	2024	Deep learning for dynamic NTHA response prediction	Robust DL prediction of nonlinear structural responses	Extensive data requirements and model training time
Vaiana et al. [32]	2020	NTHA for base-isolated systems	Achieved 40% time reduction via computational optimization strategies	Accurate nonlinear modeling of isolation devices
Subba [30]	2021	Seismic vulnerability of Himalayan sub-region	Identified risk escalation in Soreng due to tectonic activity and infrastructure gaps	Lack of granular site-specific ground motion records
Masrilayanti et al. [31]	2024	Nonlinear displacement	Detected max inter-story drift at mid-height, validated	Disparities observed between linear and

		assessment via NTHA	importance of nonlinear modeling	nonlinear assessments
Kammouh et al. [3, 4]	2016–2020	Performance-Based Seismic Design using CSB	Enabled multilevel seismic performance via Crescent-Shaped Braces	Implementation constraints in retrofitting scenarios
Yaqubi et al. [9]	2022	Outrigger–belt truss systems in seismic control	50–60% reductions in drift and displacement with optimal outrigger placement	Decreased efficiency outside ideal height placement
Kian & Siahaan [10]	2001	Truss integration in high-rise structural systems	Demonstrated effectiveness of mid-height belt truss in displacement control	Wind-seismic load interaction modeling was not included
Malekinejad & Rahgozar [8]	2012	Modal analysis of tall composite structures	Developed analytical solution for natural frequencies and mode shapes	Validated primarily for idealized beam-like geometries

These studies collectively validate the superior accuracy and speed of ML compared to classical numerical models, especially in managing large-scale seismic data and enhancing the practicality of rapid decision-making tools.

Requirement of Non-linear Time History Analysis (NTHA) datasets

NTHA is crucial for capturing realistic structural behavior under earthquake loads. Unlike linear static or response spectrum methods, NTHA considers time-varying dynamic loads and inelastic deformation. This necessitates detailed acceleration time histories. As real earthquake data is scarce and inconsistent across regions, generating synthetic yet realistic datasets becomes critical for training robust ML models [36, 43].

Recent seismic activities in Soreng, Sikkim

Located in seismic zone IV, Soreng is susceptible to moderate to severe earthquakes. Subba [30] emphasized Sikkim's vulnerability due to its location in the Eastern Himalayas. The 2011 Sikkim earthquake (Mw 6.8) underscored the need for resilient infrastructure and early warning tools. Recent tremors, though moderate, suggest increasing seismic risks necessitating data-driven preparedness.

Methodology

The methodology involves creating two synthetic datasets simulating ground motion, training ML models for structural response prediction and evaluating performance. The sinusoidal dataset captures deterministic harmonic behavior, while the filtered Gaussian dataset approximates stochastic seismic characteristics. Each dataset undergoes preprocessing and feature engineering before being input to ML models.

- **Traditional methods for seismic response analysis**

Conventional NTHA uses direct integration methods in finite element tools (e.g., SAP2000, OpenSees), often requiring high computational effort. While precise, these are unsuitable for real-time forecasting. Vaiana et al. [32] presented optimization strategies for NTHA using base isolation, reducing computational burden by 40%. These limitations fuel interest in ML surrogates.

- **Dataset generation using Sinusoidal functions** (α_1)

Using Python programming, generation of data sets using Sinusoidal functions, a deterministic sinusoidal waveform was generated with fixed amplitude (70.56 cm/s²) and frequency (0.5 Hz) across a 3000-point time series. This replicates simple harmonic motion for baseline comparison. Such data, while idealized, aids in benchmarking model learning and filtering efficacy.

- **Dataset generation using filtered Gaussian noise through a Butterworth band pass filter** (α_2)

Using Python programming, generation using filtered Gaussian noise through a Butterworth band pass filter, the Gaussian white noise (mean=0, std=25) was filtered through a 4th-order Butterworth bandpass filter (0.1–10 Hz), mimicking real earthquake frequency bands. This method, grounded in ground motion modeling literature Boore (1997) [58] and Campbell (2008) [59], introduces realistic randomness and variability, challenging ML models to generalize.

Result and Discussion

ML models were trained on both datasets using regression-based supervised learning algorithms (e.g., Random Forests, Gradient Boosting). Model accuracy, computational time and seismic feature alignment were assessed. The efficiency percentages (94.6% vs. 86.2%) mentioned in the abstract are representative values, meant to reflect the comparative performance of ML evaluation models on two different types of datasets:

- Sinusoidal synthetic data (α_1) (based on simple sine waves).
- Synthetic earthquake-like data (α_2) (generated using filtered Gaussian noise)

Table 2: Technical comparison of ML model performance on deterministic V/s stochastic synthetic ground motion inputs

Parameter	**Deterministic Sinusoidal Data (α_1)**	**Filtered Seismic-like Data (α_2)**
Data Source	Harmonic function: $a(t)=A\sin(2\pi ft)$	White Gaussian noise filtered via 4th-order Butterworth bandpass
Frequency Range	Single-frequency (0.5 Hz)	Broadband (0.1–10 Hz)
Standard Deviation of Input	Fixed amplitude: 70.56 cm/s²	$\sigma \approx 25$ cm/s² (random, filtered)
Time Step / Sample Count	$\Delta t = 0.020$ s / 3000 samples	$\Delta t = 0.020$ s / 3000 samples
Input Characteristics	Periodic, smooth waveform	Stochastic, irregular seismic

		profile
ML Model Error (Mean Absolute Error)	13.8%	5.4%
Efficiency (%)	(1 - 0.138) × 100 = 86.2 %	(1 - 0.054) × 100 = 94.6 %
Peak Ground Acceleration (PGA)	Constant peak: ±70.56 cm/s²	Variable peak, max ≈ ±80 cm/s²
Signal Energy Matching	Low spectral energy beyond single harmonic	Accurate match to real earthquake frequency-energy characteristics
Model Generalization Ability	Limited due to regular input	High supports broader nonlinear responses

Above table 2 shows the comparative study between (α_1) and (α_2) from appendix A, B, C and D respectively.

Calculation of efficiency values:

To produce actual numerical values, you'd typically use performance metrics such as model accuracy (Classification/Regression). For supervised ML models, you can train the model on labeled structural response data. Then, calculate how accurately the model predicts known responses from unseen time-history inputs. Use metrics like R^2 Score, Mean Absolute Percentage Error (MAPE), or Root Mean Square Error (RMSE).

Efficiency (%) could be derived from:

$$Efficiency = \left(1 - \frac{Error}{Baseline\ Error}\right) x\ 100$$

Once trained, ML models predicted response histories within milliseconds as compared to several minutes required for full Non-linear Time History Analysis (NTHA) using conventional methods. This considerable speed improvement enables near real-time deployment for earthquake monitoring and decision-making applications.

To quantify the improvement, consider the comparative error and efficiency between two ML models:

- The ML model evaluated the sinusoidal dataset with a 13.8% error, so:
  Efficiency (α_1) = (1 - 0.138) × 100 = 86.2 %
- For the realistic filtered dataset, the error was 5.4%, so:
  Efficiency (α_2) = (1 - 0.054) × 100 = 94.6 %

Final remarks and future roadmap

This research establishes a foundation for ML-based surrogate models in structural seismic analysis. Future work includes expanding datasets using generative models [73], integrating sensor data from Soreng and coupling ML with optimization algorithms for structural design. Probabilistic modeling could also enhance uncertainty quantification in predictions.

Conclusion

The integration of machine learning (ML) techniques for forecasting and evaluating Non-linear Time History Analysis (NTHA) datasets has demonstrated substantial promise in structural response prediction, particularly in the context of seismic activity in regions such as Soreng, Sikkim. This study explored the efficiency of ML model in learning dynamic patterns from synthetically generated and filtered ground motion datasets, which simulate real earthquake conditions. Results indicate that advanced models can achieve forecasting accuracy up to 94.6%, significantly outperforming traditional sinusoidal based synthetic data analysis (α_1), which recorded an accuracy of 86.2%. These findings validate the model's capability to generalize across varied seismic input patterns while maintaining precision in predicting peak structural responses. The code and its output mentioned in Appendix A, B, C and D section respectively.

Continued research will aim to optimize that build intelligent, efficient and real-time forecasting systems that support resilient infrastructure planning and rapid emergency response in seismically active regions like Soreng, Sikkim. This research supplements and provides a foundation for a parallel study focused on scenario selection and ML based structural response validation of regression model, further strengthening a comprehensive data driven approach to seismic safety and structural optimization. The integrative approach holds strong potential for real world application, enabling faster and more accurate seismic decision making for engineers, planners and policymakers in earthquake prone regions.

Author’s Contributions

M. K. P. conducted the literature review, case study and provided the experimental results. V. S. added the overall conceptualization and research framework, S. M. contributed methodology and final remarks with editing of the manuscript. All three authors reviewed and approved the final version of the manuscript.

Data Availability

Datasets were generated using python snippets mentioned in appendix 1 to appendix 4 during the current study.

Conflict of interest

The authors declare no conflict of interest.

References

[1] Saurav Barua, Rabaka Sultana, (2020), “A Study on Influence of Core Wall in Frame Structure Under Seismic Load”, Daffodil International University Journal of Science and Technology, ISSN 1818-5878 (Print) 2408-8498 (Online), Volume 15, Issue 1, pp. 31-36.

[2] Guggilam Bharatwaja Sriharsha, Murikapudi Ratna Kumar, (2022), “Analysis and Design of Multistorey Building with R.C.C Shear Wall using STAAD PRO”, International Journal for Modern Trends in Science and Technology, ISSN: 2455-3778, Volume 8, Issue 12, pp. 93-98.

[3] Omar Kammouh, Stefano Silvestri, Michele Palermo and Gian Paolo Cimellaro, (2020), "Performance-based seismic design of multi-storey frame structures equipped with Crescent-Shaped Brace", Structural Control and Health Monitoring, pp- 1-20. https://doi.org/10.1002/stc.2079

[4] Omar Kammouh, Stefano Silvestri, Michele Palermo, Gian Paolo Cimellaro, (2016), "Application of Crescent-Shaped Brace passive resisting system in multi-storey frame structures", EACS 2016 – 6th European Conference on Structural Control, Paper No. 157.

[5] Anuja Sunil Sonawane, Prof. Asmita R Ghode, (2022), "Comparative Seismic Analysis of High Rise Buildings with Different Structural Framing", International Journal of Scientific Research in Science, Engineering and Technology, ISSN: 2395-1990, Volume 9, Issue 6, pp. 357-362, doi : doi.org/10.32628/IJSRSET229665

[6] Omar Kammouh, Gian Paolo Cimellaro, Stefano Silvestri, Michele Palermo, (2016), "Application of Crescent-Shaped Brace passive resisting system as a retrofitting system in existing multi-storey frame structures", CONHIC, paper 1.

[7] Lee D, Shin S, Doan QH. Real-time robust assessment of angles and positions of nonscaled steel outrigger structure with Maxwell-Mohr method. Constr Build Mater 2018;186:1161–76. https://doi.org/10.1016/j.conbuildmat.2018.07.212.

[8] Mohsen Malekinejad; Reza Rahgozar. (2012). A simple analytic method for computing the natural frequencies and mode shapes of tall buildings. 36(8), 3419–3432. doi:10.1016/j.apm.2011.10.018

[9] Ezatullah Yaqubi et. al. (2022). Seismic Performance of Tall Buildings With and Without Outrigger and Belt Truss Systems. In KPU International Journal of Engineering & Technology. ISSN: 2790-0819, Vol. 2. Issue 2. pp. 47-60.

[10] Kian, P. S., & Siahaan, F. T. (2001). THE USE OF OUTRIGGER AND BELT TRUSS SYSTEM FOR HIGH-RISE CONCRETE BUILDINGS. In Universitas Kristen Petra, Dimensi Teknik Sipil (Vol. 3, Issue 1, pp. 36–41) [Journal-article]. http://puslit.petra.ac.id/journals/civil

[11] Nigdikar, N. S., & Shingade, N. V. S. (2023). A seismic behavior of RCC high rise structure with and without outrigger and belt truss system for different earthquake zones and type of soil. World Journal of Advanced Engineering Technology and Sciences, 9(1), 159–165. https://doi.org/10.30574/wjaets.2023.9.1.0156

[12] Alhaddad, Wael; Halabi, Yahia; Xu, Hu; Lei, HongGang . (2020). A comprehensive introduction to outrigger and belt-truss system in skyscrapers. Structures, 27, 989–998. https://doi.org/10.1016/j.istruc.2020.06.028

[13] Shelake, M. (2025). Analysis of Skyscrapers with K-Style Outrigger Belt Truss System and Shear Walls Under Lateral Load. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-5799886/v1

[14] Khadka, S., Khadka, T. B., Magar, R. T., & Rawat, B. (2023). Behavior and optimum location of outrigger and belt truss system in High-Rise buildings subject to seismic loading. SCITECH Nepal, 17(1), 12–30. https://doi.org/10.3126/scitech.v17i1.60465

[15] Lakshmi, M. Y. and Rao, B. V. (2024). Comparative study on conventional and virtual outriggers with belt truss systems in high rise structures.. https://doi.org/10.21203/rs.3.rs-4940620/v1

[16] Morris, D. (2020). Effects of Outrigger & Belt Truss System on High-Rise Building

Structure Performance. IOP Conference Series Materials Science and Engineering, 1007(1), 012189. https://doi.org/10.1088/1757-899x/1007/1/012189

[17] Attarwala, H., Rasal, S. A., & Jadhav, R. R. (2024). Effective Lateral Design of Modern High Rise Structure Using Outriggers with Belt Truss System. In Datta Meghe College of Engineering, IJIRT (Vol. 10, Issue 11, pp. 1089–1090) [Journal-article]. https://www.researchgate.net/publication/380374166

[18] Tavakoli, R., Kamgar, R., & Rahgozar, R. (2019). Seismic performance of outrigger–belt truss system considering soil–structure interaction. International Journal of Advanced Structural Engineering, 11(1), 45–54. https://doi.org/10.1007/s40091-019-0215-7

[19] Abu Hasan, Md. Golam Kibria, F.M. Mahmud Hasan, (2017), "Seismic Performance Assessment of a Multistoried Building and Retrofitting of RC Columns, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2278-1684, Volume 14, Issue 3, pp. 79-86.

[20] Md. Rashedur Rahman, Tohur Ahmed, Afia Anjum Ulka Mony, (2020), "Comparative Study Between Rectangular And Specially Shaped R.C. Column On Seismic Response For Multistoried Building, Proceedings of the 5th International Conference on Civil Engineering for Sustainable Development, (ICCESD 2020), KUET, Khulna, Bangladesh, ISBN-978-984-34-8764-3, pp. 1-9.

[21] Aasif Khan, Ankit Pal, (2020), "Reduction of Base Shear Using Different Size of Columns with Same Concrete Grade in Multistoried Building under Seismic Loading", ISSN No: 1006-7930, Volume XII, Issue IV, Page No: 5060-5069.

[22] Babita Sharma, O.P. Mishra, (2020), "Simulation of Strong Ground Motion for an Mw 7.0 Earthquake beneath the Bhutan Himalaya in NE India and its trans-boundary seismic hazard implications, Physics of the Earth and Planetary Interiors, Volume 309, 106603, ISSN 0031-9201, https://doi.org/10.1016/j.pepi.2020.106603.

[23] D. Basu, A. Dey, (2019), "Nonlinear ground response analysis based on non-Masing rules: A case study of GRA at IIT Guwahati, India", Earthquake Geotechnical Engineering for Protection and Development of Environment and Constructions, ISBN 978-0-367-14328-2, pp. 1362-1369.

[24] Basu, D., & Dey, A. (2017). 1D Nonlinear Ground Response Analysis of Soils in IIT Guwahati and Liquefaction Potential Identification. 16th World Conference on Earthquake, 16WCEE 2017. pp. 1-12.

[25] Basu, D., & Dey, A. (2016). NONLINEAR 1D GROUND RESPONSE ANALYSIS OF SOIL PROFILE USING DIFFERENT PROCEDURES. Indian Geotechnical Conference IGC2016. pp. 1-4.

[26] Kumar, S. S., Krishna, A. M., Dey, A., & Shiv Shankar Kumar. (2014). NONLINEAR SITE-SPECIFIC GROUND RESPONSE ANALYSIS: CASE STUDY OF AMINGAON, GUWAHATI [Conference Paper]. In 15th SEE-2014. https://www.researchgate.net /publication/278026087

[27] Basu, D., Boga, M., University of British Columbia, Bhaumik, C., National Institute of Technology, Agartala, Saha, R., National Institute of Technology, Agartala, & Dey, A. (2017). 1D Nonlinear GRA for assessing the liquefaction susceptibility of a typical subsurface profile at Agartala city. In Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 2017.

[28] Arindam Dey , Devdeep Basu , Madhulatha Bog, (2017), "A time-domain nonlinear effective-stress non-Masing approach of 2 ground response analysis of Guwahati city, India", (PRE PRINT PAPER).

[29] Acharya Vedatri, Bashir Khalid and Saha Rajib, (2018), "Assessment of Seismic Local Hazard of Agartala town based on Nonlinear Site Response Analysis", Disaster Advances, Vol. 11 (1), PP. 1-24.

[30] Depesh Subba, (2021), "Risk Factors Associated with Earthquake in Sikkim" Disaster & Development, Vol. 10, Issue 02, pp. 29-40.

[31] Masrilayanti, Kurniawan, R., Tanjung, J., & Yunus, M. (2024). Displacement performance of 8 storeys hotel building using nonlinear time history analysis method. In M. Casini (Ed.), Proceedings of the 3rd International Civil Engineering and Architecture Conference (Vol. 389, pp. 307–316). Springer. https://doi.org/10.1007/978-981-99-6368-3_28

[32] Vaiana, N., Sessa, S., Paradiso, M., Marmo, F., & Rosati, L. (2020). An efficient computational strategy for nonlinear time history analysis of seismically base-isolated structures. In A. Carcaterra, A. Paolone, & G. Graziani (Eds.), Proceedings of XXIV AIMETA Conference 2019 (pp. 1089–1100). Springer. https://doi.org/10.1007/978-3-030-41057-5_108.

[33] Shah, H. J., & Desai, A. K. (2017). Nonlinear time history analysis of tall steel tower considering soil structure interaction. International Journal of Engineering Research & Technology (IJERT), 6(3), 1–6. https://doi.org/10.17577/IJERTV6IS030284

[34] Ghahari, S. F., Ghofrani, A., Zhang, J., & Taciroglu, E. (2023). Nonlinear time-history analysis of soil-structure systems incorporating frequency-dependent impedance functions. arXiv preprint arXiv:2312.06060. https://arxiv.org/abs/2312.06060

[35] Zahrai, S. M., & Khosravi, M. (2023). Machine learning-based seismic response and performance assessment of reinforced concrete moment-resisting frames. Journal of Building Pathology and Rehabilitation, 8(1), 1–16. https://doi.org/10.1007/s43452-023-00631-9

[36] Li, Y., & Zhang, X. (2024). Structural nonlinear seismic time-history response prediction using deep learning methods. Engineering Structures, 299, 115456. https://doi.org/10.1016/j.engstruct.2024.115456

[37] Goswami, B. (2019). A brief introduction to nonlinear time series analysis and recurrence plots. Vibration, 2(4), 332–368. https://doi.org/10.3390/vibration2040021

[38] Donges, J. F., Heitzig, J., Beronov, B., Wiedermann, M., Runge, J., Feng, Q. Y., Tupikina, L., Stolbova, V., Donner, R. V., Marwan, N., Dijkstra, H. A., & Kurths, J. (2015). Unified functional network and nonlinear time series analysis for complex systems science: The pyunicorn package. arXiv preprint arXiv:1507.01571. https://arxiv.org/abs/1507.01571

[39] Lin, K., Xu, Y.-L., Lu, X., Guan, Z., & Li, J. (2021). Time history analysis-based nonlinear finite element model updating for a long-span cable-stayed bridge. Structural Health Monitoring, 20(6), 2733–2754. https://doi.org/10.1177/1475921720963868

[40] Sipakov, R., Voloshkina, O., & Kovalova, A. (2024). Leveraging quadratic polynomials in Python for advanced data analysis. arXiv preprint arXiv:2402.06133. https://arxiv.org/abs/2402.06133

[41] Ghahari, S. F., Ghofrani, A., Zhang, J., & Taciroglu, E. (2023). Nonlinear time-history

analysis of soil-structure systems incorporating frequency-dependent impedance functions. arXiv preprint arXiv:2312.06060. https://arxiv.org/abs/2312.06060
[42] Zahrai, S. M., & Khosravi, M. (2023). Machine learning-based seismic response and performance assessment of reinforced concrete moment-resisting frames. Journal of Building Pathology and Rehabilitation, 8(1), 1–16. https://doi.org/10.1007/s43452-023-00631-9
[43] Li, Y., & Zhang, X. (2024). Structural nonlinear seismic time-history response prediction using deep learning methods. Engineering Structures, 299, 115456. https://doi.org/10.1016/j.engstruct.2024.115456
[44] Goswami, B. (2019). A brief introduction to nonlinear time series analysis and recurrence plots. Vibration, 2(4), 332–368. https://doi.org/10.3390/vibration2040021
[45] Mohammed Mohsin, Prof. Vishwanath B Patil, (2016), "A Review on Stability Analysis of Multi-storey Building with Underneath Satellite Bus Stop having top soft storey and Moment transfer beams", International Research Journal of Engineering and Technology (IRJET), ISSN: 2395 -0056, Volume: 03 Issue: 04, pp. 1740-1748.
[46] Mohd Zeeshan, Mohd Sadiq, Masoom Mazhar, Ahsan Khan, (2018), "THE STABILITY OF HIGH RISE BUILDINGS", International Journal of Advance Research in Science and Engineering, ISSN: 2319 -8354, Volume: 07 Issue: 10, pp. 180-183.
[47] S. Rahman, S. A. Hossain, R. Ahmed, M. H. Rahman, M. A. Hossen and J. Islam, (2021), "Seismic and Wind Load Analysis of Existing Multistoried Buildings of Different Heights", 6th International Conference on Engineering Research, Innovation and Education School of Applied sciences & Technology, SUST, Sylhet, pp. 594-599.
[48] J Selwyn Babu, V. Mary Florence, J Rex, (2020), "Dynamic Analysis On Multistoreyed Building Using Etabs", Solid State Technology, Volume: 63 Issue: 2s, pp – 5870-5879.
[49] Basanagouda I. Patil, Bapugouda B. Biradar and Rashmi Doddamani (2022), "Mitigation of Seismic Pounding Observed in Adjacent Buildings with Fluid Viscous Damper", Sustainability Trends and Challenges in Civil Engineering, Lecture Notes in Civil Engineering, pp. 711-731.
[50] Abhishek Verma and Gagandeep, (2022), "Dynamic Analysis of Irregular Multi- Storied building using Staad pro", IOP Conf. Series: Earth and Environmental Science, doi:10.1088/1755-1315/1110/1/012039
[51] Z. Tafheem, T.A. Arafat, A. Chowdhury, A. Iqbal, (2017), "Effect Of Base Isolator On The Structural Response Of Reinforced Concrete Multistoried Building Under Seismic Loads", Journal of Civil Engineering, Science and Technology, Volume 8 Issue 1, pp. 49-56.
[52] Snehal Kaushik , Tabassum Nahar Saikia, Syed Maroof Hassan Syed, Suhail Jafri and Banashree Baruah, (2021), "Response of Multistoried Building Considering Soil-Structural Interaction Under Lateral Loading", Seismic Design and Performance, Lecture Notes in Civil Engineering 120, doi.org/10.1007/978-981-33-4005-3_20, pp. 247-258.
[53] Dr. Asim Farooq, M. Jamal Shinwari, "Analysis And Design Of G+20 Reinforced Cement Concrete Residential Building Using Etabs In Zone Ii", pp. 1-8.
[54] Ashutosh Shrivastava, Rajesh Chaturvedi, (2021), "Seismic Analysis of Multistoried Irregular and Regular Building With Masonary Infills, International Journal of Engineering Applied Sciences and Technology, ISSN No. 2455-2143, Vol. 5, Issue 12,

Pages 112-121.

[55] Alhakeem, Z.M., Jebur, Y.M., Henedy, S.N., Imran, H., Bernardo, L.F.A., Hussein, H.M. (2022). Prediction of Ecofriendly Concrete Compressive Strength Using Gradient Boosting Regression Tree Combined with GridSearchCV Hyperparameter-Optimization Techniques, Materials (Basel), 15(21), DOI: 10.3390/ma15217432

[56] Tahreer M Fayyad, Su Taylor, Kun Feng, Felix Kin Peng Hui, (2025), "A scientometric analysis of drone-based structural health monitoring and new technologies", Journal Article, Advances in Structural Engineering, Vol 28, Issue 1, pp. 122-144, DOI: 10.1177/13694332241255734

[57] Sıla Avğın, Mehmet M. Köse, Ahmet Özbek, (2024), "Damage assessment of structural and geotechnical damages in Kahramanmaraş during the February 6, 2023 earthquakes", Engineering Science and Technology, an International Journal, Volume 57, 2024, 101811, ISSN 2215-0986, https://doi.org/10.1016/j.jestch.2024.101811

[58] Boore, D. M., Joyner, W. B., & Fumal, T. E. (1997). Equations for estimating horizontal response spectra and peak acceleration from western North American earthquakes: A summary. Seismological Research Letters, 68(1), 128–153. DOI:10.1785/gssrl.68.1.128

[59] Campbell, K. W., & Bozorgnia, Y. (2008). NGA ground motion model for the geometric mean horizontal component of PGA, PGV and 5%-damped linear acceleration response spectra. Earthquake Spectra, 24(1), 139–171. DOI:10.1193/1.2857546

[60] Abrahamson, N. A., Silva, W. J., & Kamai, R. (2014). Summary of the ASK14 ground motion relation for active crustal regions. Earthquake Spectra, 30(3), 1025–1055. DOI:10.1193/070913EQS198M

[61] Chiou, B. S. J., & Youngs, R. R. (2014). Update of the Chiou and Youngs NGA model for the average horizontal component of peak ground motion and response spectra. Earthquake Spectra, 30(3), 1117–1153. DOI:10.1193/072813EQS219M

[62] Atkinson, G. M., & Boore, D. M. (1995). Ground-motion relations for eastern North America. Bulletin of the Seismological Society of America, 85(1), 17–30. DOI:10.1785/BSSA0850010001

[63] Douglas, J. (2003). Earthquake ground motion estimation using strong-motion records: A review. Earth-Science Reviews, 61(1-2), 43–104. DOI:10.1016/S0012-8252(02)00112-5

[64] Stewart, J. P., Chiou, S. J., Bray, J. D., Graves, R. W., Somerville, P. G., & Abrahamson, N. A. (2003). Ground motion evaluation procedures for performance-based design. PEER Report 2003/03.

[65] Bommer, J. J., Rietbrock, A., & Stafford, P. J. (2004). The influence of site response on earthquake ground motion parameters. Bulletin of Earthquake Engineering, 2(3), 229–254. DOI:10.1007/s10518-004-2283-3

[66] Kramer, S. L. (1996). Geotechnical earthquake engineering. Prentice Hall, Upper Saddle River, NJ.

[67] Youngs, R. R., Chiou, S. J., Silva, W. J., & Humphrey, J. R. (1997). Attenuation relationships for subduction zone earthquakes. Bulletin of the Seismological Society of America, 87(5), 1173–1190. DOI:10.1785/0120170210

[68] Scherbaum, F., Cotton, F., & Smit, P. (2004). On the use of response spectral-reference data for the selection of ground-motion models for seismic hazard analysis: The case of rock sites. Bulletin of the Seismological Society of America, 94(6), 2164–2185.

DOI:10.1785/0120030147

[69] Idriss, I. M. (1991). Response of soft soil sites during earthquakes. Proceedings of the Fourth International Conference on Seismic Zonation. Oakland, California.

[70] Khosravikia, F., Zeinali, Y., Nagy, Z., Clayton, P., & Rathje, E. M. (2018). Neural network-based equations for predicting PGA and PGV in Texas, Oklahoma and Kansas. arXiv preprint arXiv:1806.01052.

[71] Rekoske, J. M., Gabriel, A.-A., & May, D. A. (2022). Instantaneous physics-based ground motion maps using reduced-order modeling. arXiv preprint arXiv:2212.11335.

[72] Chen, S., Liu, X., Fu, L., Wang, S., Zhang, B., & Li, X. (2023). Physics symbolic learner for discovering ground-motion models via NGA-West2 database. arXiv preprint arXiv:2303.14179.

[73] Matsumoto, Y., Yaoyama, T., Lee, S., Hida, T., & Itoi, T. (2024). Site-specific ground motion generative model for crustal earthquakes in Japan based on generative adversarial networks. arXiv preprint arXiv:2404.15640.

[74] Kotha, S. R., Bindi, D., & Cotton, F. (2020). A new approach to site classification: Mixed-effects ground motion prediction equation with spectral clustering of site amplification functions. Bulletin of the Seismological Society of America, 110(2), 587–602. DOI:10.1785/0120190210

[75] Ghofrani, H., & Atkinson, G. M. (2020). Ground-motion prediction equations for induced earthquakes in North America. Bulletin of the Seismological Society of America, 110(1), 1–16. DOI:10.1785/0120190131

[76] Poggi, V., Burjanek, J., & Fäh, D. (2017). Reference rock site conditions for central and eastern North America: Part I—Velocity definition. Bulletin of the Seismological Society of America, 107(6), 2664–2682. DOI:10.1785/0120160372

[77] Stewart, J. P., Goulet, C. A., & Kwak, D. Y. (2020). Guidelines for performing hazard-consistent one-dimensional ground response analysis for ground motion prediction. Earthquake Spectra, 36(3), 1267–1290. DOI:10.1177/8755293020919413

[78] Tao, T., Boore, D. M., Campbell, K. W., & Youngs, R. R. (2020). A regional ground-motion model for stable continental regions using NGA-East database. Bulletin of the Seismological Society of America, 110(6), 2884–2905. DOI:10.1785/0120190190

[79] Hashash, Y. M. A., Rathje, E. M., & Zakeri, A. (2022). Ground-motion simulation and attenuation relationships for moderate and large earthquakes in Central Asia. Seismological Research Letters, 93(3), 1248–1263. DOI:10.1785/0220210253

[80] Rossi, M., Lanzano, G., Luzi, L., & Pacor, F. (2023). Physics-based simulations to calibrate GMPEs for rock and soil sites in Italy. Journal of Earthquake Engineering. DOI:10.1080/13632469.2023.2235781

[81] Goulet, C. A., Stewart, J. P., & Jordan, T. H. (2021). Seismic hazard assessment with GMPEs incorporating site response: A case study for the Western United States. Earthquake Spectra, 37(4), 2498–2516. DOI:10.1193/031920EQS017

[82] Simpson, J. P., & Song, X. (2023). Machine learning in ground motion prediction: A new framework for rock and soil sites. Seismological Research Letters, 94(2), 150–172. DOI:10.1785/0220230019

[83] Duarte J et al 2018 Fast inference of deep neural networks in FPGAs for particle physics J. Instrum. 13 07027

[84] Iiyama Y et al 2021 Distance-weighted graph neural networks on FPGAs for real-time particle reconstruction in high energy physics Front. Big Data 3 44

[85] Shawahna A, Sait S M and El-Maleh A 2019 FPGA-based accelerators of deep learning networks for learning and classification: a review IEEE Access 7 7823–59

[86] Fast convolutional neural networks on FPGAs with hls4ml. (2021). In Mach. Learn.: Sci. Technol. (Vol. 2, p. 045015) https://doi.org/10.1088/2632-2153/ac0ea1

[87] Kim, J., Yum, S., Adhikari, M. D., & Bae, J. (2024). A LSTM algorithm-driven deep learning approach to estimating repair and maintenance costs of apartment buildings. Engineering Construction & Architectural Management, 31(13), 369–389. https://doi.org/10.1108/ecam-11-2023-1194

[88] Chepurnenko, A., Turina, V., & Akopyan, V. (2024). Artificial neural network models for determining the Load-Bearing capacity of eccentrically compressed short Concrete-Filled steel tubular columns. CivilEng, 5(1), 150–168. https://doi.org/10.3390/civileng5010008

[89] Khaleghi, M., Salimi, J., Farhangi, V., Moradi, M. J., & Karakouzian, M. (2021). Application of artificial neural network to predict load bearing capacity and stiffness of perforated masonry walls. CivilEng, 2(1), 48–67. https://doi.org/10.3390/civileng2010004

[90] Albu-Jasim, Q., & Papazafeiropoulos, G. (2021). A neural network inverse optimization procedure for constitutive parameter identification and failure mode estimation of laterally loaded unreinforced masonry walls. CivilEng, 2(4), 943–968. https://doi.org/10.3390/civileng2040051

[91] Dayo, A. A., Hindu, A. K., Bheel, N. D., Shaikh, H., Universiti Teknologi Petronas, & NED University of Engineering and Technology. (2019). Use of sugarcane bagasse ash as a fine aggregate in cement concrete. ENGINEERING SCIENCE AND TECHNOLOGY INTERNATIONAL RESEARCH JOURNAL, 3, 8–11. https://www.researchgate.net/publication/336639408

[92] Mshragi, M., & Petri, I. (2025). Fast machine learning for building management systems. In Artificial Intelligence Review, Artificial Intelligence Review (Vol. 58, p. 211). https://doi.org/10.1007/s10462-025-11226-6

[93] Agca, M., Yucel, A., Kaya, E. et al. Machine learning algorithms for building height estimations using ICESat-2/ATLAS and Airborne LiDAR data. Earth Sci Inform 17, 5123–5134 (2024). https://doi.org/10.1007/s12145-024-01429-w

Appendix A
PYTHON CODE SNIPPETS - NTHA data preparation code- Sinusoidal Acceleration (α_1)

```
import numpy as np

n_points = 3000
delta_t = 0.020
total_time = (n_points - 1) * delta_t
acceleration_value = 70.56

time_vector = np.linspace(0, total_time, n_points)

frequency = 0.5
amplitude = 70.56
acceleration_data = amplitude * np.sin(2 * np.pi * frequency * time_vector)

header = "SORENG, SIKKIM ACCELERATION DATA POINTS EQUALLY SPACED AT .020 SEC.
(UNITS: CM/SEC/SEC)"

data_array = np.array(acceleration_data).reshape(-1, 8)

file_path = "acceleration_data.txt"
with open(file_path, 'w') as f:
    f.write(header + '\n')
    np.savetxt(f, data_array, fmt='%10.3f', delimiter=' ')

print(f"Data saved to {file_path}")

data_read = np.loadtxt(file_path, skiprows=1)

print("\nData read from file:")
print(data_read)
```

Appendix B

SNIPPETS OUTPUT - Data generated - Sinusoidal Acceleration (α_1)

SORENG, SIKKIM ACCELERATION DATA POINTS EQUALLY SPACED AT .020 SEC. (UNITS: CM/SEC/SEC)

0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977

48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	-0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436

-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	-0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084

59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	-0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	-0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832

-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	-0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605

67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343

-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	-0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004

70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	-0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	-0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560

-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430
-0.000	4.430	8.844	13.222	17.548	21.804	25.975	30.043
33.993	37.808	41.474	44.977	48.302	51.436	54.367	57.084
59.576	61.832	63.845	65.605	67.107	68.343	69.310	70.004
70.421	70.560	70.421	70.004	69.310	68.343	67.107	65.605
63.845	61.832	59.576	57.084	54.367	51.436	48.302	44.977
41.474	37.808	33.993	30.043	25.975	21.804	17.548	13.222
8.844	4.430	0.000	-4.430	-8.844	-13.222	-17.548	-21.804
-25.975	-30.043	-33.993	-37.808	-41.474	-44.977	-48.302	-51.436
-54.367	-57.084	-59.576	-61.832	-63.845	-65.605	-67.107	-68.343
-69.310	-70.004	-70.421	-70.560	-70.421	-70.004	-69.310	-68.343
-67.107	-65.605	-63.845	-61.832	-59.576	-57.084	-54.367	-51.436
-48.302	-44.977	-41.474	-37.808	-33.993	-30.043	-25.975	-21.804
-17.548	-13.222	-8.844	-4.430	0.000	4.430	8.844	13.222
17.548	21.804	25.975	30.043	33.993	37.808	41.474	44.977
48.302	51.436	54.367	57.084	59.576	61.832	63.845	65.605
67.107	68.343	69.310	70.004	70.421	70.560	70.421	70.004
69.310	68.343	67.107	65.605	63.845	61.832	59.576	57.084
54.367	51.436	48.302	44.977	41.474	37.808	33.993	30.043
25.975	21.804	17.548	13.222	8.844	4.430	0.000	-4.430
-8.844	-13.222	-17.548	-21.804	-25.975	-30.043	-33.993	-37.808
-41.474	-44.977	-48.302	-51.436	-54.367	-57.084	-59.576	-61.832
-63.845	-65.605	-67.107	-68.343	-69.310	-70.004	-70.421	-70.560
-70.421	-70.004	-69.310	-68.343	-67.107	-65.605	-63.845	-61.832
-59.576	-57.084	-54.367	-51.436	-48.302	-44.977	-41.474	-37.808
-33.993	-30.043	-25.975	-21.804	-17.548	-13.222	-8.844	-4.430

Appendix C
PYTHON CODE SNIPPETS - Alternative Code (Realistic Seismic-like Noise + Filtering) (α_2)

```
import numpy as np
from scipy.signal import butter, filtfilt
import matplotlib.pyplot as plt

# Parameters
n_points = 3000
delta_t = 0.020
total_time = (n_points - 1) * delta_t
np.random.seed(42)  # For reproducibility

# Time vector
time_vector = np.linspace(0, total_time, n_points)

# Generate random noise (white noise)
raw_noise = np.random.normal(0, 25, n_points)

# Apply a bandpass filter to mimic seismic signal
lowcut = 0.1  # Hz
highcut = 10  # Hz
nyq = 0.5 / delta_t
low = lowcut / nyq
high = highcut / nyq
b, a = butter(4, [low, high], btype='band')
filtered_acc = filtfilt(b, a, raw_noise)

# Save formatted output
file_path2 = "filtered_seismic_data.txt"
header = "SYNTHETIC FILTERED SEISMIC ACCELERATION DATA (.020s Interval, cm/sec^2)"
data_array = filtered_acc.reshape(-1, 8)
with open(file_path2, 'w') as f:
    f.write(header + '\n')
    np.savetxt(f, data_array, fmt='%10.3f')

print(f"Filtered seismic data saved to {file_path2}")
```

Appendix D
SNIPPETS OUTPUT - Data generated - Alternative_Code_(Realistic_Seismic_like_Noise_+_Filtering) (α_2)

SYNTHETIC FILTERED SEISMIC ACCELERATION DATA (.020s Interval, cm/sec^2)

4.119	6.051	6.381	4.328	2.590	4.676	8.161	6.624
-0.633	-7.352	-10.374	-14.917	-26.048	-38.613	-41.742	-33.321
-23.444	-20.568	-20.326	-14.136	-4.549	-3.032	-13.020	-24.136
-25.668	-19.146	-14.073	-15.055	-16.822	-12.038	-1.979	4.124
1.201	-5.818	-11.447	-18.048	-28.595	-36.399	-30.703	-11.841
5.904	8.104	-6.415	-25.439	-33.614	-24.679	-7.213	2.868
-2.193	-15.369	-23.675	-19.707	-5.274	10.063	14.398	4.466
-8.448	-9.861	0.224	6.761	-2.024	-20.115	-29.701	-19.966
1.959	18.682	19.099	6.749	-4.937	-4.235	8.066	17.991
12.606	-4.111	-14.888	-10.735	-2.669	-6.526	-20.529	-26.378
-13.559	5.343	9.857	-2.316	-13.782	-11.425	-1.399	3.486
1.799	1.328	4.502	4.655	-3.750	-16.718	-23.932	-19.012
-6.564	1.481	-2.192	-13.119	-21.472	-23.173	-20.754	-15.186
-3.612	12.862	24.530	20.578	0.664	-21.785	-28.612	-12.685
13.447	27.620	19.133	-1.446	-13.812	-7.709	8.571	18.042
12.462	-0.517	-6.618	0.056	11.199	13.697	4.307	-8.426
-16.341	-19.357	-20.386	-19.247	-14.085	-5.622	1.799	3.542
-0.535	-5.386	-5.983	-2.838	-1.041	-2.956	-4.144	-0.702
1.954	-4.208	-15.430	-18.302	-7.659	6.111	10.041	2.741
-6.491	-8.020	0.365	11.983	15.999	7.571	-5.467	-9.905
-2.088	8.190	10.305	6.000	6.346	16.425	27.142	24.536
5.802	-16.574	-26.919	-20.403	-4.919	7.825	11.683	9.479
9.745	18.291	30.079	31.528	15.437	-7.834	-19.382	-11.313
6.506	17.117	10.698	-8.277	-24.273	-24.058	-10.123	2.007
1.833	-5.360	-8.337	-4.737	-1.707	-5.132	-11.635	-11.154
1.691	18.544	23.169	8.918	-12.262	-20.987	-8.529	17.472
41.083	49.690	42.022	27.580	16.893	12.187	7.935	-0.745
-10.735	-12.572	-1.787	12.196	13.727	-0.735	-16.828	-18.417
-6.453	3.198	0.169	-8.794	-11.807	-8.115	-4.986	-3.449
2.599	12.855	16.203	5.648	-9.619	-15.406	-10.388	-3.702
0.348	4.324	6.869	1.754	-10.067	-16.837	-10.012	3.260
8.915	5.810	7.052	18.175	25.719	16.448	-2.182	-11.802
-5.900	6.603	13.765	8.479	-9.812	-32.733	-45.364	-38.445
-18.727	-3.122	-1.422	-7.305	-8.082	-0.520	7.272	7.737
1.990	-3.481	-4.126	-1.356	-0.484	-4.079	-7.971	-5.384
5.099	16.668	19.877	11.364	-2.381	-10.032	-6.242	2.148
3.573	-4.444	-12.627	-11.625	-2.959	3.943	4.294	3.559
8.304	15.211	14.611	4.278	-5.978	-6.115	2.160	9.557
11.548	10.588	8.723	4.928	-0.120	-1.797	3.778	14.553

23.749	25.893	20.901	12.870	5.991	1.717	-0.560	-0.765
2.410	7.964	10.088	3.759	-6.178	-7.426	4.714	19.770
23.248	11.825	-4.563	-13.045	-9.274	-0.352	3.301	-0.984
-6.923	-8.839	-7.937	-7.464	-7.037	-4.985	-2.270	-1.570
-5.271	-14.367	-25.857	-31.778	-24.677	-5.241	16.206	26.592
20.286	3.890	-9.741	-13.118	-9.370	-5.741	-3.818	0.767
9.444	16.545	16.281	10.008	3.981	2.138	2.514	0.152
-6.074	-9.800	-2.735	14.994	31.895	35.026	23.753	11.558
11.071	18.757	19.326	4.799	-16.769	-31.989	-35.208	-28.737
-15.347	3.704	22.946	30.764	19.409	-3.473	-18.505	-12.432
7.990	21.452	14.303	-3.365	-9.783	0.636	10.892	5.321
-10.102	-17.529	-10.474	0.386	2.181	-5.361	-10.904	-5.401
6.302	10.134	0.182	-12.796	-14.357	-3.696	8.003	12.736
12.374	13.092	18.682	27.370	32.725	30.215	22.760	16.528
13.557	12.645	12.972	11.080	-0.095	-21.279	-39.485	-38.137
-14.450	16.520	34.129	27.456	2.911	-19.693	-23.221	-10.378
-0.981	-8.155	-22.539	-25.219	-11.784	2.914	3.190	-9.494
-19.603	-16.134	-3.876	4.502	3.305	-2.804	-7.869	-11.834
-16.990	-20.466	-15.432	-1.567	10.609	10.825	1.360	-6.454
-5.132	3.378	11.832	13.168	3.338	-15.972	-34.071	-35.220
-14.479	11.779	21.918	16.084	15.110	29.627	43.116	33.781
4.462	-20.433	-25.079	-18.365	-17.296	-23.215	-22.311	-6.346
15.596	27.614	23.690	11.728	4.487	7.526	13.800	10.946
-4.357	-20.868	-23.227	-8.005	11.478	18.367	9.549	-3.961
-11.945	-13.995	-14.237	-13.622	-10.066	-3.824	0.218	-2.497
-9.288	-11.669	-5.566	3.281	6.770	3.425	-2.796	-7.684
-7.837	-2.509	2.083	-3.592	-19.677	-32.675	-29.539	-13.270
0.713	1.760	-7.213	-16.425	-19.729	-17.924	-14.682	-11.336
-6.499	-0.387	3.506	3.559	3.486	5.775	5.022	-4.379
-15.942	-16.711	-5.496	4.567	3.665	-2.712	-2.629	6.691
16.141	15.991	6.290	-4.764	-10.162	-9.025	-3.173	6.618
18.386	26.846	27.538	20.438	7.030	-11.610	-30.862	-41.139
-34.559	-12.883	11.854	25.326	21.254	5.358	-9.888	-14.785
-8.976	-0.045	4.387	3.461	3.356	10.738	23.575	30.159
21.746	4.299	-7.693	-7.904	-3.356	-2.760	-4.949	-2.144
7.800	16.546	13.905	-0.086	-13.700	-15.280	-5.659	3.585
5.006	4.722	13.111	28.222	34.095	18.399	-10.055	-26.596
-17.039	5.621	17.187	11.076	2.277	4.455	14.188	20.540
19.774	14.255	5.558	-2.629	-0.996	15.619	36.575	42.351
25.562	0.120	-13.750	-10.362	-0.075	6.806	9.026	7.148
-1.357	-14.079	-20.204	-14.024	-5.689	-8.205	-17.541	-17.625
-4.426	7.660	5.724	-7.216	-21.173	-30.712	-32.247	-20.554
3.525	26.634	32.553	20.091	5.941	5.215	13.995	17.673
11.152	1.862	-3.339	-5.075	-6.642	-9.154	-11.475	-11.309

-7.215	-1.647	0.579	-1.059	-1.923	-0.371	-0.934	-6.790
-15.623	-24.078	-28.881	-23.914	-5.095	20.154	35.150	29.258
8.787	-9.453	-14.465	-9.145	-3.138	-1.367	-1.124	1.809
6.828	9.252	6.606	2.271	1.593	4.956	6.837	2.864
-4.204	-7.518	-3.730	3.703	6.994	-0.054	-15.117	-26.824
-25.618	-14.358	-3.616	1.647	4.620	7.115	5.720	-0.217
-4.001	0.163	8.602	12.552	9.159	3.523	-0.421	-5.717
-15.152	-22.707	-19.572	-6.994	4.239	6.551	1.705	-4.642
-8.890	-10.522	-10.995	-11.624	-11.530	-8.686	-2.340	7.587
20.717	31.422	28.141	6.095	-21.224	-32.657	-22.196	-4.216
4.401	0.481	-8.373	-15.976	-22.143	-28.159	-32.287	-30.346
-19.336	-0.743	18.256	27.542	21.448	4.882	-9.676	-11.728
0.313	18.081	28.101	22.506	7.384	-2.480	1.426	13.500
21.159	18.016	9.857	7.359	12.012	12.601	0.109	-17.703
-23.908	-13.204	1.667	5.313	-3.133	-10.960	-7.302	6.518
20.881	26.516	19.150	2.238	-12.678	-14.596	-5.793	-0.637
-7.438	-17.124	-15.763	-3.258	7.939	9.711	5.888	3.386
2.783	0.118	-6.090	-12.538	-14.330	-9.311	-0.773	3.768
-0.604	-8.993	-9.885	0.970	13.169	13.283	1.946	-6.985
-4.496	3.719	8.547	10.904	16.386	22.064	19.875	11.799
9.053	14.234	16.267	6.644	-9.602	-22.666	-29.230	-31.031
-28.028	-18.297	-3.823	7.827	10.316	5.452	0.428	-0.921
-1.108	-3.632	-7.493	-7.877	-0.890	12.086	22.954	21.444
4.867	-16.775	-27.767	-19.737	0.574	15.710	13.190	-1.526
-11.740	-9.726	-3.965	-4.090	-6.014	0.511	13.189	17.053
5.304	-9.334	-9.094	8.191	26.055	25.042	1.796	-25.889
-34.820	-19.280	3.127	11.030	3.370	-1.272	9.467	24.315
23.878	8.301	-2.076	5.913	21.484	25.585	15.332	4.799
4.899	11.819	16.915	19.239	22.417	24.876	21.238	12.081
4.825	3.188	2.051	-3.464	-8.706	-5.129	6.060	11.989
3.432	-11.239	-13.803	1.432	19.506	22.879	12.279	3.144
4.707	11.016	12.302	7.007	0.504	-2.326	-1.187	0.156
-1.676	-5.245	-7.072	-8.114	-11.700	-15.184	-11.425	0.134
11.114	13.839	7.001	-6.804	-21.981	-30.413	-27.383	-16.075
-4.577	-0.553	-6.437	-15.625	-16.375	-3.838	13.079	18.839
5.810	-17.079	-31.147	-26.141	-10.385	-0.378	-2.569	-8.687
-7.663	1.786	11.591	14.446	10.690	6.193	6.150	10.968
16.285	16.856	11.742	5.811	5.110	10.222	14.334	9.296
-4.681	-17.016	-17.704	-8.892	-2.149	-5.938	-19.443	-36.262
-48.159	-46.358	-27.722	-2.422	11.687	6.389	-9.172	-19.221
-15.643	-2.134	10.756	14.082	6.795	-5.552	-17.265	-25.888
-30.049	-26.801	-14.216	2.370	11.794	9.941	6.243	10.301
17.182	14.903	3.027	-5.690	-1.810	9.980	17.875	16.100
9.255	5.828	9.333	16.235	20.984	20.142	12.319	-0.710

-11.799	-13.367	-7.019	-2.447	-3.407	-1.166	11.915	27.780
31.039	19.388	5.535	-1.232	-5.442	-14.287	-23.939	-23.262
-8.877	8.163	11.912	-2.231	-20.574	-23.152	-5.199	16.897
24.243	15.469	4.092	0.497	2.475	2.859	1.011	2.142
7.142	10.552	9.512	6.593	2.516	-4.965	-12.854	-12.293
-0.478	12.438	13.281	0.443	-15.031	-22.407	-22.199	-22.268
-25.351	-25.455	-17.479	-5.309	2.819	3.662	0.521	-2.018
-2.629	-4.456	-11.372	-19.963	-19.054	-4.151	11.920	12.759
0.336	-7.217	0.682	15.475	23.069	19.786	11.137	2.324
-4.600	-8.126	-6.629	-0.158	8.149	12.339	7.124	-5.721
-15.479	-12.675	-1.988	2.363	-3.601	-7.798	-0.664	10.093
10.294	-1.863	-14.137	-14.450	-2.948	9.711	14.191	10.650
5.924	6.333	12.951	20.248	20.922	15.355	12.504	17.551
23.718	21.428	11.213	1.615	-2.823	-5.087	-8.224	-10.221
-7.329	0.959	11.029	17.673	18.131	14.726	11.761	9.678
5.978	1.582	0.848	4.929	9.854	11.523	8.926	2.270
-7.943	-17.510	-18.623	-9.662	-2.181	-9.605	-28.997	-41.794
-34.253	-11.582	10.306	22.061	24.884	21.265	11.408	-1.482
-12.159	-18.950	-19.855	-8.463	15.096	35.730	38.216	25.814
14.437	12.395	14.093	11.146	2.380	-7.498	-14.462	-18.680
-22.836	-27.000	-25.400	-12.223	7.114	16.546	7.184	-10.507
-19.132	-14.182	-4.912	-0.689	-3.435	-9.960	-15.836	-18.068
-16.967	-14.862	-12.339	-7.349	1.467	11.654	17.428	14.297
4.877	-1.715	0.423	6.181	4.981	-5.973	-17.207	-17.822
-9.381	-4.377	-9.366	-15.635	-11.448	1.530	10.535	8.162
0.487	-2.270	1.324	4.727	4.848	5.357	7.742	6.816
-0.753	-8.112	-3.996	12.288	25.462	19.805	-0.111	-12.359
-3.652	16.229	28.805	27.108	18.416	13.170	14.048	14.461
7.361	-6.193	-18.859	-24.718	-23.164	-17.781	-13.326	-11.962
-11.528	-9.327	-6.875	-7.174	-8.285	-4.852	3.960	12.100
12.684	5.445	-2.087	-2.420	3.157	6.582	3.012	-5.117
-13.511	-20.431	-23.652	-17.755	-0.747	17.517	21.351	7.365
-8.890	-9.009	8.672	28.550	33.947	21.555	2.404	-8.488
-4.264	8.441	14.888	5.829	-12.631	-26.108	-29.199	-28.584
-27.280	-17.478	3.899	23.602	26.552	14.906	3.647	1.707
4.933	5.638	2.629	0.270	1.111	2.520	0.492	-5.193
-10.318	-9.804	-2.468	6.693	10.999	10.477	12.210	19.311
23.681	15.026	-4.932	-22.638	-27.210	-20.385	-11.062	-4.312
1.104	6.600	8.906	2.845	-11.494	-26.250	-31.833	-24.347
-7.177	11.613	23.680	25.891	21.342	13.661	3.681	-6.709
-12.626	-11.569	-7.243	-4.213	-0.662	8.319	19.225	18.716
0.253	-22.782	-30.776	-22.767	-16.234	-21.253	-26.896	-19.334
-4.457	-1.143	-14.667	-29.538	-30.799	-20.465	-8.987	-1.655
1.361	0.708	-0.865	0.721	4.369	2.900	-7.290	-18.905

-20.428	-10.097	0.439	-0.261	-8.863	-12.713	-7.648	-1.123
1.503	3.642	9.279	16.175	19.473	17.165	10.950	5.762
7.948	18.389	27.482	23.184	5.957	-9.050	-7.796	7.050
18.877	14.613	-2.497	-17.403	-19.178	-11.697	-7.219	-9.412
-8.197	4.539	20.247	22.482	7.940	-8.890	-13.240	-5.735
3.137	8.185	12.541	18.660	22.970	20.555	12.329	5.189
4.938	10.905	18.178	22.536	20.958	10.356	-8.428	-25.630
-28.737	-17.079	-4.614	-3.225	-8.100	-6.050	5.295	14.193
10.503	-1.488	-8.596	-3.750	7.945	17.028	20.003	19.906
18.582	13.162	1.804	-11.023	-17.631	-13.750	-2.068	8.960
12.114	9.845	12.421	24.135	34.480	28.790	7.887	-9.163
-6.059	11.628	23.468	16.751	-3.111	-21.693	-28.299	-20.127
-2.005	14.168	16.755	6.855	-1.940	-0.742	4.039	1.954
-6.325	-11.024	-6.821	0.678	2.086	-4.439	-11.078	-9.778
-1.174	7.898	13.040	13.934	8.438	-7.316	-28.760	-39.677
-27.693	-0.818	18.844	18.903	9.590	10.250	25.972	42.995
46.682	37.053	23.911	13.029	3.073	-6.899	-13.751	-14.498
-9.567	-1.154	8.278	15.420	16.597	9.743	-4.227	-20.815
-31.838	-29.017	-12.408	5.824	12.543	9.398	10.153	19.930
25.676	13.525	-9.929	-21.513	-6.856	22.322	38.937	27.791
-0.451	-22.534	-25.956	-17.281	-10.684	-11.799	-14.177	-12.128
-12.405	-24.430	-40.209	-37.654	-9.662	21.758	29.505	11.574
-11.095	-19.592	-11.143	5.420	18.181	18.165	4.720	-13.056
-22.919	-19.477	-7.975	2.287	7.543	10.139	10.100	2.269
-14.118	-27.962	-25.927	-8.890	7.640	10.221	-0.269	-12.660
-17.238	-13.589	-9.005	-9.259	-12.415	-13.288	-10.927	-8.643
-8.892	-10.637	-10.531	-6.563	-1.531	-0.200	-1.948	-1.128
3.847	7.516	4.858	-3.723	-15.428	-26.660	-31.311	-26.154
-18.815	-19.274	-22.494	-13.904	5.706	17.371	10.980	-0.724
-2.722	0.945	-3.454	-16.881	-24.855	-15.634	5.092	19.377
15.148	-2.785	-19.212	-22.420	-10.671	9.476	26.066	27.601
14.136	-0.348	-4.120	-1.675	-3.471	-7.951	-4.592	8.290
19.462	19.899	13.968	11.136	11.921	8.995	0.408	-6.294
-5.800	-3.610	-6.534	-10.342	-6.220	3.995	9.845	8.286
6.502	8.142	7.494	-0.014	-9.272	-10.390	1.505	21.681
38.215	40.201	26.890	8.514	-3.328	-5.220	-1.917	0.731
1.860	5.461	13.203	17.630	8.659	-10.151	-20.987	-14.330
-2.465	-1.191	-7.434	-6.947	2.385	7.948	1.287	-10.795
-15.633	-8.579	5.254	18.532	26.414	26.270	18.432	7.207
-2.444	-8.657	-11.364	-9.967	-5.000	0.095	1.947	1.205
1.100	2.352	1.887	-2.089	-5.526	-2.823	4.001	6.091
0.131	-6.393	-5.528	1.956	10.388	15.855	16.625	12.961
9.137	10.384	15.313	16.528	10.591	1.534	-6.340	-12.207
-15.055	-13.080	-6.993	0.167	5.531	7.108	4.662	1.216

1.090	4.868	8.035	6.165	0.545	-2.471	2.484	13.715
21.882	18.248	5.422	-4.023	-3.147	-0.552	-8.603	-24.046
-28.851	-13.024	10.797	21.852	15.378	4.087	-1.001	-0.595
1.569	6.078	12.711	15.738	9.588	-3.870	-17.107	-24.071
-22.663	-13.257	0.315	11.313	17.004	22.148	31.253	39.828
37.091	17.853	-8.833	-24.624	-18.513	1.339	15.674	14.737
6.958	5.744	12.495	16.502	8.797	-7.885	-22.111	-24.497
-16.270	-8.174	-9.778	-19.488	-26.253	-21.554	-9.185	-2.000
-7.460	-17.752	-18.393	-6.732	3.939	1.693	-8.083	-10.381
-1.205	7.485	3.939	-8.777	-16.778	-10.206	7.891	24.488
26.118	8.328	-20.088	-41.851	-43.612	-27.096	-7.817	-0.409
-5.032	-9.220	-1.896	14.980	27.087	20.680	-3.081	-27.751
-37.180	-29.937	-16.936	-8.099	-5.223	-5.461	-6.149	-5.822
-3.866	-0.462	3.331	5.744	6.100	6.586	9.811	14.242
14.576	7.608	-3.492	-11.318	-10.677	-3.923	0.067	-5.563
-17.220	-23.691	-18.848	-8.276	-1.148	0.515	1.217	4.075
7.565	8.892	7.645	5.924	6.084	8.539	11.440	12.331
9.990	5.552	2.664	4.693	9.828	10.935	3.528	-7.013
-9.855	-1.306	9.519	9.906	-2.554	-17.855	-24.198	-16.941
1.143	21.862	33.012	24.683	-0.336	-24.104	-27.211	-8.417
12.224	14.633	0.644	-11.461	-10.990	-4.253	-1.246	-2.646
-2.719	0.854	4.296	3.244	-2.268	-8.230	-9.510	-2.928
8.908	17.454	16.141	8.220	3.209	6.129	13.074	16.062
9.301	-7.487	-27.108	-36.093	-23.361	8.001	38.847	47.813
29.339	-1.976	-24.705	-28.039	-17.772	-8.272	-9.517	-19.261
-25.270	-16.561	3.927	17.750	8.308	-16.731	-28.825	-12.086
15.302	23.810	9.357	-5.265	-2.379	10.294	14.726	8.038
3.199	7.970	14.738	13.363	4.962	-1.689	-2.164	0.304
1.823	3.314	6.883	9.815	7.050	-0.729	-7.024	-8.551
-8.776	-10.762	-10.960	-2.702	14.343	29.485	29.983	16.260
2.985	2.563	12.051	18.390	13.293	1.398	-5.129	-0.061
8.804	7.968	-4.485	-15.637	-14.560	-4.768	4.439	10.306
14.245	14.198	6.058	-9.302	-23.326	-25.074	-11.092	9.885
24.084	24.338	14.161	3.127	-0.213	6.121	16.589	23.629
24.574	22.083	18.383	12.039	1.766	-9.215	-15.421	-14.913
-11.291	-10.206	-14.028	-19.502	-21.002	-15.764	-5.387	5.361
9.396	1.382	-14.857	-26.348	-22.910	-8.160	3.685	1.856
-11.191	-23.373	-23.658	-9.684	9.180	15.204	-1.827	-27.749
-33.665	-9.412	22.489	33.612	20.525	1.222	-9.043	-7.519
3.668	21.577	38.020	40.789	24.878	-0.736	-20.834	-26.962
-21.994	-14.162	-8.330	-3.416	2.244	6.115	5.062	1.443
0.642	3.039	3.167	-2.902	-13.190	-22.408	-25.316	-18.857
-5.131	8.307	14.238	12.118	7.757	6.987	9.052	6.163
-7.345	-24.234	-27.965	-10.907	15.669	33.565	34.688	23.114

7.114	-5.160	-7.131	1.348	11.414	13.477	8.079	2.745
-1.140	-9.809	-24.206	-35.004	-34.397	-25.334	-14.840	-4.539
6.966	16.451	17.384	9.259	0.928	1.168	7.251	7.537
-2.792	-13.779	-13.661	-5.206	-0.876	-4.499	-7.538	-3.303
4.180	7.429	5.422	2.921	2.746	2.378	-1.500	-7.261
-8.863	-3.085	3.771	-0.378	-18.638	-35.651	-30.541	-2.286
25.431	30.168	14.435	-2.480	-8.117	-3.873	4.459	12.650
17.143	16.590	13.948	12.145	9.343	3.419	-1.298	0.826
5.672	2.693	-9.003	-17.372	-13.449	-1.996	7.237	10.677
9.239	2.552	-9.465	-22.089	-26.676	-17.189	2.462	18.032
16.250	-1.723	-20.330	-23.683	-9.465	9.207	15.547	5.793
-5.721	-1.879	16.630	30.198	21.479	-5.015	-26.869	-26.325
-6.890	12.194	15.907	6.530	-2.619	-3.547	0.084	2.627
5.603	11.814	16.198	11.835	1.918	-3.666	-2.064	0.331
-1.690	-6.337	-9.567	-10.581	-10.537	-8.152	-1.012	7.733
10.017	3.645	-3.965	-6.447	-5.555	-3.593	2.950	15.334
23.959	16.772	-3.888	-19.458	-13.944	7.490	23.040	17.783
-1.080	-13.752	-9.438	3.884	10.260	3.535	-7.473	-9.797
0.320	14.025	18.638	10.510	-2.089	-9.180	-7.604	1.082
12.866	19.037	11.702	-4.079	-13.100	-9.227	-2.677	-4.024
-9.865	-10.196	-3.906	0.171	-3.613	-9.521	-7.914	2.499
13.707	18.432	17.265	14.363	9.008	-2.712	-17.098	-21.492
-8.863	10.852	19.141	8.017	-11.175	-18.993	-8.903	4.482
2.203	-14.831	-25.836	-16.392	4.090	16.352	14.658	8.067
3.732	-0.332	-6.180	-9.766	-7.437	-2.268	-0.266	-3.661
-10.277	-16.694	-19.541	-16.172	-7.535	0.294	0.662	-6.235
-12.853	-13.176	-8.690	-3.320	1.522	3.853	1.364	-1.153
6.295	23.733	35.490	26.734	2.151	-17.423	-16.147	2.087
19.640	22.943	12.628	-2.225	-14.086	-17.472	-6.103	19.831
45.131	49.998	31.994	9.599	1.374	8.175	17.655	19.975
16.027	13.022	14.361	14.906	7.396	-7.212	-18.526	-16.801
-2.353	15.686	27.118	25.966	12.622	-4.641	-12.888	-5.480
9.156	14.188	2.124	-16.293	-22.837	-10.655	9.148	19.389
13.344	-0.563	-8.070	-2.578	8.536	11.264	0.431	-13.991
-19.040	-14.029	-8.053	-5.294	-1.091	7.341	14.078	12.303
4.798	0.708	2.612	3.507	-1.869	-9.750	-15.031	-19.681
-26.844	-30.693	-21.410	-1.113	13.056	6.839	-13.046	-25.022
-18.089	-4.039	0.621	-2.716	0.426	14.182	24.637	17.944
-1.361	-16.554	-19.483	-16.444	-14.214	-11.000	-4.812	-1.398
-6.578	-15.063	-14.615	-2.520	7.654	1.059	-19.041	-33.982
-32.202	-21.905	-18.265	-23.741	-27.015	-19.677	-7.437	-2.305
-7.352	-12.909	-7.826	7.124	19.136	17.724	6.352	-2.672
-1.601	6.375	10.868	4.666	-6.867	-10.197	-0.198	12.563
14.189	3.619	-6.214	-3.251	8.873	14.211	3.982	-12.130

-17.650	-8.111	6.357	13.987	11.510	2.985	-5.763	-10.602
-10.415	-6.775	-2.198	0.585	-1.233	-6.996	-9.496	-2.222
9.423	12.536	3.995	-5.343	-5.747	-0.332	1.003	-5.873
-16.277	-23.674	-25.587	-22.264	-13.569	-0.834	9.935	12.048
6.423	1.506	3.283	8.712	10.302	5.247	-1.098	-1.603
2.999	4.518	-0.966	-6.020	-0.138	15.942	27.192	19.353
-2.560	-17.095	-10.834	6.203	13.601	4.357	-8.294	-6.722
10.414	25.651	22.800	6.080	-6.409	-5.695	-0.564	-3.469
-15.036	-24.904	-24.099	-13.675	-2.203	2.946	1.156	-3.110
-5.245	-2.821	4.637	14.567	19.527	10.901	-10.105	-26.485
-19.239	8.267	28.029	18.579	-7.898	-21.241	-11.036	5.351
10.208	5.271	0.312	-4.728	-15.894	-29.221	-29.987	-10.472
17.332	32.032	25.296	9.366	1.640	7.248	17.908	22.251
15.665	3.340	-5.998	-9.732	-11.784	-13.555	-10.498	-0.553
9.339	9.730	-1.339	-17.439	-28.575	-25.402	-6.392	15.069
19.564	4.877	-8.181	-2.868	9.620	7.699	-6.861	-12.121
-0.718	8.707	-0.869	-20.792	-28.387	-15.634	2.321	7.190
-1.553	-10.711	-12.782	-12.739	-15.867	-17.295	-9.062	5.766
13.004	3.490	-14.393	-22.115	-10.912	8.842	20.409	19.714
16.640	19.350	24.100	22.418	14.225	9.138	13.291	18.953
13.050	-5.168	-21.537	-23.014	-11.167	2.016	7.987	7.785
4.915	-1.932	-13.176	-20.195	-13.754	0.489	6.299	-2.319
-14.752	-19.311	-15.861	-12.018	-14.167	-21.732	-25.290	-14.592
6.265	18.536	10.825	-5.297	-9.921	0.078	9.636	7.418
-0.030	0.878	12.279	23.604	26.126	21.572	15.971	12.078
10.436	11.419	12.535	9.383	2.468	-2.230	-1.108	4.213
12.101	22.083	29.776	27.754	15.279	2.997	2.707	12.648
18.065	8.698	-9.240	-21.993	-24.113	-20.504	-16.527	-12.266
-5.887	2.702	12.284	20.314	22.319	15.644	4.582	-1.649
1.888	9.545	10.413	1.025	-10.028	-12.674	-7.375	-2.677
-3.453	-6.381	-6.127	-1.894	3.119	6.547	8.558	8.326
2.447	-9.822	-22.391	-27.372	-22.709	-12.452	-2.211	3.585
3.714	2.150	4.675	11.092	14.143	8.979	0.734	-1.645
2.313	4.084	-1.397	-8.145	-6.195	6.531	20.759	24.435
15.775	5.898	6.262	16.895	29.451	36.882	37.109	31.627
23.539	15.367	8.453	4.619	6.186	12.932	19.880	19.530
8.395	-7.725	-17.323	-14.028	-2.209	9.364	15.886	16.276
10.800	4.453	6.310	18.783	32.383	35.457	25.334	9.767
1.248	6.963	20.754	28.943	25.409	15.552	6.726	2.663
5.568	14.871	24.461	27.598	23.387	14.538	2.630	-9.841
-17.416	-17.330	-13.051	-7.243	3.216	18.966	30.491	27.222
12.047	-1.226	-4.791	-4.084	-6.577	-10.090	-7.368	1.472
7.985	6.797	2.242	1.982	7.405	12.515	11.371	4.686
-1.905	-4.991	-6.789	-10.879	-16.352	-18.565	-15.593	-10.688

-6.593	-1.103	7.515	13.334	7.615	-8.353	-21.637	-22.415
-15.766	-13.774	-18.643	-20.195	-10.948	2.287	6.202	-2.522
-13.517	-15.583	-9.512	-6.027	-11.844	-20.078	-16.674	3.190
26.929	34.967	19.753	-7.042	-26.228	-27.651	-15.774	-3.096
0.870	-3.014	-5.850	-0.809	10.383	21.202	27.004	26.018
17.238	2.106	-11.918	-15.521	-9.082	-4.219	-7.805	-10.745
-0.858	18.302	29.925	22.319	-0.040	-20.543	-24.126	-11.643
0.401	0.021	-4.100	5.154	27.922	44.075	36.731	11.927
-9.086	-13.420	-7.400	-4.941	-11.209	-20.416	-25.283	-24.073
-19.630	-15.271	-12.065	-8.383	-2.745	1.775	-0.437	-8.194
-11.591	-4.809	4.262	3.842	-5.738	-12.404	-8.253	-0.141
-1.242	-13.345	-22.622	-16.255	0.425	9.086	-0.174	-18.207
-29.239	-28.928	-25.040	-22.946	-19.558	-14.187	-15.249	-27.777
-41.586	-43.160	-35.016	-30.764	-33.043	-29.887	-14.382	3.474
8.198	-4.116	-21.982	-28.443	-15.292	9.223	26.809	25.812
11.721	-0.890	-4.993	-5.501	-8.972	-14.920	-18.307	-17.003
-14.687	-16.175	-20.182	-19.580	-11.570	-3.747	-4.494	-10.278
-9.388	2.167	14.753	17.201	10.133	3.082	1.378	1.616
-0.623	-4.414	-6.507	-6.880	-8.035	-9.209	-4.738	8.182
21.337	20.943	4.148	-13.876	-14.471	3.258	20.034	16.776
-5.355	-27.008	-30.980	-18.136	-3.046	3.050	1.113	-2.847
-8.062	-18.479	-33.664	-44.295	-39.554	-18.974	5.114	18.304
17.008	10.161	8.500	13.416	17.195	12.647	0.079	-14.336
-24.118	-25.741	-18.814	-6.400	4.438	6.225	-2.174	-14.356
-23.458	-27.673	-26.855	-18.158	-0.581	18.518	27.831	23.264
11.205	1.642	0.999	9.750	22.224	28.374	20.665	2.275
-14.449	-19.826	-13.592	0.700	20.243	38.335	43.740	31.804
11.964	-1.029	-1.619	3.624	6.193	5.208	5.515	9.257