Adaptasi Positional Encoding pada Arsitektur Transformer untuk Sintesis Notasi Gamelan yang Koheren dan Terkendali

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Rumusan Masalah

Model LSTM pembangkit notasi gamelan yang dikembangkan oleh Fanani, A.Z. dkk. (2025) gagal menangkap relasi tersirat antarnotasi. Mekanisme pengacakan Algoritma Genetika (GA) digunakan Fanani, A.Z. dkk. (2025) untuk menangani kelemahan LSTM tersebut, tetapi GA justru berpotensi merusak struktur koherensi seluruh notasi. Kondisi tersebut mengakibatkan peran notasi terhadap keseluruhan struktur terabaikan sehingga ciri khas notasi dan identitas musikal gamelan memudar seiring bertambah panjangnya sekuens notasi. Apabila hal ini tidak diatasi, koherensi tematik dalam komposisi notasi gamelan tidak terwujud. Oleh karena itu diperlukan pendekatan baru, model pembangkit notasi gamelan yang dapat mempertimbangkan peran tersirat setiap notasi dalam struktur lagu melalui mekanisme perhatian (attention mechanism).

Previous Work
Original vs Rebuild - LSTM

Syarif AM, Azhari A, Suprapto S, Hastuti K. Gamelan Melody Generation Using LSTM Networks Controlled by Composition Meter Rules and Special Notes. JAIT [Internet]. 2023 [cited 2025 June 9]; Available from: http://www.jait.us/show-224-1287-1.html
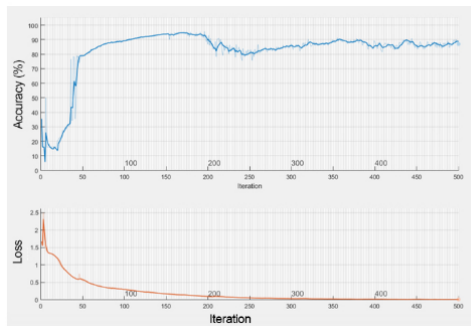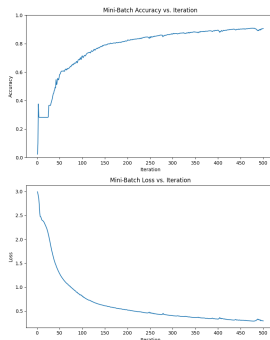

Figure: Original

Figure: Rebuild

Figure: Buku Referensi

Insight

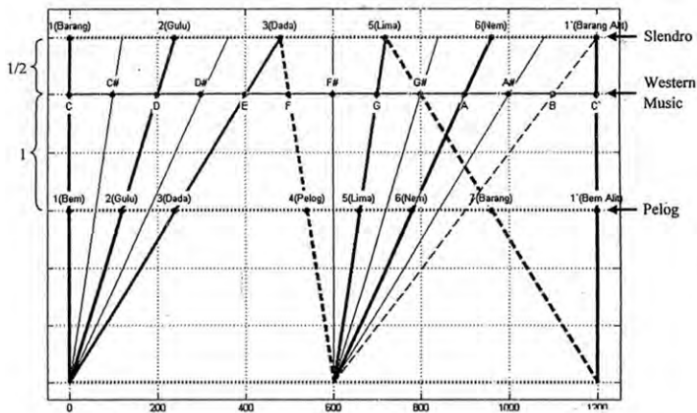| Nada	Frekuensi Fundamental (Hz)													
	6	1	2	3	5	6	7/1	2	3	5	6	7/1	2	3
Slendro	114,62	133,22	152,76	176,93	204,37	233,31	269,54	310,12	355,83	409,50	465,41	541,83	621,04	712,50
Pelog Barang	-	124,39	153,90	166,11	213,71	231,97	250,34	312,28	339,95	433,14	464,33	509,59	637,73	694,34
Pelog Bêm	-	124,31	155,11	167,86	213,87	232,47	292,53	312,01	339,91	433,57	464,06	590,27	637,63	694,11

Figure: Frekuensi fundamental tiap nada gender

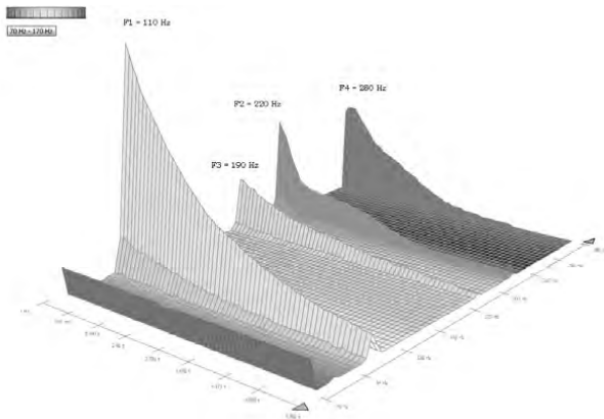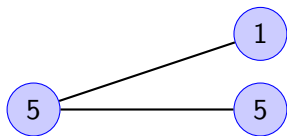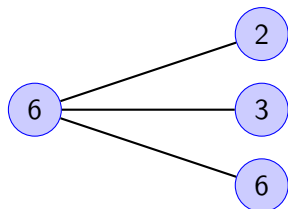Figure: Struktur interval dalam cent antara slendro, pelog dan western
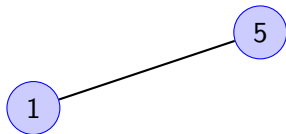
Figure: Kempul nada 6

Kenong nada 5 digunakan untuk
me-ngenongi nada 1 dan 5
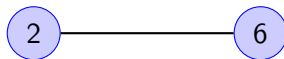

Kenong nada 6 digunakan untuk
me-ngenongi nada 2,3 dan 6

Penggunaan kempyung memiliki relasi dengan patet.

Patet Sanga
Nada seleh 1 diberi kempyung 5

Patet Nem dan Manyura
Nada kenong seleh 2 diberi kempul 6

Original vs Rebuild - LSTM

Epoch	Iteration	Time Elapsed (hh:mm:ss)	Mini-batch Accuracy	Mini-batch Loss	Base Learning Rate
1	1	00:00:05	35.49%	1.6725	0.0100
100	100	00:06:56	89.39%	0.3051	0.0100
200	200	00:13:57	86.85%	0.0992	0.0100
300	300	00:21:01	86.98%	0.0374	0.0100
400	400	00:28:07	88.26%	0.0198	0.0100
500	500	00:35:17	86.91%	0.0143	0.0100

Figure: Original Report LSTM

```
PyTorch version: 2.8.0+cu126
input size: 20
hidden units: 40
num classes: 20
Using device: cuda

--- Starting Training (replicates 'trainNetwork') ---
Epoch [50/500], Iteration: 50, Loss: 1.2815, Accuracy: 58.38%
Epoch [100/500], Iteration: 100, Loss: 0.8172, Accuracy: 71.44%
Epoch [150/500], Iteration: 150, Loss: 0.6095, Accuracy: 79.09%
Epoch [200/500], Iteration: 200, Loss: 0.5202, Accuracy: 82.47%
Epoch [250/500], Iteration: 250, Loss: 0.4588, Accuracy: 84.70%
Epoch [300/500], Iteration: 300, Loss: 0.4030, Accuracy: 86.62%
Epoch [350/500], Iteration: 350, Loss: 0.3653, Accuracy: 88.10%
Epoch [400/500], Iteration: 400, Loss: 0.3291, Accuracy: 89.53%
Epoch [450/500], Iteration: 450, Loss: 0.3073, Accuracy: 90.26%
Epoch [500/500], Iteration: 500, Loss: 0.2938, Accuracy: 90.60%
--- Training Complete ---
Total Training Time: 7.57 seconds
```
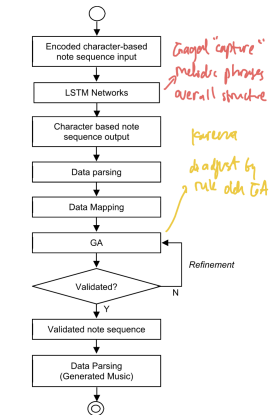
Figure: Rebuild

FIGURE 1. Hybrid LSTM-GA model diagram for explanatory music generation.

Figure: Original

Fanani AZ, Maulana Syarif A, Novita Dewi I, Karim A. Enhancing Creativity and Validation in Explanatory Deep Learning-Based Symbolic Music Generation: A Hybrid Approach With LSTM and Genetic Algorithms. IEEE Access. 2025;13:105280–301.
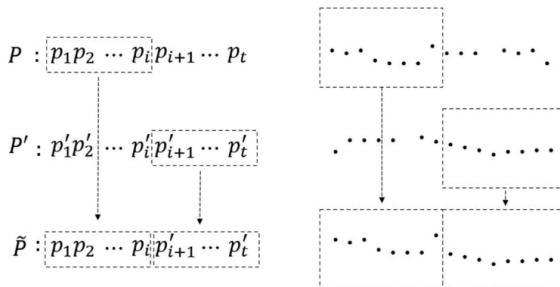
Figure: Contoh pitch mismatch method

- Koherensi Musikal
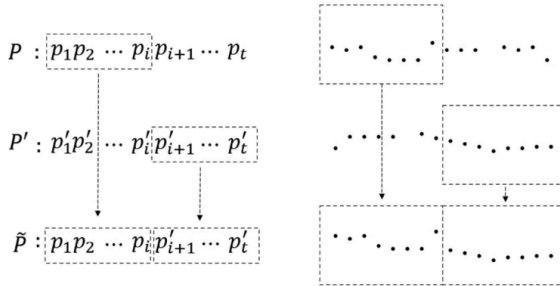- Sequence Modeling
- User in the loop System

Figure: Contoh pitch mismatch method

Fu X, Deng H, Yuan X, Hu J. Generating High Coherence Monophonic Music Using Monte-Carlo Tree Search. IEEE Trans Multimedia. 2023;25:3763–72.

- Bagana membuktikan incoherence?
- Reverese Paper : LSTM, BiLSTM, G.A. Small prev dataset Gamelan
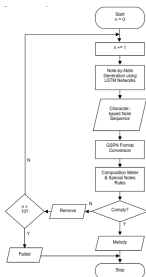- Objective : Function untuk scoring tingkat coherence pada gamelan

Figure: Rebuild LSTM

(Input layer 19 , Hidden layer 200 units) Attempt more than 10x. Syarif AM, Azhari A, Suprapto S, Hastuti K. Gamelan Melody Generation Using LSTM Networks Controlled by Composition Meter Rules and Special Notes. JAIT [Internet]. 2023 [cited 2025 June 9]; Available from: http://www.jait.us/show-224-1287-1.html
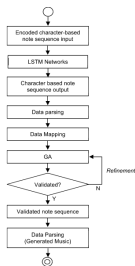
Figure: Rebuild LSTM with GA

(Input layer 17 , Hidden layer 200 units) Fanani AZ, Maulana Syarif A, Novita Dewi I, Karim A. Enhancing Creativity and Validation in Explanatory Deep Learning-Based Symbolic Music Generation: A Hybrid Approach With LSTM and Genetic Algorithms. IEEE Access. 2025;13:105280–301.