

Sesquialtera in the Colombian bambuco: Perception and estimation of beat and meter

Estefanía Cano, Fernando Mora Ángel, Gustavo López, José R. Zapata, Antonio Escamilla, Juan F. Alzate, Moisés Betancur

Goals of our study

1. Understand how cultural insiders (people familiar with bambuco) perceive meter in bambuco
2. Evaluate state-of-the-art beat trackers in a bambuco dataset

What is bambuco?

Bambuco is one of the national rhythms of the Andes region in Colombia



- Bambucos show musical elements typical of ancient Spanish-Iberian and Colombian peasant dances, typified as sesquialtera whose main characteristic is a bi-metric behavior (3/4 - 6/8).

- Bambuco has become one of the most important and representative symbols of regional identity.

- It shares roots and music characteristics with many other music expressions across Latin America.

What is sesquialtera?

Sesquialtera in bambuco is characterized by the use of elements in two different meters (3/4 and 6/8). This bi-metric behavior can be observed within the melodic line, or between the melodic line and the bass line.

Melody
Guitar
Tiple

Elements of 3/4 and 6/8 meters

What are the challenges of analyzing rhythm in bambucos ?

1

Downbeats are usually rests or unaccented strokes

2

There is a (caudal) syncopation that extends the last eighth note across the bar line

3

There are many sub-levels of accentuation produced by different instruments

4

There can be many rhythmic variations over one piece

Down beat could be a rest
Caudal syncopation

Melody
Guitar

The accompaniment pattern suggests 6/8 at the top voices and 3/4 at the bass voice.

1. Meter Perception Study

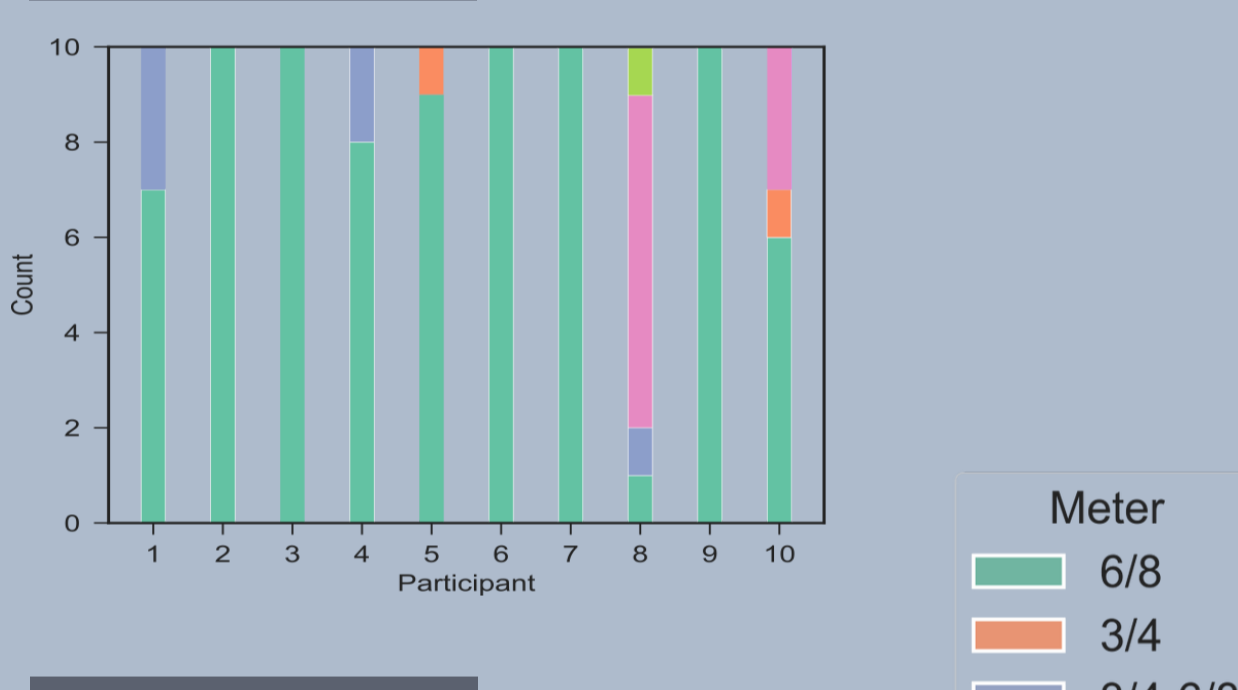
Method:

- We asked 10 Colombian musicians to tap the beat of 10 bambucos using Sonic Visualiser.
- Beat annotations were analyzed to extract the underlying meter used to tap the beats.

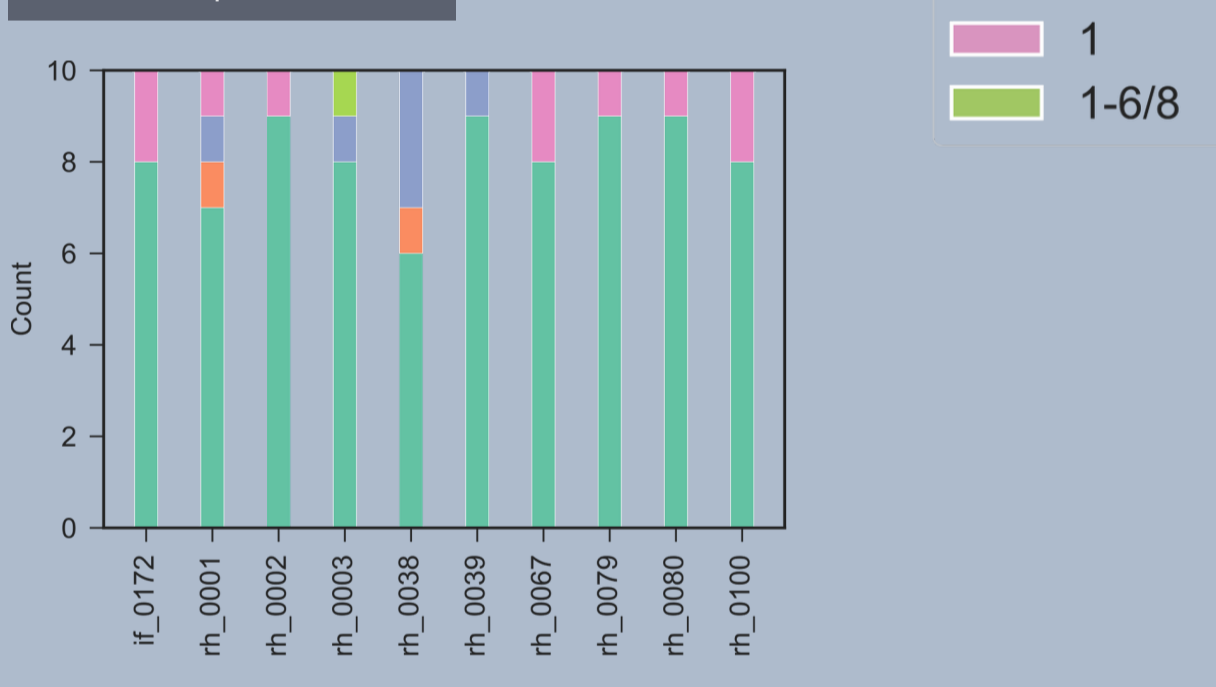
Dataset: Selection of 10 bambucos from the ACMUS-MIR dataset [1]

Results: A total of 5 different meters (or meter combinations) were found in the annotations. Results are summarized in the figures below:

Summarized per participant



Summarized per track



Conclusions

- Results show that meter perception can differ greatly between participants.
- There is a clear tendency towards 6/8 meter. This could be related to the fact that Andean Colombian music is written in 6/8 as a convention in academic settings.
- All bambucos were annotated in at least 2 different meters.
- This study has shown that perception of meter in bambucos is diverse and rich.

2. Beat tracking in bambucos

Method:

- We selected 2 of state-of-the-art beat trackers MadMom [2] and MutiBT [3] and extracted beat positions for our bambuco dataset [4].
- To account for the bi-metric behavior in bambucos, ground-truth annotations both in 3/4 and in 6/8 were used.
- We calculated a set of 5 evaluation metrics taken from [5].

Dataset: Selection of 10 bambucos from the ACMUS-MIR dataset [1]

Metrics:

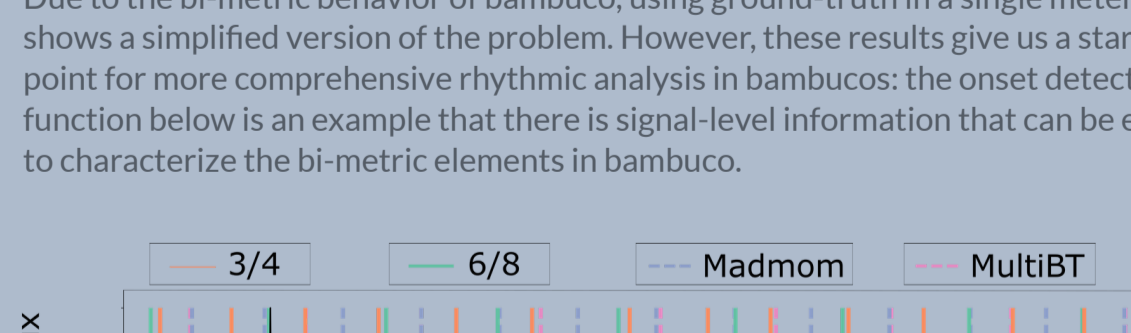
- F-measure (F1), Allowed Metrical Level Continuity (AMLC), Allowed Metrical Level without continuity (AMLt), Correct Metrical Level Continuity (CMLc), and Correct Metrical Level without continuity (CMLt).

Results:

	Algorithm	F1	AMLC	AMLt	CMLc	CMLt
3	Madmom	75.06	60.76	77.05	50.89	64.27
	MultiBT	42.79	23.32	25.24	12.43	14.33
6	Madmom	41.13	9.23	10.71	5.64	5.72
	MultiBT	45.15	42.87	51.76	32.38	35.54

Conclusions

- While Madmom produced better results when assuming 3/4 as the underlying meter, MultiBT produced better results with 6/8.
- In all cases, those metrics that enforce tracking continuity are lower than those that don't.
- Due to the bi-metric behavior of bambuco, using ground-truth in a single meter only shows a simplified version of the problem. However, these results give us a starting point for a more comprehensive rhythm analysis: the next step is to design a detection function below is an example that there is signal-level information that can be exploited to characterize the bi-metric elements in bambuco.



REFERENCES

[1] F. Mora-Ángel, G. A. López Gil, E. Cano, and S. Grollmisch, "ACMUS-MIR: An annotated data set of Andean Colombian music" in 7th International Conference on Digital Libraries for Musicology, Delft, The Netherlands, 2019.

[2] S. Böck, F. Krebs, and G. Widmer, "A multi-model approach to beat tracking considering heterogeneous music styles" in 15th International Society for Music Information Retrieval (ISMIR) Conference, 2014, pp. 603-608.

[3] J. R. Zapata, M. E. P. Davies, and E. Gómez, "Multi-feature beat tracking" IEEE/ACM Transactions on Audio, Speech, and Language Processing, vol. 22, no. 4, pp. 816-825, 2014.

[4] Audio and annotations: <https://zenodo.org/record/3829091#.Xxd3lZ7TuUk>.

[5] M. E. Davies, N. Degara, and M. D. Plumbley, "Evaluation methods for musical audio beat tracking algorithms" Queen Mary University of London, Centre for Digital Music, Tech. Rep. C4DM-TR-09-06, 2009.