Multi-modal Recordings of Maracatu *de Baque Solto* (Brazil): Technical Concerns and Preliminary Analyses

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MARACATU *DE BAQUE SOLTO*: FROM BRAZIL TO LISBON

Maracatu *rural* or *de baque solto* (rural-style or free-beat) is a Carnival performance-ritual occurring in the Zona da Mata Norte region of Pernambuco state (Brazil), and strongly associated with an afro-indigenous worship known as Umbanda-Jurema (Garrabé, 2010; Teixeira, 2018). While the urban type of Maracatu, called *nação* or *de baque virado* (nation-style or turned-around beat) has spread out internationally (Cruz 2012), Maracatu *de baque solto* has remained a local and understudied cultural practice.

Maracatu *de baque solto* is a "multi-modal" performance, featuring up to 200 members: a board of directors, tens of masqueraded dancers, 2 poets (*mestres de apito*) improvising short, chanted verses, a brass section formed by 2 to 4 musicians (*músicos*) playing trumpets and trombones, and a group of 5 percussionists called *terno*[2] (Figure 1). Previous field research suggested that these aesthetic means act as protective devices against negative entities unleashed by rivals' envy, affecting people's health (Bonini Baraldi, in press). Sounds and movements, when executed "in consonance" (*consonância*), i.e., in a highly coordinated way, are believed to "lock" (*fechar*) the performers' bodies, protecting them. Conversely, a non-coordinated musical or kinetic action produces "holes" (*furos*) that may "fracture" (*desmantelar*) the group, exposing its members to any kind of health problems.

Our long-term aim is to understand how this high level of acoustic and choreographic coordination is achieved in Maracatu performances. In conjunction with field-research, we believe that recording the *terno* in separate parts, and the musicians' and dancers' movements with Motion Capture (MoCap) technologies, will allow us to "translate" the concepts of "consonance" and "closure" at the formal level of music and dance analysis. This paper describes how we obtained these multimodal recordings. Additionally, we present some preliminary considerations on the automatic onset detection of the *terno* instruments. In future research, these onsets will be useful to analyze what musicians mean when they say that the *terno* is "closed" (highly coordinated). Onset detection also allows the visualization of microtiming profiles, thus contributing to ongoing research on timing deviations in other Latin-American musical genres (Naveda et al., 2011, Fuentes et al., 2019).

Fig. 1. Dancers of the Maracatu group *Leão de Ouro* ("Golden Lion") in Pernambuco. Photo: F. Bonini Baraldi, 2017.

Fig. 2 Poet and percussionists of the Maracatu group *Leão de Ouro* in Lisbon. Photo: F. Bonini Baraldi, 2019.

MULTI-MODAL RECORDINGS

In December 2019, we invited 13 Maracatu performers (1 director, 1 poet, 2 musicians, 5 percussionists, and 4 dancers) to Lisbon for a 10-day residence. A one-week workshop with local inhabitants was organized in order to form a larger Maracatu group. During an outdoor party in a fixed location, we realized a multi-track recording of the 5 percussionists (Figure 2). Two days later, we organized a multi-modal recording in the Faculty of Human Kinetics of the University of Lisbon. In a studio equipped with MoCap equipment, we simultaneously recorded the 5 percussionists in separate tracks and in stereo; the musicians' gestures with Qualisys MoCap optical system; the dancers' movements with Xsens MoCap kinematic system; and standard video with a Sony portable camera.

Audio signal acquisition

From an audio analysis perspective, Maracatu presents a particularly complex sound scene to interpret. The proximity of the percussionists, together with their loud and fast playing style make it extremely challenging to obtain isolated recordings per instrument using conventional microphones. Alternative means for signal acquisition must be pursued to facilitate the precise annotation of temporal events necessary for microtiming analysis. As detailed in Davies et al. (2020), our approach used contact microphones. We placed two pickups (less than 1 cm in diameter) on the *onguê* (one per bell), two on the *bombo* (one per skin) and a single pickup for *tarol*, *porca*, and *mineiro* (Figure 3). The contact microphones were connected to an eight-channel USB audio interface for synchronous signal acquisition. We used this setup both in the live performance and the laboratory session. In the first case, we recorded 34 pieces pertaining to 2 different rhythmical genres (29 *marcha* and 5 *samba*, approx. duration 35 s each), in the second case, 17 pieces (11 *marcha* and 6 *samba*).
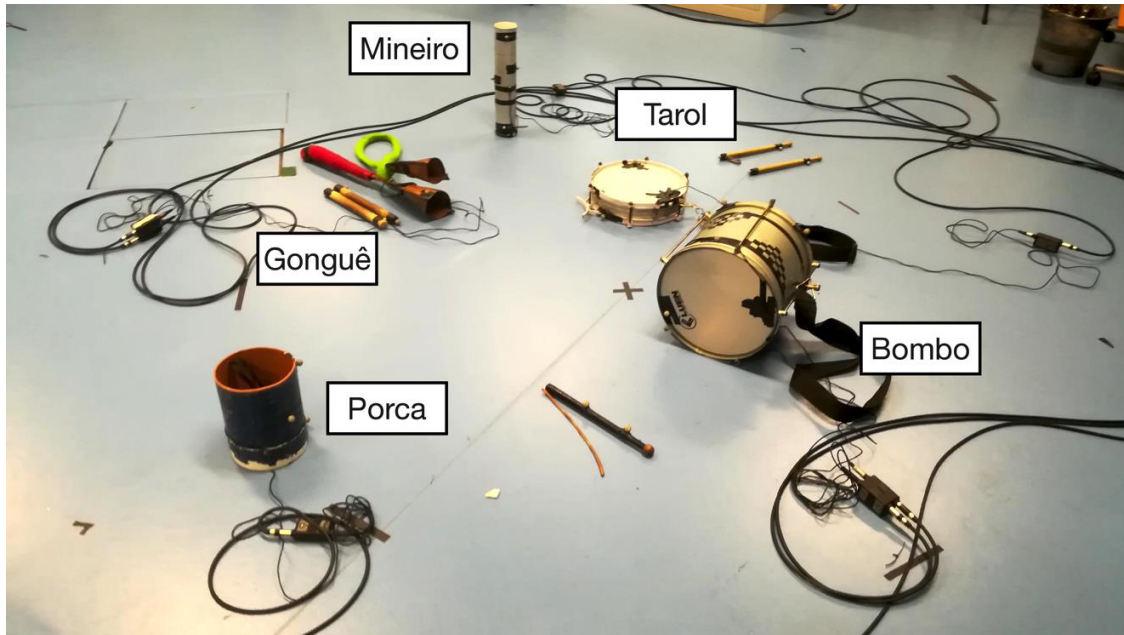
Fig. 3. The 5 percussion instruments of the *terno* with the connection of contact microphones. Photo: M. Davies.

Musicians' gestures

The upper body kinematics of the 5 percussionists were recorded with an optical system of 14 infrared high-speed cameras (Oqus 300, Qualisys AB, Sweden) and 2 video cameras (Oqus 210c), using the Qualisys Track Manager software. We placed a total of 173 reflective markers (25 mm diameter) on each instrument (3 to 5), drumsticks, and on specific anatomical landmarks of each of the five musicians (28 to 30 markers for each musician). The main challenge of this MoCap recording consisted in preserving the musicians' playing style and position in space (in a circle and close to one another), while avoiding light interference among markers (Figure 4). Even though the set-up was somewhat laborious and intrusive due to the many markers used, the musicians affirmed they were not disturbed by the markers while playing. The virtual reconstruction of the musicians' movements was successful, with minimal loss of information on the markers. With this setup, we also recorded the sounds and movements of each percussionist playing *marcha* alone, then in all combinations of 2, 3, and 4 instruments playing together.

Dancers' movements

Full body kinematics of the dancer were recorded at 240Hz with a full-body IMUs (Inertial Measurement Unit) suit (Xsens MVN Link System, The Netherlands), using the Xsens MVN Analyse software. The dancer's Xsens recordings were synchronized in time with the musicians' Qualisys recordings using an external trigger button (Qualisys AB, Sweden). The post-recording synchronization with the audio capture was made possible through an initial single clap from the dancer. With this setup, we recorded short extracts (30s to 1 min) of *marcha* and *samba* movements of 3 different dancers, one at a time (Figure 5). Since Maracatu performances often feature a sort of "battle" between two dancers, we also recorded the movements of one dancer (wearing the Xsens suit) while "fighting" with another one (not wearing the suit). The videos of the dancers' Xsens MoCap "avatars" were projected on a screen in real-time, stimulating comments and discussion with the performers.

Fig 4. The 5 percussionists and a dancer during the MoCap laboratory recordings. Photo: F. Bonini Baraldi, 2019.

Fig. 5. Aguinaldo Roberto Da Silva wearing the Xsens suit. Photo: F. Bonini Baraldi, 2019.

ONSET DETECTION AND MICROTIMING

Since manual annotation, even on well-separated signals, is extremely labor-intensive, we adopted a semi-automatic approach where automatic onset estimates were corrected by a human annotator. To streamline this process, we retrained an existing deep neural network for temporal analysis (Davies & Böck, 2019) on a per-instrument basis. This use of "instrument-adapted" networks drastically reduced the number of missed and erroneous detections. Next, we automatically realigned the detected onsets at the sample level of the waveforms, greatly improving the temporal accuracy. The final output was obtained by human intervention using the open source software, Sonic Visualiser.

Over the 34 pieces of the live performance, we annotated 45,000 onsets across four instruments of the *terno*: the *tarol*, *bombo*, *porca* and the low bell of the *gonguê*, omitting the *mineiro* from our initial analysis due to the difficulty of making precise annotations. As described in (Davies et al., 2020), we adapted an existing approach applied to Brazilian samba and Uruguayan candombe (Fuentes et al., 2019) in order to visualize the microtiming profiles of Maracatu.

CONCLUSIONS

For the first time, a Maracatu *de baque solto* group was invited to perform in Portugal, both in a public space and in a laboratory setting. We obtained multi-track recordings of the percussion instruments in a live performance, as well as a multimodal corpus (multitrack audio, stereo audio, MoCap gestures, standard video) of the musicians' and dancers' action in a laboratory setting. While MoCap techniques are increasingly used in the ethnomusicological domain (among others, see Bonini Baraldi et al., 2015), to the best of our knowledge optical and kinetic MoCap systems have never been combined in a single recording session. The audio recordings allowed the development of new algorithms for automatic onset annotation. On a longer time frame, the multimodal corpus here described will allow us to "translate", at the level of formal analysis of music and dance, local concepts such as "consonance" and "closure". Combined with long-term ethnographic field research, they should deepen our understanding of how participants of a music-dance culture conceive relations among sound, movement, and health. Additionally, our preliminary microtiming analyses (Davies et al., 2020) contribute to ongoing research on timing deviations and groove in Latin musical genres (Naveda et al., 2011, Fuentes et al., 2019).

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NOTES

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[2] The percussionists are never called "musicians", and people say they "hit" (*bater*) their instruments rather than "play" them (*tocar*). This vocabulary reflects their lower social status and lack of musical studies, in comparison to brass "musicians".

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