

# Towards the tangible: microtonal scale exploration in Central-African music

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## Abstract

This lecture presents TARSOS, an easy-to-use platform for automated pitch analysis, and its usage to explore tone scales in non-Western music.

### 1. Introduction

Two main considerations were the starting point of this research: i) ethnomusicology is mainly performed from an anthropological and ethnographical approach, and ii) current Music Information Retrieval (MIR) applications are biased towards Western music and are thus not suitable to the particularities of other musical cultures. This research tries to develop an unbiased approach by a flexible interface for both detection and representation of the tone scales. This means that no predispositions towards a certain music theory or pitch organization are made. Our goal is to document the endangered musical heritage of African oral cultures, specifically its tone scale diversity. The specific characteristics of tone scales in this wide range of music, urged us to develop a very flexible system for pitch analysis, pitch representation, pitch (and scale) interpretation and fitting forms of output.

In this context, we have developed Tarsos, a software platform for pitch extraction and representation that allows detailed study of the interval structure of a song.

Tarsos can be freely downloaded at: <http://tarsos.0110.be>.

## **2. Methodology: Tarsos, inner workings summarized**

TARSOS is a modular software platform to extract the pitch organization of a musical piece. First the audio is analyzed in blocks of 10ms and for each block a fundamental frequency estimation is made. Secondly, the found frequencies are converted to cents and are not quantized to any predefined set of pitch classes. Then a fine-grained histogram, that allows up to 1200 values per octave, is built from the annotations. Using automatic peak detection the pitch classes are assigned. Simultaneously, an interval table is created that shows all pitches and all intervals between the pitch classes. This table is most convenient for studying the interval structure. The scale is also projected on the keyboard for listening and experiencing the microtonal sonification, it can also be sent to a MIDI instruments by pitch bend MIDI message.

Tarsos contains several ways for representing the annotations. One can also select in time and in pitch range for building histograms around a certain part or tessitura. TARSOS allows zooming in into great detail for viewing all annotations. If necessary, the automated peak selection can be adjusted manually by adding, deleting or shifting assigned pitch classes.

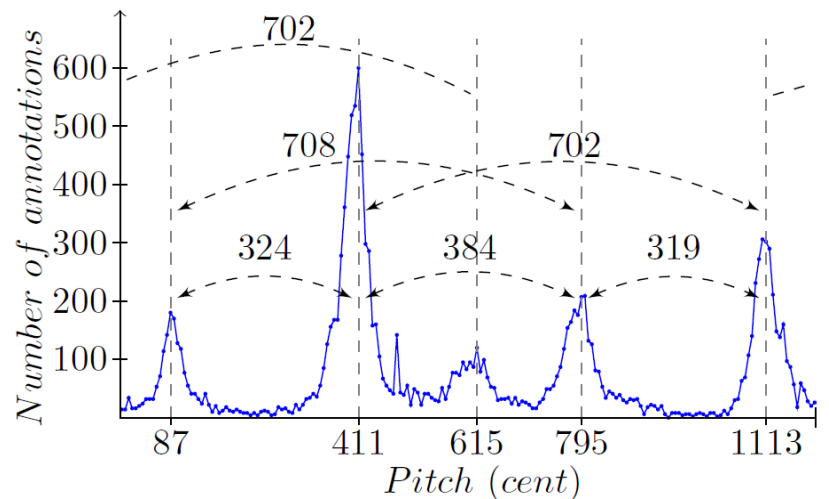
All tone scale information is saved as a Scala file. Scala is a software tool for experimentation with musical tunings, such as just intonation scales and non-Western scales. It supports scale creation, editing, comparison, analysis, storage...

### 3. Case studies

In this section we will highlight two pentatonic recordings from a different type. These recordings are conserved and digitized in the archives of the Royal Museum for Central-Africa (RMCA, Belgium) whose unique collection that focused on Central-Africa, is accessible via <http://music.africamuseum.be>.

#### 3.1 pentatonic unequal temperament: recording MR.1961.4.17-6

P.C.	87	411	615	795	1113
87	0	324	528	<u>708</u>	1026
411	876	0	204	384	<u>702</u>
615	672	996	0	180	498
798	492	816	1020	0	319
1113	174	498	<u>702</u>	881	0



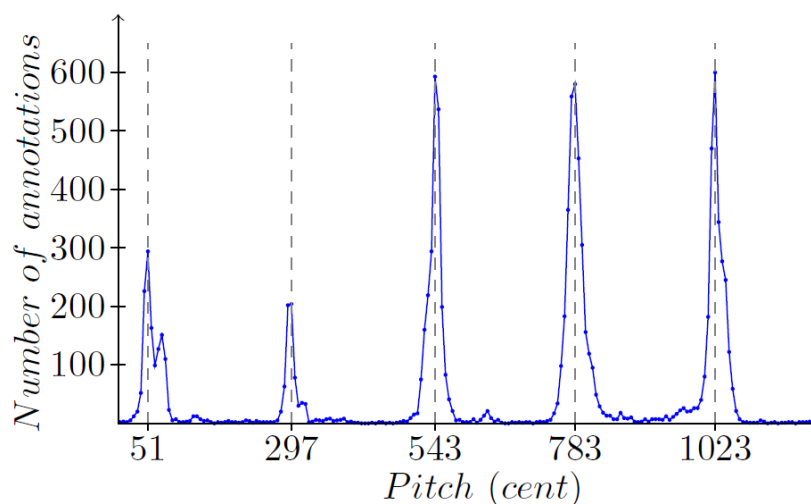
**Figure 1:** On the right the pitch class histogram is displayed. The horizontal axis represents an octave, that is divided into 1200 cents. The annotations made by Tarsos are projected on it. The five numbers under the axis are the pitch classes that have been localized by peak detection. The pitch classes are listed in the table that also contains the intervals between the pitch classes. The recording MR.1961.4.17-6 has a pentatonic tone scale consisting of three smaller and two larger intervals of about a minor third. Between the pitch classes 411 and 795 a pure major third can be found. This constellation gives rise to a series of three almost perfect fifths.

MR.1961.4.17-6 was recorded in Rwanda in 1954. It contains a song by Bizuru, an important musician who regularly played at the Royal Court in Rwanda. He died in 1955. The song displays the love story between a Rwandese woman and a European man, Longo Longo, an

administrator whose original name was Borgers. The chant, inspired on a song from either players from Mulera, is brought on *umuduri* (musical bow) and singing. The scale (see Fig 1) is pentatonic containing following intervals: 324, 204, 180, 319, and 174 cents; thus three smaller intervals and two larger that linger around the pure minor third. A pure major third lies in between these two minor thirds (the two smaller intervals 204+180 make 384 cents), by which an nice enchainment of fifths arises that is mirrored at the same time. Another mirror of intervals can be found between 180-319-174.

### 3.2 pentatonic equal temperament: Recording MR.1976.25.3-A2

P.C.	51	297	543	783	1023
51	0	<u>246</u>	492	<u>732</u>	972
297	954	0	<u>246</u>	486	<u>726</u>
543	<u>708</u>	954	0	<u>240</u>	480
783	468	<u>714</u>	960	0	<u>240</u>
1023	<u>228</u>	474	<u>720</u>	960	0



**Figure 2:** MR.1976.25.3-A2, a xylophone recording with an almost perfect equally divided pentatonic tone scale.

Due to the rigid equal division the fifths are rather large.

This piece has been recorded in 1972 in Nigeria and contains the performance of two xylophone players, one musician is playing as soloist, the other plays the accompaniment. The second part of the recording is enriched with singing. This style of music is brought as dance music that announces the change of the seasons. The metallic sound of the instruments allows a perfect

annotation that in this case shows a very nice example of a pentatonic meantone tuning. It has the intervals: 246, 246, 240, 240, 228 cents. As a consequence all fifths are, on average, 720 cents. Due to the equal division all intervals can of course be mirrored. See Figure 2 for the pitch class histogram and interval matrix. The recordings made in this region all used a rigid pentatonic meantone scale organization.

#### **4. Conclusion**

Ethnic music offers a unique environment of characteristic timbres, rhythms, tones, scales, and textures that need adapted or completely new, innovative tools for being computationally described. As this paper focuses on pitch, that is the only parameter we can detail on in the case studies, while we nevertheless are aware that a piece of music has to be seen as a whole, with respect to the interaction of all the other musical parameters, and in an interaction with its societal context as well. Work in progress is all we can say.

#### **5. Related Works / Bibliography**

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