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TOWARDS FLAMENCO STYLE RECOGNITION: THE CHALLENGE OF MODELLING THE AFICIONADO

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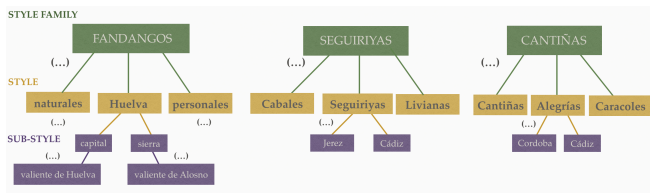


Figure 1: Hierarchical organisation of flamenco style families, styles and sub-styles.

1. INTRODUCTION

Flamenco is a rich music tradition from the southern Spanish province of Andalucía. Having evolved from an oral tradition, the singing voice remains the central musical element, typically accompanied by a guitar and rhythmic hand-clapping. Since its existence, flamenco songs have been transmitted orally throughout generations and only manual transcriptions are the rare exception. Consequently, performances are highly improvisational and not bound to a musical score. Despite its improvisational character, flamenco music is based on a hierarchical structure of style families, styles and sub-styles (Kroher, Díaz-Bañez, Mora & Gómez, 2015), each of which is defined by a set of melodic, rhythmic and harmonic concepts (Figure 1). Based on these characteristics and their experience, flamenco *aficionados* can identify a flamenco style in a matter of seconds.

In the relatively new field of computational flamenco analysis, automatic style recognition is considered a key challenge. So far, approaches have been limited to the discrimination of two styles belonging to the *tonás* family, the *deblas* and *martinetes* (Cabrera, Díaz-Bañez, Escobar-Borrego, Gómez & Mora, 2008). In this particular case, performances of the same style share a common melodic skeleton which is subject to strong melodic ornamentation. Based on this knowledge, previous approaches have focused on classification solely based on melodic similarity (Díaz-Bañez, Kroher & Rizo, 2015; Mora, Gómez, Escobar-Borrego & Díaz-Bañez, 2010; Gómez, Mora, Gómez & Díaz-Bañez, 2015). Even though promising results have been obtained, this particular task represents only a small sub-problem of automatic flamenco style classification.

In a first step towards the development of a generic system for automatic style categorisation of flamenco recordings, we demonstrate the particular challenges and difficul-

ties of this task on 78 recordings belonging to three styles: *fandangos de Huelva*, *seguiriyas* and *alegrías*. We investigate in how far the melody-based approach generalises to these three styles (Section 2) and furthermore explore the domains tonality (Section 3) and rhythm (Section 4) as potential features for style classification.

2. MELODY

It has been demonstrated in Díaz-Bañez et al. (2015) that for the particular case of discriminating styles from the *tonás* family, a classification based on melodic similarity yields nearly perfect accuracies. In order to evaluate in how far this concept holds for the three styles investigated in the scope of this study, we follow the method proposed by Díaz-Bañez et al. (2015) to compute pair-wise similarities of automatic melody transcriptions (Kroher & Gómez, 2016) of the first sung verse. The resulting similarity matrix S holding the pair-wise similarity values can be represented as a graph $G(V, E)$, which we visualise using the *Gephi* software (Bastian, Heymann & Jacomy, 2009). We furthermore evaluate the discriminate power of the obtained representation by computing the *cluster quality* q as the ratio of intra and inter cluster edges, where a cluster is formed by all instances belonging to the same style.

The cluster qualities for different style combinations (Table 1) and the graph visualisations (Figure 2) indicate a poor class discrimination among *fandangos de Huelva*, *seguiriyas* and *alegrías* compared to the task of discriminating among two members of the *tonás* family: *deblas* and *martinetes*. We identify conceptual as well as methodological causes for this behaviour: Contrary to the particular case of members of the *tonás* family, not all styles necessarily share a single common melodic skeleton, but may encompass a large set of characteristic melodies or melodic patterns. In other words, the degree of intra-style melodic similarity is highly style dependent. Further experiments show that a reliable discrimination based on the melodic contour is achieved in lower hierarchical structures, e.g. among sub-variants of a style which tend to share the same melody. We furthermore observed that in particular in the *alegrías*, melodies exhibit structural differences, i.e. repetitions of a phrase or sub-phrase, which cause a high local alignment cost resulting in low melodic similarity values.

styles	cluster quality $q(S)$
Martinete vs. Debla	3.19
Alegrías vs. Seguiriyas	1.15
Fandangos de Huelva vs. Seguiriyas	1.06
Alegrías vs. Fandangos de Huelva	1.07

Table 1: Cluster quality for various style combinations.

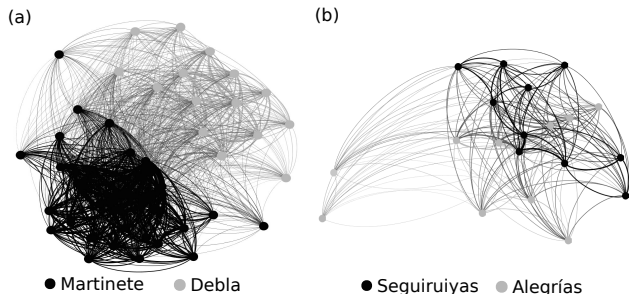


Figure 2: Graph visualisations of melodic distances.

3. TONALITY

In flamenco music, apart from major and minor, we encounter a third scale, the *flamenco mode*: While its diatonic structure is identical to the *phrygian mode*, the dominant is located on the second and the subdominant on the third scale degree. Among the three considered styles, the *alegrías* are set in major mode, *seguiriyas* in flamenco mode and the *fandangos de Huelva* are bimodal in a structural sense, where the guitar plays in flamenco mode during its solo sections and modulates to major when the vocals set in.

In order to detect and investigate tonality across styles, we analyse the distribution of occurring pitch classes (Gómez, 2006; Temperley & Marvin, 2008): We extract pitch class profiles from automatic vocal transcriptions and chromagrams of guitar sections and compute the correlation with pitch class templates for the major mode taken from Temperley & Marvin (2008) and for the *flamenco mode*, which we have estimated by analysing 40 flamenco recordings from this tonality.

Displaying the resulting correlation values obtained from the vocal melody across styles (Figure 3 (a)), clearly reflects the mode affinity of *alegrías* and *seguiriyas*. The *fandangos de Huelva* seem to be spread across both tonalities, which indicates a weak tonal identity. This is an interesting finding, since vocal melodies of the *fandangos de Huelva* are in literature referred to as being sung in major mode (Fernández-Martín, 2011). Further studies indicate a typical pitch class distribution in the *fandangos de Huelva* which differs clearly from the major mode known from Western music. When analysing the same illustration for pitch histograms extracted from guitar sections, we identify a clear separation tendency between the *alegrías* which are played in major mode and the *fandangos de Huelva* and *seguiriyas* in flamenco mode.

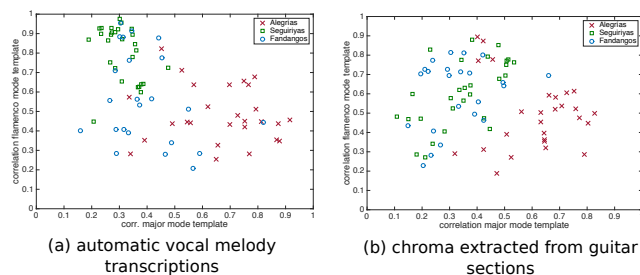


Figure 3: Histogram correlation with major and flamenco mode templates.

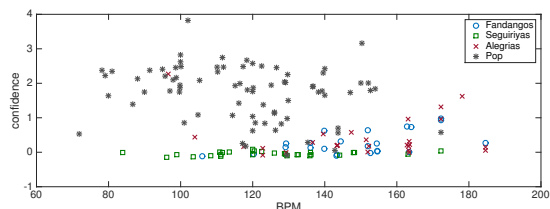


Figure 4: Estimated tempo and confidence.

4. RHYTHM

Flamenco is based on a complex accentuation of style-dependent metric structures: While the *fandangos* are set in a 3/4 meter, both *alegrías* and *seguiriyas* are based on a 12/8 pattern. *Seguiriyas* are performed in slow tempo with weak rhythmic accentuation and tempo fluctuations. The faster *alegrías* are characterised by a complex accentuation shifting between on- and off-beat, which is often emphasised by hand-clapping. In the case of *fandangos*, the tempo and its stability can vary strongly among performances.

We apply a beat tracking algorithm proposed by Zapata & Gómez (2014) to estimate the tempo value in BPM and together with confidence value. We compare the tempo estimates obtained from the three considered styles to the estimate for pop recordings taken from the *Jamendo*¹ dataset.

The results in Figure 4 indicate that the flamenco recordings yield overall lower confidence values than the pop recordings, probably due to the irregular accentuation. Among the styles, the *seguiriyas* obtain the lowest confidence values. Both *alegrías* and *fandangos de Huelva* are on average estimated to have a faster tempo and return a higher beat confidence.

5. DISCUSSION

We have introduced the task of automatic flamenco style detection and have shown the limitations of existing problems. Based on the findings of this study we identify a need to develop novel descriptors related to melodic, harmonic and rhythmic content targeting style-specific characteristics. In particular, we aim to develop systems capable of extracting chord progressions, characteristic melodic patterns and the underlying metric structures.

¹ <http://www.mathieuramona.com/wp/data/jamendo/>

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