PLAYER IDENTIFICATION FOR TRADITIONAL IRISH FLUTE RECORDINGS

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ABSTRACT

The abstract should be placed at the top left column and should contain about 150-200 words.

1. INTRODUCTION

1.1 Background

Irish Traditional Music (ITM) has progressed from its roots of social dance music to become a medium for listening. Represented at several large-scale music festivals in Europe and the US, and over 1500 weekly 'sessions' where musicians can meet and share repertoire, the indigenous music of Ireland has a large, international audience [21].

Playing of the wooden simple system flute (see Figure 1) in ITM was historically linked predominantly to the west and northwest of Ireland. The Irish cultural revival has allowed the flute to play a wider role as an intrinsic part of the sound of ITM alongside tin whistles, accordions, and fiddles [23].

Traditional flute players are individuated based on their use of techniques such as ornamentation, phrasing and articulation [12, 13, 14, 18] alongside idiosyncratic timbral differences [1, 2, 22]. Mastery is judged by creativity and technical ability within the stylistic bounds of traditional music and distinctive characteristics often develop organically as a player learns and refines their skills.

In order to determine stylistic differences between players, we must first develop methods to detect these differences in audio signals. We evaluate recordings produced by six accomplished traditional flute players, all playing music from a predetermined corpus offering a range of typical modes and rhythms.

1.2 Related work

The influence of instrument and player in the production of flute timbre has been studied by changing the flute material and wall thickness, showing that each has little effect on the overall sound produced and that individual players contribute more to spectral differences [4, 8, 22]. Analysis of three players across six wooden simple system flutes showed significant differences between long-term average spectrum (LTAS) plots of different players when compared to a single musician playing different flutes. Analysis of short-term harmonic magnitudes was also performed using the stable central portion of each note, showing differences between magnitudes of the first four harmonics [2]. A dataset of 20 commercial recordings containing four traditional Irish solo flute melodies from each of five players was analysed by comparing harmonic magnitudes of all instances of particular notes [1].

The methods above rely on signal processing but state of the art identification techniques use probabilistic modelling. Convolutional neural networks (CNN) have been used for audio classification by converting recordings into 20 ms window size spectrograms with 10 ms overlap [15]. The use of CNN to automatically detect musical patterns has also been successful with 13 Mel-frequency cepstral coefficients (MFCC) being used as input features, representing timbre, tempo and key variations [16]. A CNN

Figure 1. Player with keyed blackwood simple system flute.

was trained to perform artist and genre recognition on the 'Million Song Dataset' [5] using segments related to note onsets and feature vectors containing 12 timbre and 12 chroma components [10].

Lidy & Schindler [17] used CNN to classify genre, mood and composer as part of MIREX 2016. FFT was applied with a Hanning window of 3072 samples and 50% overlap, a 40-band Mel filter being applied to the resultant spectrogram. Accuracies per fold of over 65% for genre, 60% for mood and 67% for composer were returned.

Costa et al [9] performed music genre classification on three separate databases containing Western, Latin and African music comparing CNN with handcrafted features and support vector machine (SVM) classifiers. Each database was recorded to a different specification and a Discrete Fourier Transform with a window size of 1024 samples and Hann window function was computed. This was then represented visually as a spectrogram showing a 60 second excerpt from each track. The CNN system compared favourably to other classifiers in a number of scenarios, particularly in the case of African music where the sources were largely field recordings. When labelled by country, function, ethnic group and instrumentation, over 90% accuracy was reported for country and ethnic group, and over 70% for instrumentation.

CNN are also used for automatic musical instrument classification [20] and recognition in ensemble-based recordings [11]

The remainder of this paper is structured as follows: Section 2 details the method of segmentation, feature extraction and classification. In Section 3 we discuss evaluation of.... Results of the studies into ... are presented in Section 4 and finally conclusions and further work are discussed in Section 5.

2. METHOD

2.1 Convolutional neural networks (CNN)

In order to capture the stylistic differences between each player we divide recordings into 5 second segments. We then extract timbral features as these are important in class distinction. Each player contributes distinct timbral features as part of their style. For that purpose we extract 40 MFCCs, excluding the first coefficient, to accommodate for differences in timbre over a range of played notes.

2.2 Overview

3. EVALUATION

3.1 Dataset

For these evaluations, we require a dataset that is representative of a range of respected players with individual stylistic traits. The dataset comprises of 247 recordings of traditional 'tunes' played on solo flute and includes 168 recordings of 6 experienced players alongside 79 released recordings of 9 professional players detailed in [3].

The dataset is representative of the four most popular melodic styles, namely the reel, jig, hornpipe and polka

Tune Title	Type	Scale	Ends on
Maids of Mount Cisco	Reel	G	Ray
The Banshee	Reel	G	Soh
Cooley's Reel	Reel	G	Lah
Banish Misfortune	Jig	G	Doh
Morrison's Jig	Jig	D	Ray
The Home Ruler	Hornpipe	D	Doh

Table 1. Corpus recorded by all players detailing tune type, scale and ending note

[12]. The structure of most traditional melodies in ITM can be attributed to two scales, D and G, and four classes defined by the ending note of the tune and given the solfa name Doh, Ray, Soh and Lah [7, 19].

The corpus of tunes shown in Table 3.1 was chosen to be representative of a typical player repertoire and to represent a range of scales and classes. 6 players played each tune twice without tempo restriction and twice in time with a click track played through headphones and set to represent a typical speed according to [6]. Players also recorded two other tunes picked from their own repertoire.

3.1.1 Recording

The recordings were collected as 16-bit/44.1kHz WAV files using a Thomann MM-1 measurement microphone connected to an Audient ID14 audio interface. The microphone was positioned above the midpoint between the 3rd and 4th toneholes, as shown in Figure 1, in order to minimise wind noise.

3.2 Evaluation of methods

3.3 Onset detection evaluation

3.4 Note and ornament classification evaluation

4. RESULTS

4.1 Sub1

4.2 Sub2

4.3 Sub3

5. CONCLUSIONS AND FUTURE WORK

6. REFERENCES

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