

# A comparative between Mel Frequency Cepstral Coefficients (MFCC) and Inverse Mel Frequency Cepstral Coefficients (IMFCC) features for an Automatic Bird Species Recognition System

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**Abstract**—In this paper a comparative between Mel Frequency Cepstral Coefficients (MFCC) and Inverse Mel Frequency Cepstral Coefficients (IMFCC) features for an automatic bird species recognition system is proposed with the aim to validate IMFCC as a feature that can also be extracted for bird species recognition. In biodiversity monitoring task there are some traditional techniques and, bioacoustics studies biodiversity by a noninvasive way based on the relationship between animal species and its sounds. Bioacoustics methodology for avian conservation are based on automatic speech recognition techniques and one of the traditional extracted features in this area are MFCC. Nevertheless some new studies uses IMFCC as a complementary frequency information. From results, it is concluded that IMFCC features have better performance than traditional MFCC features but, performance still depends on the recognized bird sound.

**Index Terms**—bioacoustics, bird classification, HMM, IMFCC, MFCC.

## I. INTRODUCTION

Biodiversity monitoring represent an invaluable tool in conservation and climate change reduction [1], [2]. Although there are some traditional invasive monitoring techniques, a noninvasive method is preferred. Bioacoustics studies biodiversity based on the relationship between animal species and its sounds.

Bird species are very sensitive to climate change and its conservation and understanding represents an important challenge [3]. In this sense, bioacoustics traditional methodology for avian conservation are based on automatic speech

recognition techniques [4], [5], [6], [7]. Although there are a huge variability of techniques and features to be extracted from sound, one of the traditional features in speech recognition, are Mel frequency cepstral coefficients (MFCC). Despite the high efficiency by using MFCC features, some new studies proposes the use of inverse mel frequency cepstral coefficients (IMFCC) as a new perspective that take into account frequency information missed by MFCC features improving the spectral modeling [8], [9], [10], [11].

Even though MFCC features have been applied in bioacoustics, the application of IMFCC features in avian conservation systems have not been applied yet. In this paper a comparative between MFCC and IMFCC features for an automatic bird species recognition system is conducted with the aim to validate the use of IMFCC features as a feature that can also be extracted for bird species recognition. From results, it can be observed that IMFCC features give better performance than traditional MFCC features. However, the performance still depends on the bird species to be recognized.

In the following: Section II explains basic mathematical background of MFCC and IMFCC features. Section III present the used automatic bird species recognition system. Section IV summarized the comparative results between MFCC and IMFCC features, and some discussion. Finally, Section V concludes this paper.

## II. FEATURE EXTRACTION: MFCC AND IMFCC

### A. MFCC

Human perception of sound can be described by the Mel scale and MFCCs are based on this configuration. The basic idea is to capture sound frequencies by a filter bank and

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