PITCH INTERVAL DETECTION AND CLASSICAL FLUTE PEDAGOGY: AN 'ELEMENTARY' CONNECTION

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ABSTRACT

Pitch is our perceptual evaluation of frequency. Detecting pitch is an important step in determining and assessing music performance. To that end, we propose that distinguishing pitch intervals and their relationship to harmonic content may aid in self-assessment of music performance techniques. This paper describes the implementation and initial findings of using offline pitch interval detection to help flutists learn and refine their comprehension of pitch and harmonic relationships.

1. INTRODUCTION

Technological tools, such as computational music analysis (CMA) and music information retrieval (MIR), are integral components for music assessment. These research tools help to advance our knowledge and study of music, both perceptually and cognitively.

The flute is one of the oldest known musical instruments. It provides a rich resource for music assessment because of its monophonic, sinusoidal-like waveform. The flute also has a long-standing pedagogical foundation from which to extract and to study key performance techniques. In this short paper, we investigate the use of offline pitch interval detection in flute performance to inform a musician of his or her performance technique with regard to the specifics of pitch or frequency.

2. BRIEF STATEMENT ON PEDAGOGY

Pedagogy involves how we tutor or teach a subject, which, for our purposes, is the study of flute instruction. This encompasses many aspects of learning how to play the flute, including hand positioning, articulation, breathing, and technique, to more advanced concepts, like music theory. (McBrearty 2010) Our preliminary study focuses on music theory, with special attention to the perceptions of pitch and pitch intervals. This research applies to an intermediate level player; one who has already mastered the basics of producing a decent tone on the instrument, knows most or all note fingerings, and knows how to decipher beginner-level music. While an intermediate player can produce notes, the flutist might not be able to perceive pitch intervals within a musical phrase or to comprehend their relationship to the musical phrase. The ability to detect pitch intervals becomes essential in music training, to develop pedagogical training from beginning to intermediate level.

2.1. Table of Pitch Intervals

A pitch interval is the ratio between two pitches (or frequencies). Flute players use equal temperament for tuning, as opposed to just intonation. This means that each successive pitch is mathematically derived using the 12^{th} root of 2 (see **Table 1**).

Interval	Pitch ratio
Unison	1.000000 : 1
m2^{nd}	1.059463 : 1
M2^{nd}	1.122462 : 1
m3^{rd}	1.189207 : 1
M3^{rd}	1.259921 : 1
Perfect 4^{th}	1.334840 : 1
Aug 4^{th} Dim 5^{th}	1.414214 : 1
Perfect 5^{th}	1.498307 : 1
m6^{th}	1.587401 : 1
M6^{th}	1.681793 : 1
m7^{th}	1.781797 : 1
M7^{th}	1.887749 : 1
Octave	2.000000 : 1

Table 1 Equal Temperament Pitch Interval Ratios

3. CMA & MIR IMPLEMENTATION

Music Information Retrieval (MIR) is the science of retrieving and assessing music information, such as melodic, rhythmic and harmonic aspects, often using digital signal processing (DSP). Computational Music Analysis (CMA) is also the study of gathering music information, but with an emphasis on the human

component of assessing the analysis component, such as with algorithmic evaluation.

3.1. Pitch Interval Detection

We use the MIRToolbox (Lartillot, *et al*. 2008) as a basis for our system. Pre-recorded solo flute music is used for training and initial testing of our pitch interval detector. First, we call a custom, sample-based onset detector using `mironsets()` and iterate through `frames{i}`, derived from the number of onsets. Within that iteration, we extract the `mirpitch()` after an `mirautocorr()` and `mirpeaks()` assessment. We store the most recent and the current pitches, and then calculate their interval through ratios and use **Table 1** to compute the intervallic relationship between the pitches. By modifying the arguments taken in by each function, we can improve the analysis.

4. DISCUSSION & CONCLUSION

In this short paper, we speculate about the relevance and the importance of interval detection within the scope of self-assessment in music performance. We describe the pedagogical as well as the musical implications of our research.

Although initial results take place offline, as opposed to in real-time, they provide a valid basis for further investigation. We propose a more comprehensive, long-term evaluation, as well as an exploration of CMA and MIR assessment tools beyond the MIRToolbox. Using this proposed system in real-time, an intermediate flute player will be able to interact with and self-assess pitch intervals, thus extending his or her playing technique and knowledge of pedagogy.

5. REFERENCES

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