ASSESSING QUALITY OF SOUND EMISSION IN BEGINNING CLARINETISTS USING OPTIMIZATION PROCESSES

Francisco Chávez[1] **Francisco Fernández de Vega**[1]
[1] Department of Computer Science, University of Extremadura, Spain
{fchavez,fcofdez}@unex.es

ABSTRACT

One of the main problems that beginning clarinetists face is the proper understanding of specific terms that teachers introduce as a way of analyzing the kind of sound produced by the student. Although the goal is to provide insights on how to improve, typically students misunderstand the terms that they will only properly comprehended after years of practicing with their teachers. Among the terms applied to a proper clarinet sound, centered sound is one of the most commonly employed, although not the only one. This paper is a first attempt to shows some of the analysis required over the sound emitted by the student, so that a software tool can be later developed capable of classifying quality and sound center in real-time, and will ultimately help students to improve even when the teacher is not present.

1. INTRODUCTION

Properly playing any musical instrument usually requires a number of years of practicing under the guidance of an expert. Thus, a young student interested in playing clarinet, for instance, will study under the supervision of a professional clarinetist, who taking the role of an expert teacher tries his student to reach a desired dexterity with the instrument. Nevertheless, the small number of hours that the student spent with his teacher, typically one hour per week in the Spanish conservatories system, and the language employed by the teacher makes it difficult for the student to properly understand the way of improving. Thus, reaching the level of a professional clarinetists typically takes ten years in Spain.

When dealing with the terms employed by teachers to describe the quality of sound produced by students, a number of labels can be found, such as: *color, texture, sound center, focused sound, dark or bright sound, etc*. Although the terms can be connected to physical components of the sound, instrument, and physical actions performed by students, such as overtones of the main frequency, or embouchure, to name but a couple, the fact is that the connection is not clearly described by teachers. It is thus difficult for students to understand what is described, and it takes long to first learn the differences in sound quality, their relationship to labels employed when describing the sound, and finally physical actions that may change that quality of the sound.

Some authors have already studied the influence of physical elements producing the sound in the clarinet, such as [1], [3], and also how to measure the quality of an instrument, [4]. Yet, to the best of our knowledge few have studied how to provide software tools that both analyze the sound quality components due to students performance while also providing real-time advice on how to improve.

This paper presents a first approach for qualitatively analyzing some components of the sound, with the idea of developing a software tool that can be easily employed by students when practicing at home. The technique employed will allow to provide real-time feedback on the quality of the sound, so that the student will have larger capability for reacting and improving, and hopefully reduce the number of years required for playing the clarinet. Although this research have been applied to clarinet, a similar approach could be applied to other wind instruments.

2. DISPLAYING AND ASSESSING SOUND QUALITY

Many possibilities exists to analyze sound quality, but we resort here to some basic components of the sound signal that can be analyzed and showed on real-time, thus providing the basis for developing software tools, such as android applications, that can be easily used by beginning clarinetist to get quick feedback during their home practice.

3. ANALYZING SOUND QUALITY

We have first displayed the spectra computed over the sound produced by a beginner, an experienced clarinetist, and finally by a well know performer in the clarinet world: Sabine Meyer. We have simply recorded several seconds of sound produced by the beginner and the experienced clarinetist, and we have later extracted some seconds of solo performance by Sabine Meyer on Mendelssohn Clarinet concert N. 2. After applying a fast Fourier transform to some of the samples from the record, we obtained the results provided in figures 1, 2, 3. We can clearly see that the

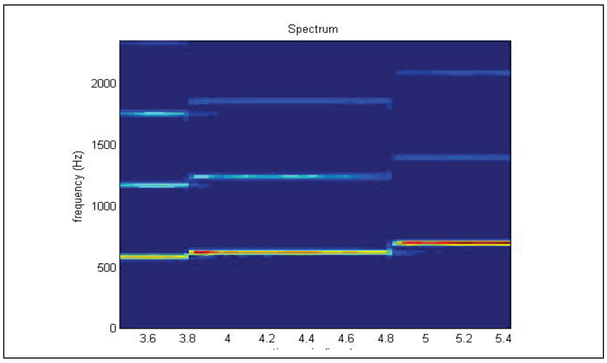

Figure 1. Student spectrogram

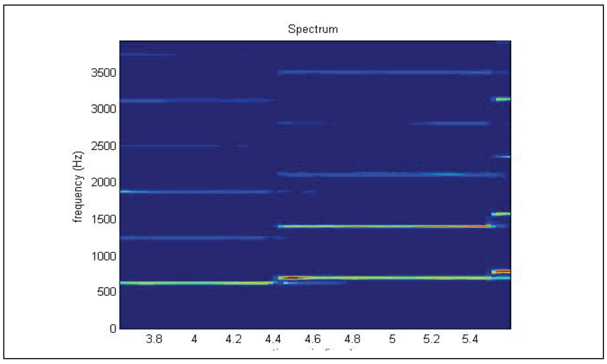

Figure 2. Profesional spectrogram

number of overtones grows progressively from the student to the pro, and from it to the one produece by S. Meyer. This means that information obtained from the spectrograms can be easily applied to decide whether the sound quality is high or low, by simply taking into account the number of overtones displaying high energy: the larger the number of overtones, the better the sound quality.

4. FUZZY CLASSIFIERS AND SOUND CENTER

On the other hand we have also considered how sound center can be measure and then how a proper real-time classifier system could be developed. Considering that sound center is related with how every note belonging to different registers in the clarinet are tunned, and the difficulty for properly tuning high register clarinet notes, for

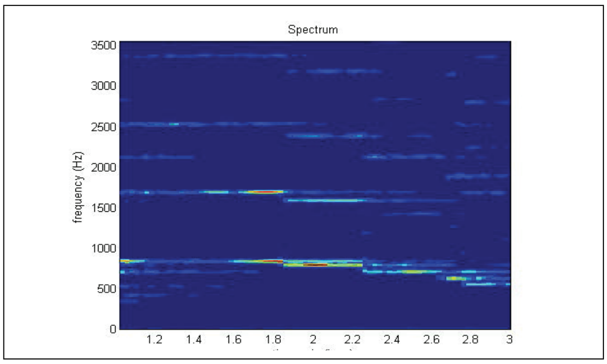

Figure 3. Sabine Meyer spectrogram

	Success Rate Training		Success Rate Test	
	SR-C1	SR-C2	SR-C1	SR-C2
$\bar{X}$	62.67%	65.70%	59.06%	59.30%
σ	10.64	10.94	13.05	12.37

Table 1. Success rate in training and test process. SR-C1: Success Rate Class 1 (Sound centered). SR-C2: Success Rate Class 2 (Sound not centered)

instance, we have considered the possibility of allowing a machine learning method to learn from samples extracted from sound properly centered and also from clarinet sound which clearly is not centered.

In this first approach, we have asked a clarinet player to produce sound with both qualities. Each of the sound has then been sampled, and then differences among the fundamental frequencies produced and those that should have been really produced -given that the instrument is tunned to 440 Hz, for instance- computed. This information has been then provided to a Fuzzy Rule Based System that tunes the rules by means of an evolutionary algorithm [2].

We applied a well-known 5-fold cross-validation process and the preliminary results are shown in table 1. The results show us that although we still have large variances the success rate show a way to developing useful tool capable of telling students whether the sound generated is centered or not.

5. ACKNOWLEDGEMENT

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