Intonation Properties of Clarinets and Methods of Their Measurement

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Abstract
The intonation curve of wind musical instruments is a basic parameter for assessing of their quality. The BIAS system is destined for measuring intonation properties especially of brass musical instruments. By measuring intonation properties of woodwind instruments using this method it is very complicated to replace the excitation mechanism (mouthpiece and vibrating reed).

Introduction

The BIAS system uses wideband noise signal for the excitation of airspace inside the tube of a musical instrument. The dependence of the input acoustic impedance on the frequency is determined from the response.

The aim of the experiment was to verify the possibility of using the BIAS system for measuring the intonation properties of woodwind musical instruments, especially of clarinets.

The way of exciting the airspace inside the musical instrument differs in brass and woodwind musical instruments. On brass instruments, it is human breath with a mouthpiece; On a clarinet, is the airspace exciter the vibrating reed on mouthpiece. It is necessary to replace this complicated excitation mechanism to a simple physical model for measuring the intonation properties of clarinets using the BIAS system.

Replacement of the mouthpiece and reed is not ideal, and the influence of the final impedance and imperfect closing of the airspace adds errors of measurement, especially at high frequencies. The task here is to find a suitable corrective curve, which describes these imperfections.

Experiments

The frequency of the main resonance peak is obtained by measuring several tones using the BIAS system. The intonation difference is the subtraction of this frequency from the right frequency of the tone in tempered tuning. The intonation curve of the clarinet is the dependency of these intonation differences on frequency for the entire tone range. The second method for defining the intonation curve is using a musician, where intonation differences are measured using an automatic tuner.

The intonation curve of 14 clarinets was measured using both methods. The chromatic scale was played live by a musician. As a musician has an automatic tendency to correct each tone, a so-called intonation test was also played. The intonation test contains all tones within the tone range of the musical instrument, but in random order. The intonation curve contains the average values of these two measurements. Intonation differences were measured by the KORG automatic tuner and processed by the computer.

The intonation curve of the clarinet was also measured by the BIAS system. Fig.1. shows an intonation curve measured by the automatic tuner and measured by the BIAS system. The necessary corrective curve for this method of excitation and for this instrument is the difference between both these measurements.

The resulting corrective curve describing some of the imperfections of replacement of the excitation mechanism of the clarinet are the average values from all measurements (fig.2.). This corrective curve was interpolated by the curve of the third order.

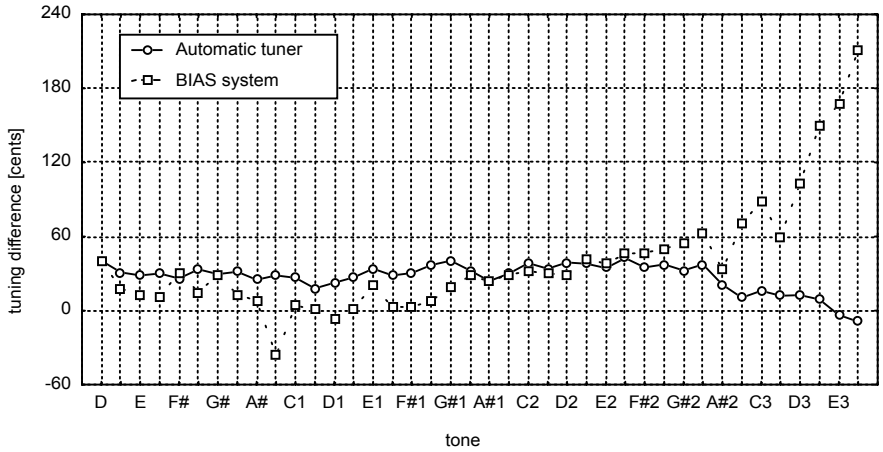

Fig. 1. : Intonation curve measured by the automatic tuner and intonation curve measured by the BIAS system.

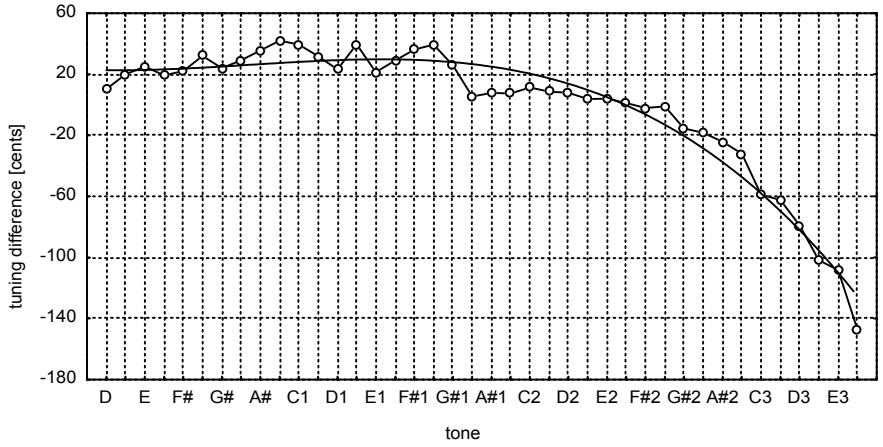

Fig. 2. : Resulting corrective curve for the measurement of the intonation properties of clarinets by the BIAS system.

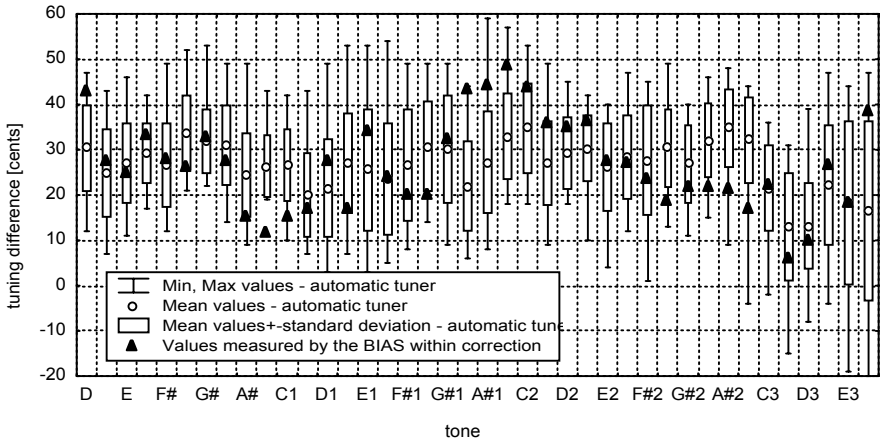

Fig. 3. : Comparison of the values measured by the automatic tuner and values measured by the BIAS system within the correction.

Results and discussion

It is likely possible to use the BIAS system to ascertain the resonance properties and intonation curves for woodwind instrument as well. When we measure the clarinets using this method it is necessary to use the corrective curve (fig.2.) on measured results. This curve represents measurement error resulting from imperfections of the clarinet excitation mechanism replacement model.

Important question is also the suitability of the calculation algorithm of the response for this group of musical instruments.

The moisture on the inside of clarinet has a large bearing on its intonation properties. This problem can not be simulated by the BIAS system.

It is also imperative to search for a more suitable replacement of the excitation mechanism of woodwind musical instruments.

Conclusions

Our experiment was carried out using a clarinet with classical inner diameter. The corrective curve also describes errors measurement of the intonation properties of these clarinets using the BIAS system. The physical properties of the clarinet barrel (length, inner diameter, surface finish, etc.) are very important for the intonation of the clarinet.

It will be interesting to verify the results of the experiment for the clarinets with other sizes of inner diameter or with other surface finishes.

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