An Investigation of the Clarinet Reed's Vibrating Surface Area

Whitney Coyle,[†] *Carter Richard*

Rollins College

[†]wcoyle@rollins.edu

ABSTRACT

A hope for many musicians is that they will find an instrument that will play "in-tune" without significant effort on their part. Thus, in order to design a "playable" clarinet the tuning tendencies and tuning homogeneity throughout the range of the instrument must be known. The playing frequencies of the instrument depend on several control parameters including the blowing pressure, reed opening and the instrument's input impedance. Using analytical formulas we can now rapidly predict these frequencies based on the different control parameters and resonance frequencies. The analytical formulas take into account four effects known to influence the playing frequency. The effects are each included separately: reed-induced flow, the reed dynamics, the inharmonicity of the resonator and the temperature gradient within the clarinet. The effect of reed-induced flow has been found to be the cause of the largest frequency shift and it is therefore necessary to ensure the accuracy of the input parameters for this effect. One user input constant for this effect is the vibrating surface area of the reed, Sr. Due to the nature of playing this reed instrument, this value is difficult to determine experimentally. Past studies give a range of values for this parameter, Sr, but none agree what this value should be. The analytical formulas also assume a uniform, rectangular region that is vibrating as a cantilever beam. This may not be an accurate enough description of the reed vibrations and the model could be improved through better understanding of this parameter. This paper will present a brief parameter study showing the sensitivity of the current model to the parameter choice for reed-induced flow and detail the techniques used to investigate more closely the actual value of Sr including the use of vibration mode analysis of the reed using ESPI (electronic speckle pattern interferometry) as well as high-speed camera analysis of the reed while it is being driven by an artificial blowing machine.