Improving the production of bassoon reeds using additive manufacturing

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Introduction

The production of instrument reeds has remained unchanged for thousands of years, utilizing the unique properties of reed cane. This material provides the musician with a unique combination of hardness, flexibility, and density that is ideal for instrument reeds. Double reed instruments, specifically bassoons, use a more complex reed that requires much more precision and fine tuning. The production of traditional reeds (Figure 1) is time consuming, and premium synthetic reeds (Figure 2) made of polypropylene cost more than $150 and are only available from one source. Synthetic reeds offer more durability and consistency, without requiring constant maintenance. A possible alternative to these production methods is to use a 3D printer. By using a 3D printer, the produced reed may have the same advantages as the premium synthetic reed, at a much lower cost.

Materials and Methods

Based on measurements of traditional reed by Ewell & Williams (2002), a 3D model of a reed was made using SOLIDWORKS® software. This 3D model was then printed using Polyjet additive manufacturing (AM) technology, with different reed designs being printed on a high quality Objet® 500 ConnexTM 3D printer. The reeds produced were compared, tested, and improved based off of the troubleshooting tips used for maintaining traditional reeds until the design provided a reed that was playable (Figure 3). Reeds were then compared to a traditional reed using frequency graphs to determine the design that is closest in sound to the traditional reed (Figure 4).

Results

The reeds were played on a Fox Renard bassoon, and the sound was recorded with a laptop running Audacity® in a quiet environment to reduce ambient noise. The recordings were then analyzed with a Discrete Fourier Transform (DFT) to generate a frequency spectrum and imported into Excel for analysis. Graphs were generated for each DFT to easily visualize the frequencies. A similar process was used by Blais (2011) to evaluate the deterioration of a reed’s quality over time.

The final reed designs were compared with a traditional reed and evaluated for optimum cost to performance ratio. The cost was assessed by a combination of the amount of material used in the printing of the AM reed, the time consumed in printing a single reed, and the labor cost of preparing the reeds. The performance was assessed with a 95% confidence interval for the differences between the traditional reed and each AM reed design, with the interval that is closest to zero having the best performance. The current reeds have intervals around 0.5 for the crow, 0.07 for the chromatic intervals around 0.5 for the crow, 0.07 for the chromatic

Conclusions

With a design that has been established and verified as being reasonably close in sound to that of a traditional reed, the advantages of improved consistency and durability associated with premium synthetic reeds could be available at a more reasonable price. These reeds could replace the traditional method of handmade bassoon reeds, being more time efficient and yielding more consistent performance. A reed manufactured using AM would be especially valuable to the beginning and student bassoonist, or one that is unable to make their own due to material or time limitations. With further testing, this design could be perfected to provide consistent and durable quality at a reasonable price. These reeds would be a great addition to the current methods of reed making, and similar processes, with minor modifications, could be applied to other reed instruments, such as the oboe or clarinet.

References