Virtually Reconstructing an Ancient Musical Instrument

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This project aims to help restore ancient Greek musical tradition and, thus, give us a better understanding of Greek culture by digitally reconstructing the chelys, a tortoise-shell lyre over 2500 years old. In past studies done on the instrument, sound tests were conducted on a physical reconstruction, a process both inefficient and expensive. To overcome this difficulty and study how the natural variability of tortoise shells affected sound outputs, my project designs a method of digitally modeling the instrument such that its dimensions can easily be changed. The frequency at which a material tends to vibrate when a force (in this case, a sound wave) acts on it is known as its eigenfrequency. When an instrument's strings are tuned to its eigenfrequencies, sound waves will have a higher amplitude, improving the quality of the instrument. This project uses analytic geometry to derive a geometric system describing the chelys's sound box, where dimensions are input parameters. Using this model, I attempt to find the best dimensions of the chelys through maximizing the number of eigenfrequencies around each of its seven notes. In addition, I investigate why the Greeks might have changed to using wood as the material of the sound box. Finally, I attempt to discover the optimal reconstruction from resources widely available today. My methodology can be generalized for use in studies of other instruments. Furthermore, it provides informative simulations of an instrument when there is insufficient evidence to reconstruct it from its archaeological remains.

Awards Won:

Third Award of $1,000

American Mathematical Society: One-Year Membership to American Mathematical Society to each winner (7 winning projects, up to 3 team members per project)

American Mathematical Society: Third Award of $500