Art or Science? String-Bow Interactions on a Novel Optoelectronic Cello

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A quantitative analysis comparing player's perceived quality of cello bows and rosins, and string motion has been carried out using a novel optoelectronic cello. Novel optical sensors directly measured the absolute string displacement of each string independently. The sensor is a dual-segment photodiode placed close to the string, illuminated by a laser diode, with the string casting a shadow on the photodiodes. The differential signal across the photodiodes is proportional to the string displacement. Data files were reviewed for time and frequency domain signatures. Results were acquired from five cellists, two different cello bows (one of perceived high quality and one basic) and three different grades of rosin. Data showed that string motion would resolve into distinct modes. The high sensitivity of the optical sensor allowed the moment of the bow first touching the string to be observed. The delay from first touch to initiation of a regular mode of string motion was measured. A correlation between this time delta and perceived bow quality was observed. It was noticed that sudden changes in the mode of the string motion would occur when the note "broke", a sudden change in the audible tone. A correlation between the rate at which these breaks occur and the quality of bows was found. In summary, two distinct time domain measurement approaches have been investigated: with (perceived) higher quality bows and rosins, the transition time from bow touch to establishing stable tone is shorter, and the ability to maintain a stable tone is greater.

Awards Won:

Third Award of $1,000

University of Arizona: Renewal Tuition Scholarship