Violin exercisers

Measurement and review by David Andrews

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Violins are made to be played. Like the human body, they respond to and improve with sensible exercise. Not everyone can play their violin(s) as much as they would like: they need a little help.

In April 2010 I launched an Acoustic Enhancer Mk1 which proved very popular with players, makers and dealers. Reports were more than favourable, some even most enthusiastic. Several people asked for objective corroboration of what their ears and hands told them. Although I was convinced good things were happening, I did not have any actual evidence of tonal changes. The following tries to rectify that.

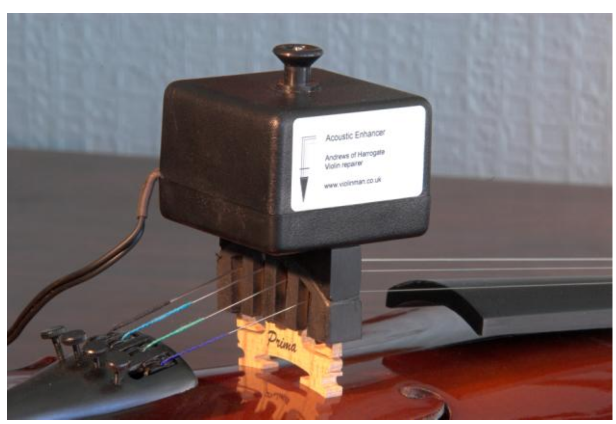
I first read about this vibration theory[1] where the author has bought a well-used but very ordinary violin …

> *which, although every judge knew it to be a trade instrument, was not inferior in tone to an Italian one … This led me to imagine that constant vibration shakes the resinous particles out of the wood, whereby rendering it more porous and better adapted for producing a good tone, than it otherwise is.*

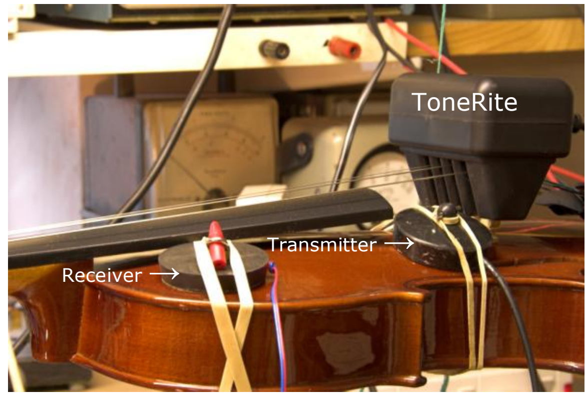
The author refers back to the procedure detailed in his 1828 edition of the same book in which true perfect fifths are bowed for 15 minutes each, starting at the bass end with open G and open D. Then a silk cord is tied accurately in the half position as a barré so producing Ab and Eb. A and E follow and so on chromatically rising until all fifths in 1st position are covered.

With the aid of electronics could I devise a method for similarly stimulating the violin and measuring the results?

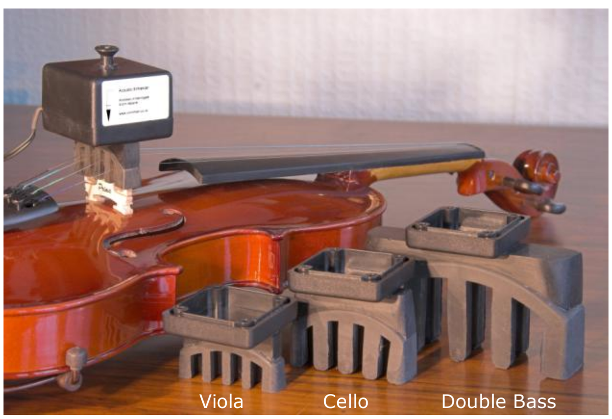
There are two main units on the market at present - ToneRite® [2] and the Acoustic Enhancer Mk2 [3].



The ToneRite comprises a vibrator (coil and rubber-mounted spring/armature) on a custom-made rubber fitting which hugs the bridge. It is powered by 115v @ 60Hz (US) or 50Hz (UK). For UK use a transformer from 240v to 115v is needed, available from Caswell's for £11.50. The amplitude (not the frequency) of the vibrations can be varied by an in-line rotary control. Typical output measured by the receiver transducer (see right) ranged from 25mV p-p[4] to 220mV p-p. The unit produced a very quiet buzz.
A separate ToneRite is needed for each instrument.

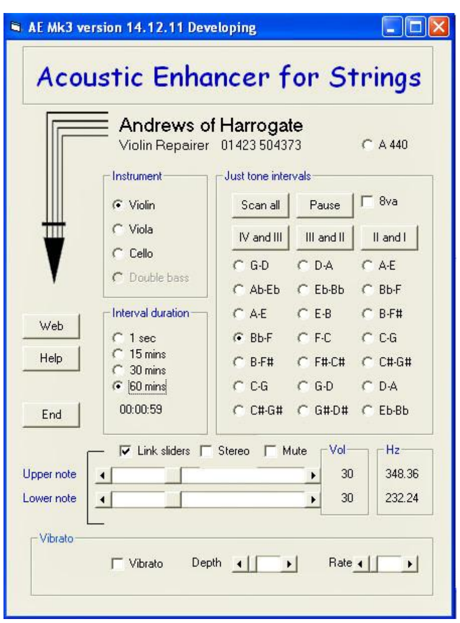


The AE Mk2 (and Mk 1) uses a 12v DC brushless motor. The base plate is fixed to a yoke attached to an Ultra heavy rubber practice mute which hugs the bridge. It is powered by a switchable 3-12v DC "wall wart" (3 pin UK) working on 90-240v AC input at 50/60Hz. For US use 2 pin adaptor is needed. Typical output measured by the receiver transducer ranged from 40mV p-p @ 25Hz on 3v DC to 1000mV p-p @ 100Hz on 12v DC. The unit produced a very quiet buzz on low voltage settings which increased in line with the DC voltage and frequency.



In the Mk 2 version, base plates are available for violin, viola, cello and double bass (see left), and fit to the vibrator by four screws. One vibrator and four base plates thus cover the whole string family. Also, the minimum operating frequency (and noise) is lower than that of the Mk 1.

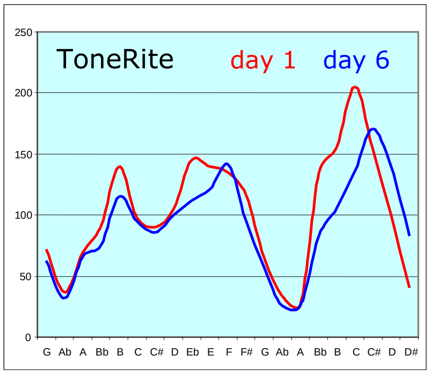
To measure the effects of the stimulation I devised an AE Mk3 where PC-produced sine waves were amplified and fed to the transmitter. The resulting voltage from the receiver was a measure of the "acoustic conductance" of the wood. The size of the voltage in mV depended on many factors but I was only interested in the comparative voltages, with all other variables held constant. The set up was a simpler version of one used in a university physics laboratory to examine the acoustic(al) properties of wood[5].

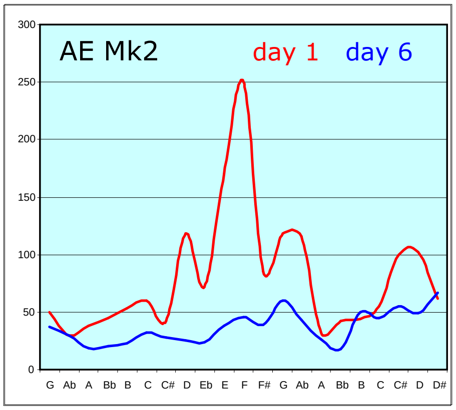


The software runs on a standard PC or laptop and produces sine waves through the soundcard line/headphone output socket. This feeds a specially-adapted 3 watt amplifier powered from the USB port 5v line, which terminates in cascaded miniature transformers to raise the output impedance to something approaching that of the piezoelectric transmitter (in the MΩ region). The resulting output voltage is about 20v p-p (approx. 7v rms) from the 5v supply. All the first position semitones on a violin, viola and cello are produced, together with the just tone perfect fifths above. A cycle function allows each note or interval to sound for up to 60 minutes before moving up the chromatic scale. Thus I had simulated electronically Jacob Otto's chromatic fifths. By noting the output of all semitones on a virgin instrument[6] and running the ToneRite and AE Mk2 for 6 days before taking another set of readings, graphs showing any changes were compiled.

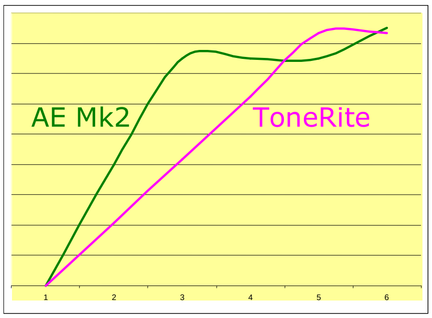
The ToneRite graph shows a reduced peak around C, but otherwise the contours are similar across the 6 days.

The AE Mk2 has removed most of the irregularities resulting in a more even sound.





An aside – quite a few hours were spent trying to track down a note an octave below that produced by the software. For example, low G on the violin has a frequency of 195Hz, and yet when sounded with the D above (293Hz) there was a strong note produced of 97.5Hz. But, this note was not showing on any instrumentation. Eventually the light dawned: I was hearing the Tartini tone, strongly produced by a just tone fifth, but not produced at all! It was a product of non-linearity in everyone's ears. Apparently some electronic organs use the technique to produce a 16′ pitch for free.



Readings were also taken to assess the "acoustic conductance" of the violin when stimulated by both devices rather than by specific notes of the AE Mk3. Starting with virgin instruments in both cases, it is clear that both devices caused an improvement in response over the 6 days (see left). The AE Mk2 peaks at 3 days whereas the ToneRite takes 2 days longer. This is probably due to the relative powers of vibration of the two devices.

So far I have only been able to achieve a general improvement in the response of the instrument. Several players asked me about localised treatment – to minimise a wolf note or enhance a particular string for example. That was the reason I devised the AE Mk3: it applies a specific frequency or small range of frequencies to the violin. Whilst useful for testing the effects of the ToneRite and the AE Mk2, it did not cause any detectable changes when used on its own. Perhaps greater power is needed, comparable with the dB output of bowed strings as in Jacob Otto's original. However, I'm not sure I could live with those sound levels over hours let alone days! As they stand, both devices tested run inconspicuously. Having no defined audible pitch, they can be used in musical environments.

Summary

a) Whilst playing a violin is the best exercise, where that is not possible (too many or too little time), both devices will improve the instrument.
b) They are also useful for settling an instrument after repair, bridge or sound post change.
c) Low amplitude (low noise) vibration in the 25-100Hz region improves the response of all the notes on the violin.
d) Optimum duration for treatment seems to be 3-6 days but can continue safely indefinitely.
e) ToneRite costs from £149 (violin) to £199 (double bass) plus £11.50 for the transformer needed in UK, from www.caswells-strings.co.uk. Post free over £150.
f) Acoustic Enhancer Mk2 vibrator with power supply costs £55 plus £22-£44 for bases from www.violinman.co.uk (UK post paid). Non-UK prices are slightly higher to include Airsure Small Packet tracked delivery. Free US or EC mains adaptor included.

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[1] *A Treatise on the Structure and Preservation of the Violin* by Jacob Augustus Otto 1848, pub. William Reeves, London

[2] http://tonerite.com/.
UK supplier http://www.caswell-strings.co.uk/shop/search.php?orderby=position&orderway=desc&search_query=tonerite

[3] http://www.violinman.co.uk/Acoustic%20Enhancer.htm

[4] p-p is the voltage between the positive and negative peaks of the sine wave when viewed on an oscilloscope. RMS (root mean square) is about 35% of the p-p value and is measured on a (milli)voltmeter.

[5] http://online.physics.uiuc.edu/courses/phys199pom/Labs/Sonic_Mechanical_Resonance_DAQ_Syst.pdf

[6] Each test cycle used a new Primavera 100 4/4 violin from The Sound Post to ensure comparability.