Response to the Reviewers of MS 32444: "Using Hilbert Curves to Organize, Sample, and Sonify Solar Data" submitted to the *American Journal of Physics*

by W. D. Pesnell, Kyle Ingram-Johnson, and Kevin Addison

Dear Drs. Romano and Price,

Thank you for the reviews of manuscript MS 3244, "Using Hilbert Curves to Organize, Sample, and Sonify Solar Data," being considered for publication in *American Journal of Physics*.

We thank the referees for their comments. The comments have improved the paper, while unfortunately increasing the length a little, but the new version should withstand their scrutiny.

We added a co-author in this revision.

None of the reviewer comments argued against the paper being published. Although a detailed rebuttal of those comments is not included changes I made are highlighted in bold in the revised manuscript. I implemented many of the specific points raised by Reviewer #1. Reviewer #2 has some excellent ideas for further ways to sonify solar data that are discussed here.

I think the manuscript is ready for publication in *Journal of American Journal of Physics*.

Sincerely,
W. Dean Pesnell

1. Reviewer #1

The first reviewer was quite positive about the paper. They provided extensive suggestions about ways to improve the paper. I have implemented almost all of those suggestions. I did not change 1-D and 2-D as suggested as that will be up to the editors. Also, treating time series as a compound word is another editorial decision.

The subsections on the EUV spectral irradiance were swapped so that the spectrum is now presented first and then the variation in time. This allowed some of the concepts of the EUV to be more easily explained. The spectrum is a Fourier transform in the electromagnetic spectrum not in time. The rearrangement allows the discussion to proceed in a more linear fashion.

I note that "beat" was defined in line 103 of the original manuscript (line 108 in the revised version.)

I apologize for missing the definition of some of the acronyms. I use Bibtex for the citations and the acronyms were part of those `\cite` commands. That oversight has been fixed.

The 0.1-7 nm channel name is consistently one significant digit and was not changed.

Finally, Audacity does not ingest and interpret MIDI commands except by the indirect method I describe at line 372. We examined other software but elected to only report the sonifications we did and not write a white paper on software synthesizers.

We thank the reviewer for their comments and recommendations.

2. Reviewer #2

The second reviewer was also quite positive about the paper. They made suggestions about ways to represent the data and software that could be used to sonify data. I agree with the need to move past the MIDI standard for these applications. The MIDI timbres are still reminiscent of those I heard in college. JythonMusic was selected because it used Python rather than because it used MIDI. I was working with a high school student who is not a musician and cast the problem in mathematical terms rather than musical performance. The JythonMusic interface was easy to learn and gave rapid results. One way forward would be to work with another musician (I am a performing musician as well as a scientist) who is interested in the electronic side. I was constantly asking other performers about their synthesizer software. None of them used software that ingested data (their software was for live performances) nor were they interested in developing ways to sonify data. I will look at the packages the reviewer listed for other ways to sonify solar data.

A sentence was inserted into the conclusions to summarize these ideas.

I also agree with the idea of preprocessing the data (we tried this when we played the full data over smoothed versions), but that is active research at this time. We have found that it is difficult to convey the concept of motion across an image using sonification but these explorations are in the early stages and were not reported here.

As we point out in the text, sampling along the Hilbert curves does give a better idea of what the data is doing while the raster scan emphasizes the shape of the Sun. I see this as the biggest obstacle in sonifying images containing real data. You can inform people about the gross features in the images or try to give them an idea about the variation of the textures. The Sun is always round so we are trying to emphasize the textures.

We thank the reviewer for their comments and recommendations.