



Listening to glitches

*Peter Saulson
Syracuse University*



Outline

Overview of "audio project" at Syracuse

Methods

Focus on DARM_ERR glitches

What we've heard so far

Are we just hearing the response of our whitening filter? No.

Thoughts on what we've heard, and what to try next



Overview of SU "audio project"



Since the spring, the Syracuse group has started listening to DARM_ERR and other channels from our detectors, to see if we can learn things missed by other methods.

Participants: Josh Smith (postdoc), and two undergrads: Gavin Hartnett and Dave Evans.

Gavin focused first on listening to response to loud audio injections.

I reported on his study of "wawa" response at a DetChar telecon.

Today, I want to report on Dave Evans's study of the sounds (and time-domain waveforms) of DARM_ERR glitches.



Methods

We download the data of interest using GUILD.

Whitening is done in MATLAB. We apply custom-tuned high pass, low pass, and (many) notch filters, using a MATLAB script developed in GEO.

The MATLAB script also writes the whitened data as a file in .wav format.

We then explore the .wav file using *baudline* (www.baudline.com), an interactive spectrogram display tool available for Unix (but not Mac!)

Results are available on several web pages:

<http://www.phy.syr.edu/research/relativity/ligo/restricted/audio>

<http://www.phy.syr.edu/research/relativity/ligo/restricted/glitch>



Why listen to DARM_ERR glitches?

When you listen to the ifo in the control room, you can hear a lot of different things going on.

- » seismic noise/upconversion
- » violin modes
- » mirror modes
- » locking/unlocking transients
- » cross-talk (in, say, H1) from swinging mirrors of unlocked other ifo

Goal: to hear the different character of different glitches, in the hope that classification will lead to clues to the origin and solution to glitches from different sources.



Dave's glitch page



Dave Evans has started accumulating a number of glitches (first from H1/H2, now adding L1) on his webpage:

http://www.phy.syr.edu/research/relativity/ligo/restricted/glitch_catalog

The major section of the page is a table listing glitches by their time, and giving links to graphs of the waveform and links to .wav files of the filtered DARM_ERR signals.

Dave also gives his personal classification of each glitch.



Some sample glitches

Glitch 6: A "sine Gaussian" in H1 and a "ringdown" in H2

Both sound at first just like "thumps", but the "ringdown" is perhaps (?) a bit more musical.

You can hear our whitening filter transient at the beginning of the H2 file.

Glitch 10: four H2 "ringdowns"

Glitch 28: H1 "sine Gaussian"

Glitch 68: many "sine Gaussians" in H1

L1 Glitch 5: a few more unmusical glitches

This is almost no variety. My student is bored, and this time I can't blame him.



*Is it our fault that they
all sound almost the same?*



It isn't our filter transient.

That is at a much higher frequency.

You can listen from a link at the top of the webpage.

*We can faithfully hear injections, which don't
sound like glitches.*

Glitch 36: Injected sine Gaussian

Glitch 73: Injected ringdown



Did Dave pick the wrong glitches?



Dave selected his glitches from the BNS glitch site linked off of the S5 run page, and from Glitch shift reports.

His selections haven't (yet) been very systematic, though.

Still, it is hard to see how he could have selected these all to be so much the same.

Why are they all so much the same?



*Why do they sound
so much the same?*



A lot of work of the Glitch Team is based on the assumption that we can classify glitches by their causes, as revealed by the other signals that they are coincident with.

But, shouldn't glitches with different causes give responses in the ifo that are somehow different?

What should universalize the response?



What we'll try next



I've asked Dave to systematically work through glitches from lists that classify them (PowerMag, ISS, seismic, etc.) to carefully check whether or not you can hear the difference.

Other suggestions?