

## SOUNDTHEORY GULLFOSS INTELLIGENT EQ

Happy with my frequency balances, tones and dynamics, I've been disappointed with the width and imaging of my soundstage, even though I typically analog sum mixes for the soundstage depth. Once mastering squeezes out all but the last 9 or 10 dB of dynamics, I'm underwhelmed, wishing I had more separation, more clarity and less congestion. If only there were a way to easily fix that beyond better rooms, better hearing and better skills. Well, I think now there is.

Gullfoss is an intelligent equalizer that employs a sophisticated algorithm that has modeled what the human ear likes to hear, can apply those standards at varying user-selected degrees to incoming audio, utilizing EQ changes in tremendous number and frequency (up to 100 times per second) and increase the perception of clarity, space and dimension—and do all that without latency, artifacts



or phase destruction. This probably sounds as impossible to you as it did me, as it should.

What makes all this possible is the depth and versatility of said algorithm; developed by Andreas Tell, an Icelandic fellow who dedicated 12 years of his life to the research behind Gullfoss (which is also the name of an iconic Icelandic waterfall and popular tourist draw). His work

had much to do with quantum physics and mathematical theorems, more so than psychoacoustics or artificial intelligence.

The controls provided are not typical: Recover seeks to find elements within the mix, correct their equalization and phase relationships, and bring them more to the forefront. Tame seeks to find elements with too much prominence in your mix, cor-

rect their balances and subdue them. Bias allows you to choose your bias toward Recovering or Taming during moments of threshold in a fine-tuned way beyond the relative settings of Recover or Tame. Detail allows you to dial in more (or less) top-end and brightness, while Boost allows you to tailor the “loudness response curve” perceived as largely bottom-end response, with a boost or cut.

### Gullfoss Inventor Andreas Tell Tells All

By Rob Tavaglione

**Tavaglione: Is Gullfoss intended for most/all tasks, or particular applications? Would you say it's advisable for individual tracks, subgroups or primarily whole mixes?**

**Tell:** We have not really finished exploring the usefulness of GF [Gullfoss]. It's definitely useful on individual instruments, mix buses and the master stereo sum, but we've also cleaned up dialogue and greatly enhanced stereo live recordings, especially those done with very simple equipment. You know how frustrating it is if you put your 2-track recorder on the table in your acoustic jam session and the recording sounds nothing like it was when you were there? GF fixes that amazingly well and restores that feeling of being right in the middle of it, so we certainly won't limit the use cases to a few intended ones. As a scientist, I love to experiment and I can only recommend trying the same.

**How did you come up with this concept?**

**Tell:** I was doing a lot of live sound for a band I was involved with. I usually received compliments for the sound, but I was never entirely happy myself. At some point I realized that the problem was nothing I could solve with an EQ—or, in fact, any tool available at that time. I didn't quite know what the solution could be until another question randomly came up in a discussion: “Why do waterfalls sound so pleasant?” You're probably tempted to answer with “Because they sound like pink noise!” but that's not really an answer. Why does pink noise sound pleasant then?

At this time, I was already deeply involved in researching auditory perception, and we had been working on this particular model for many years, so it was obvious to try to use the model to see what pink noise does to it. We found that pink noise could even be improved upon, but also, more importantly, that the reason why it sounded good was very deep and could be generalized to a much more powerful concept that would also give an answer to the other question, “What can be done with live sound to improve it beyond simple equalization?”

The actual insight is difficult to formulate in simple terms, but it is essentially about information.

What we found was that the amount of information reaching the brain, as modeled by our perception algorithm, could be maximized by dynamically equalizing the signal depending on its content. Maximizing this information translates to a more pleasing sound with more detail, clarity, spatial precision and presence. And it is exactly what GF does.

**How did you manage to model the psychoacoustic perception and traits that we desire in our audio?**

**Tell:** The model we use is based on an idea that I came up with more than 15 years ago. In order to understand where I came from, it's also important to understand that we are not really using psychoacoustics.

“Psychoacoustics” is the name of the discipline that describes acoustical perception by means of empirical methods. The methods usually involve listening tests, and produce tables listing the description of the perception of test subjects to certain sound stimulation. Such experiments are extremely difficult to interpret and hard to evaluate because of the subjectivity of perception. Also, because hearing is very deeply nonlinear, these specific listening conditions and stimuli are not easily extrapolated to a more general auditory scenery. In other words, working with psychoacoustic methods is a lot of frustrating guesswork and bad approximation.

I was very aware of that back then and did not find the signal processing methods related to perception and, more generally, time-frequency processing very satisfactory. The academic physics research I was doing was all about quantum theory, but apparently auditory perception was always in the back of my head. The mathematical methods I had used and developed eventually inspired me to take a different approach to time-frequency analysis. This led me to a formulation of time and frequency that was deeply about geometry and information, and, later, to a purely theoretical construct that describes perception as a process that, under the pressure of evolution, optimizes certain informational properties. The resulting computational perception model is therefore based on first principles with very few free parameters that depend on the actual physical realization of the human auditory system and can be estimated easily.

This is also why GF is all about information. We don't apply any measures of aesthetics based on what music has been successful earlier. Instead, we try to please your brain in a very fundamental way and leave aesthetic decisions to the user.

**Is Gullfoss considered to be “artificial intelligence” or simply objective intelligence?**

**Tell:** This is a difficult question. The modern understanding of artificial intelligence is very closely linked to machine learning, which does not find any application in our technology. As a theoretical physicist, I much prefer to understand every aspect of a model and work from first principles.

Training a black-box neural network with examples of what it should be doing can be impressively successful, and recent progress in deep learning certainly gave a few stunning examples for that. However, it also has a number of problems. Machine learning methods often reproduce very well what they have learned, but then fail spectacularly at extrapolation. Another related problem is that of “overfitting,” or favoring certain aspects over others. There is very little you can do about it other than training longer with more examples, but the selection of these examples already creates a bias for the result. So in this context I would probably say no, GF is not artificial intelligence; it is insight and careful design.

**Is this the end, or the beginning? That is, does Soundtheory hope to apply such intelligence to other audio processing functions? What might we expect from you in the future?**

**Tell:** Oh, we're definitely not stopping here! Our auditory perception model has many applications that we need to explore. And apart from that perception model, we also have a few more algorithms that may find use in a future product. Where exactly we are going has not been decided yet, but in the short term, we will invest more work into GF to make it even better; what comes after that remains to be seen.

For an extended version of our interview with Gullfoss founder Andreas Tell, visit <https://www.prosoundnetwork.com/pro-sound-news-blog/gullfoss-inventor-andreas-tell-tells-all>

Whenever engaged, Gullfoss exhibits the amount of work it is doing with a frequency/amplitude display that rapidly bounces with the frequent boosting and cutting. Vertical meters show the Bias, the amount of Recovering or Taming, and the input and output level, as well as a pair of frequency filters (the red lines at the extreme left and right). These filters allow you to contain Gullfoss' EQ-ing to only the frequencies that lie between the frequency extremes you exclude, or you could reorder the two filters to create a bandpass-filter excluding a specific frequency range. The process will seem less complicated once you jump in and begin to tweak around.

Recover and Tame have a range from 0 to 200; upon taking each up to a mere 25 or so, the mix begins to clean up, revealing inner detail and clarity, as if the smoke got sucked out of the room. Take those controls up to 75-ish and the mix seems to jump to life with separation, transients, detail and attack. Take things up over 100 (which Soundtheory does not recommend) and finally things begin to get just a little too aggressive. A little too rude and crisp, the processing is then audible, but not loaded with artifacts like you might think. Still,

like most things audio, moderation is the key to success.

Pull those controls back to reasonable levels, fiddle with Bias a little, maybe rebalance the top to bottom a touch, and the rewards are quite obvious in the sweet spot or headphones. Your mix gets bigger and wider, depth and detail are increased, murky low-mids are removed, transient detail is enhanced and the EQ balance seems more even and consistent. Out of the sweet spot, you cannot tell all of the above improvements, but EQ is definitely improved; in fact, I found that even if the playback system does not allow accurate imaging (car stereos, poorly placed speakers, mono systems) or is frequency-limited (i.e. Auratones), that translatability is nonetheless always enhanced by Gullfoss.

It was as if I had better drum overhead technique and mics, as if my guitars got out from under a blanket, as if my basses had that elusive perfect low-mid EQ sculpt, as if my vocals had a better mic and ideal EQ (and width, as my vocal stereo-izer processors and doubles basked in the glow). My reverbs—and especially my echoes—had an increased intelligibility and imaging I was convinced I could reach out and touch.

Convinced I had found the solution to my mix problems, I began to experiment. Solo mono sources could gain fidelity, if maybe not so much size. Voices, basses, single-miked instruments could all gain an ideal EQ curve, like using the world's most responsive (and least destructive) multiband compressor or dynamic EQ. Stereo sounds, like synths or stereo-miked instruments, came to life with not only idealized EQ, but now with a bigger, wider and prettier soundstage. Stereo subgroups like drums gained significantly, too, with pinpoint internal imaging, better transients and smart, nimble EQ.

I tried Gullfoss on some live on-location gospel mixes I had recently completed, with interesting results. The usual improvements in frequency response, clarity and transient response were there, but I also noticed that a sense of the actual room came through better. I still remember how that choir sounded in that church, and I felt like I could sense that imaging and energy with more truthfulness. I am going to apply Gullfoss to my choir, drum and instrument subgroups (and mixes) in round two of this very project and preserve more of the concert's vibe.

I'm afraid I cannot explain how this works—it defies logic—but I can say that the CPU hit on my black-donut Mac Pro was minimal and I didn't even get a dropout when bypassing/engaging with my Digital Performer 9.51 DAW host. (Gullfoss buffers the audio even when in bypass.) Frankly, I'm rushing this review to press out of excitement, but I hope to find more operational limits over time and repeated experimentation.

Gullfoss is in an Early Access phase now, priced at \$99, but with limited online authorizations only. Once Early Access ends, the price will be \$199 for one offline activation and three online ones.

It appears we now have a growing crop of postmodern plug-in processors that can clearly exceed hardware limitations. I can sense resentment from some of you out there that AI (artificial intelligence) may ultimately spell the end for audio engineers. Gullfoss is not AI, however, just quite intelligent; it requires your experience to gauge severity, appropriateness and artistry. Fear not—it's like my colleague said when testing, "Don't worry, this isn't your enemy replacement. This is the ultimate assistant." [Soundtheory.com](http://Soundtheory.com)



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