

# Sub-Nyquist Sampling While Listening to my Girlfriend

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## Abstract

The issue of listening to my girlfriend [Tiffany](#) while playing Dark Souls games is a long established problem which has yet to find a permanent solution [1]. With the release of the [Elden Ring](#), the need for an efficient sampling scheme in order to maintain enough concentration to defeat the multitude of tough bosses throughout the game is paramount. In order to make an initial play through of [Sekiro: Shadow's Die Twice](#), I got stuck at the [Guardian Ape](#) until I estimated the minimum Nyquist sampling rate while listening to Tiffany and managed to save enough mental bandwidth to finally make it through the third zombie monkey stage of the battle [2]. Likewise, Elden Ring has shown to be filled with boss battles so tough that a sub-Nyquist sampling scheme must be developed to retain all information while listening to my Girlfriend while maintaining enough bandwidth to recognize certain enemy attacks in a split second to effectively dodge. This paper adapts, implements, and tests the [Sampling methodology](#) [3] to create a mixed Modulated Wideband Converter (MWC) so that I only listen to the words I absolutely need to hear.

Keywords: Digital Signal Processing, Relationship Advice, Elden Ring, Speech Processing, Margit the Fell Omen

## 1. Introduction

According to the book Tiffany made me read about the seven keys to a healthy relationship. Effective communication is an important part of making this thing we call love work. We've been through some rough times [4-7], but we both always managed to try and understand each other and make this relationship work by the power of active listening and advanced scientific research performed on each other in secret [8]. Despite successfully tracking her mood swings [7], it is now a daily ritual to talk about our days after work even when things are going well.

Even though it's the first boss, [Tree Sentinel](#) took me more than an hour and a half to beat because I was so distracted actively listening to Tiffany complain about work and how much her mother badgers her about getting married and having kids. Even while listening to the conversations at a minimum [nyquist rate](#), it took me forever to realize I needed to progress far enough to obtain a horse and to hold the left trigger long enough for a power attack. Similar issues have propagated in more early game bosses. A previous meta-analysis of earlier dark souls games have determined that the required concentration will only grow [9] and a better scheme will be required.

## 2. Background

I have had a long and fruitful relationship with Dark Souls games, and Tiffany. Call me a romantic, but the amount of time and effort I've put into speed running the original Dark Souls game has taught me the value of hard work and determination. Likewise, Tiffany's hot. We're also good together, ya know? Like peanut butter and Jelly, ever since college. It's not that I'm trying to ignore Tiffany, I just want to find an efficient way to love both parts of my life.

When a meta analysis showed that conversational information can be easily reconstructed with a third of the words that were spoken, I knew there was a way to do both.

### 2.1 Discrete Tiffany Fourier Transform (DTFT)

As initially developed in [10], the Discrete Tiffany Fourier Transform (DTFT) is able to take the parsed values of Tiffany's tones and uniformly spaced verbal positioning to transform her speech into the frequency domain. This has allowed the development of the Tiffany Conversational Signal Processor (TCSP) [2] and the genius, Ex-Boyfriend Low Pass Filter [11] which stopped a near breakup at the beginning of the pandemic when Jeff started texting her

again out of boredom and she wanted to reconnect. Yeah Right!

The DTFT is a simple transform which takes Tiffany's word placement and value before transforming it into the complex frequency domain. Even when drunk and non-uniformly spacing her words, the [Lomb-Scargle Periodogram \[12\]](#) has been adapted to handle the transform in a robust real-time implementation [13]. The math for the transform can be seen below where  $X$  is the time domain of Tiffany's speech,  $k$  is the position of the sentence of each word,  $N$  is the total number of words in the period of speech and  $x$  is the corresponding value in the Tiffany speech frequency domain.

$$x_n = \frac{1}{N} \sum_{k=0}^{N-1} X_k * e^{i2\pi kn/N}$$

Equation 1: DTFT Equation

Once transformed into the frequency domain, Tiffany's words can be at higher bandwidths by mixing with sin waves and then reconstructed at will!

## 2.2 Minimum Nyquist Sampling Rate

In the study shown in [2], over 80% of Tiffany's words are unnecessary to reconstruct information. Once trained, I could understand 95% of the information conveyed by Tiffany by listening to one out of every five words once the pattern was decoded.

As previously mentioned, only listening to one in five words from Tiffany allowed me the bandwidth to detect each attack from the Guardian Ape in Sekiro while also not [cheesing](#) the battle like I nearly had to do. Though every five words is as efficient as possible, more attention is required for many of the early bosses of Elden Ring. I have begun the game as the [Wretch class](#) and it's much tougher than I anticipated.

## 2.3 Margit, The Fell Omen

[Margit, The Fell Omen](#) is an early game boss in Elden Ring which is insanely hard to beat. Even though I beat all of the [recommended bosses](#) ahead of time and have equipped the [wolf summon](#), he is too tough to beat with only 80% of my mental bandwidth.

After doing some cursory analysis, while I may be able to bring Margit down to 60% health before dying from his fast attack, Tiffany is going through some serious office drama because of some legal issue right now and it is getting to be too much to listen to her problems while managing to get the timing correct on my own dodge. After running some

simulations on the probability of strikes both offensive and defensive with my average response time, it appears that I have a 0.1% chance of beating Margit the Fell with my current build and strategy.

Alternatively, I could spend two hours grinding some nearby units to increase my Wretch character's stats high enough to increase the odds to 5 percent with an expected win at 20 attempts according to the geometric distribution. I could also spend sixteen hours developing a more efficient TCSP to buy back some more concentration. Needless to say, the long term investment of a better TCSP proved to be the correct choice considering the long term impacts for the current and future playthroughs of Elen Ring and other Dark Souls games.

## 3. Sub-Nyquist Sampling Scheme

Using the Xampling method developed in [3], a more efficient method was found. The words used by tiffany create a large bandwidth when transformed by the DTFT. In essence, only particular bandwidths of the transformed Tiffany data contain actual information. When this was determined, a multi modal Modulated Wideband Converter (MWC) was created to only transform the important spectrum of her speech while filtering out the rest.

Next a higher dimensional tonal transform was used to prioritize information as with a percussive filter as utilized in [14] in which a voice recognition system dissected the speech of a Scottish accent by tracking curse words, voice percussion and emotional back-propagation for system learning. Because the last attempt at using a machine learning model to understand Tiffany's emotions went so poorly due to her complex nature [7], we will be only transforming her speech into a condensed text to be translated by myself.

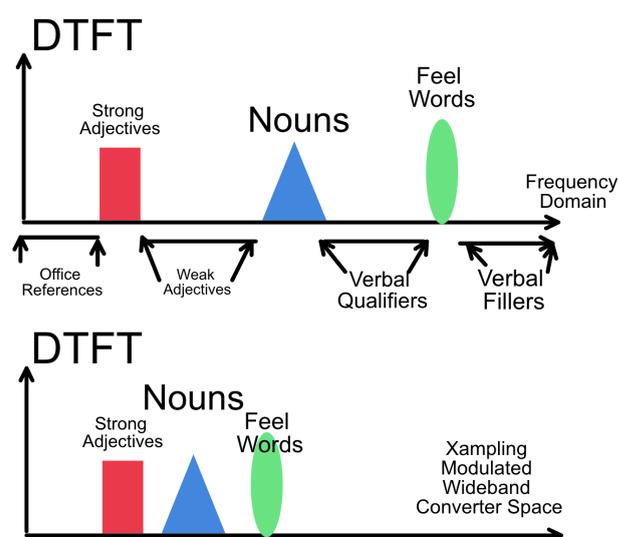


Figure 1: MWC Conversion of DTFT Space.

### 3.1 Band Selection

It's tough to understand what part of speech to prioritize. Discussed in preliminary research, Tiffany's speech patterns are incredibly sparse [2]. According to the information in figure 1, much of her speech is unnecessary for information reconstruction.

Accordingly, Tiffany stores the majority of her information in specific nouns, particularly people and places, as well as strong adjectives, and strong feel words. These of course are not to be confused with the strong feel words contained in the filler speech such as general verbal fillers, Sad Dad Band lyrics, weak adjectives, verbal qualifiers and the low frequency but predictable office references. A colleague recently completed a meta study in which 83% of American women were found to repeat office references at an alarmingly regular rate. This tendency has not dropped since the Office has moved to the Peacock streaming service [15].

### 3.2 Higher Tonal Dimension

Extremely similar to the system designed in [14], tones, expletives, and feelings are easily translated into parsed speech for machines and humans to better understand. By filtering the actual frequency tone, once coded by a library of historical tiffany audio data, the DTFT can directly better classify speech priority within the TCSP to best inform myself to understand the conversation. Because this can be coded directly from volume and frequency and I already understood the translation of her volume and frequency, these elements were not filtered out of the speech filtering and condensing process of the TCSP.

### 3.3 Band Pass Filtering of Aliasing Issues

Once speech was translated by its own priority, a band pass filter was implemented. While this might have been mixed out by the algorithmic MWC, physically filtering out the rest of the speech information was an important step to prevent any [aliasing issues](#) seen while translating sample data as shown in figure 2.

Previously filtered weak adjectives and verbal fillers were translated through the DTFT into an accidental aliased signal where I thought Tiffany's boss was inappropriately flirting with her, except it turned out he was just being the normal douche bag. It was just an aliasing effect in between the weak adjectives modifying the boss's assistant who totally had a puppy crush on her but didn't have the cajones to do anything about it. Kevin's just always needed to move on and hit on girls his age.

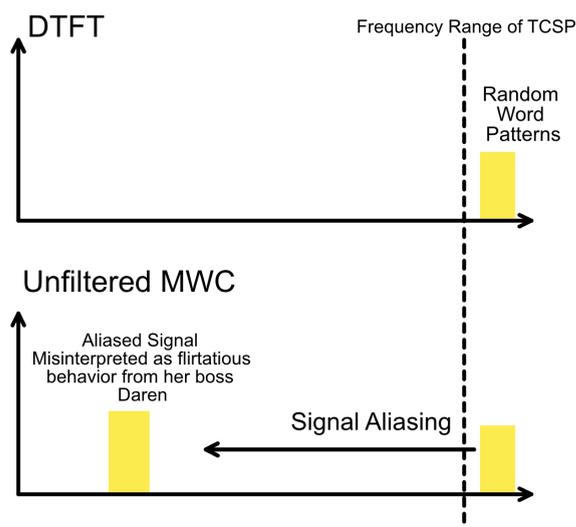


Figure 2: Aliasing example from TCSP

## 4. Digital Board Design

Ideally, the newer efficient TCSP would need to work in real time to create any benefit in my current play through of Elden Ring. The system made up of four raspberry pi's, microphones, A/D converters, and a Skateboard mobile central processor can be seen in figure 3. Once completely processed, the output Tiffany conversation is fed into the headphones.

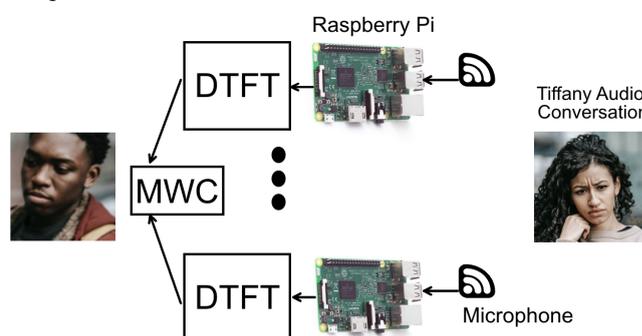


Figure 3: Digital Board Design for TCSP

Meanwhile, real time tones will remind me that I should repeat Tiffany's phrases and ideas from what she is talking about so that I can express to her that I am indeed listening to what she's saying.

While most of the office references are incredibly predictable, a separate tone is induced to remind me to feign a laugh at each one. As discovered from [4], she will not continue to love me if I do not share an equal love for the workplace based drama.

## 5. Results and Discussion

After the new TCSP was programmed calibrated with a Sekiro run from the beginning of the game to the [first Genichiro fight](#), the new and improved TCSP was

operational. Once dialed in, the initial metrics did appear to filter out more of Tiffany's speech than previously filtered by the previous scheme achieving Sub-Nyquist frequency.

Now implemented, the new TCSP was then tested by further attempting to defeat Margit, the Fell Omen while Tiffany complained about her day. I was able to finally defeat the boss only after a dozen tries. The amount of time survived and percentage of health of Margit is shown in Table 1 which show's a steady decline in Margit Health remaining on death as I learned how to defeat the boss.

Attempt	Time Survived	Margit Health Remaining
1	1:12	83%
2	1:22	89%
3	0:57	79%
4	1:45	69%
5	2:02	73%
6	1:52	52%
7	2:33	44%
8	2:54	24%
9	2:42	12%
10	3:02	3%*
11	3:31	32%
12	4:12	0%

Table 1: Margit Health

\*That attempt was so close, I almost had him!

It was a huge success! The algorithm managed to translate large swaths of conversations with Tiffany while I was playing video games down to the bare bones amount of dialogue. Unfortunately, after further review, it appeared that it might have filtered out too much. For example, the conversation below translated as such:

*Tiffany: I can't believe Daren gave me all of that stupid bitch work, he always does. Even worse, he almost pulled me off the project because of the deadline we blew which was really Jessica's fault. Are you done yet? How many times do you have to hit that guy before you can move on?*

*Me: Almost, that sucks.*

*Tiffany: I feel like, they're just looking for an excuse to get rid of me. Like, I mean, they don't want to admit it, but if I wasn't there, I don't think any work would get done. Fucking Jessica is always just blowing off work and putting it off until the last minute. Before I know it, everyone thinks it was my task and not hers when someone comes asking questions. I don't know why you play that stupid game. I almost got fired today. Are you even listening?!?*

*Me: I am, Jessica is the worst, that sucks.*

*Tiffany: It's serious Chad! Can you hear me through those headphones? If I can't convince the Daren that it was Jessica who signed those tax forms I might go to jail! My name's all over this paper work because I trusted her. By the time this is over I don't know if I can trust anyone ever again.*

*Me: You can trust me babe, Ah Fuck! I should have fuckin dodged that! This game is Bullshit!*

*Tiffany: Don't you understand, you would be an accomplice if I get prosecuted in this mess. If what I'm hearing is true, those Russian Offshore accounts we managed might be interpreted as treason! I swear if it weren't for Jessica wanting to sleep with that sketchy dude on our Boston trip, we would have never gotten into this mess.*

*Me: Wow, Fuck Russia, I can't believe she's so awful, I hope she gets fired. OH YES! Finally! Got 'EM!*

This period of conversation recorded right before I finally beat Margit, the fell Omen, was translated into:

*Tiffany: Daren, Stupid Bitch work, Blamed me, off project, blew deadline Jessica's fault.*

*Tiffany: excuse, rid of me. No work done if I'm gone. Fucking Jessica. Blow off, everyone think my task. Almost fired.*

*Tiffany: Chad Serious! Headphones! Can't Daren, Jessica tax form jail! Paper work, trust. Trust anyone again?*

*Tiffany: Understand? Accomplice. Russian accounts managed treason. Jessica Sleep dude Boston, mess.*

Because the system was still in a trial state I was able to review the recorded audio and determine that there were some key details that I missed while attempting to beat Margit the Fell Omen. It turns out that below the Tiffany Nyquist sampling rate, there are too many important pieces of information that must be directly translated to avoid what I experienced yesterday.

## 6. Conclusion

While the newly improved TCSP showed promise in distilling normal Tiffany conversation into a small enough bandwidth so that I was able to continue playing Elden Ring, it may be too under-developed to rely on as a faithful Tiffany sampling device. We haven't stopped arguing and I'm still

trying to figure out how Jessica has all of our tax information. While in theory, information may be able to be distilled down to a small number of elements, the nuance of language may be too complex to be subsampled into something I can respond to while playing Elden Ring. It's too hard.

## 7. Future Work

As predicted in [9] the game is getting more tough. I know I need to be a better listener for Tiffany right now, but I can't seem to beat this new dude [Godrick the Grafted](#). I know this new TCSP seems to be causing more problems than it's worth, but this guy is even harder than Margit! We're going to tweak this thing and try it again. It'll work this time.

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