The Whittaker-Shannon (Nyquist) Sampling Theorem states that you can recover a bandwidth of your signal that is half of your sampling rate.

If you under-sample, then you get aliasing, which is when your spectral islands overlap. So, it’s important that your sampling rate can cover a bandwidth that spans the full absorptive feature that you are probing.

Intuitively, your DCS comb stretches from one overlap of the two combs to the next overlap. The number of comb teeth within that window is obviously given by:

The optical spectral bandwidth that is mapped to the DCS comb, is also obviously given by:

By the sampling theorem, you can then recover

As far as understanding the interferogram goes, the above is I think all that you need to keep in mind.

The next thing to consider is what time resolution you have. The time to acquire a single DCS interferogram is given by the “rep rate” of the DCS interferogram:

The trade-off of the time resolution and the optical spectral bandwidth you can recover is what makes higher rep-rates beneficial.

All the spread sheet does I believe is it combines the above information together with the mechanism by which you are locking the two combs. It can’t be that complicated since it is done in excel but thinking in real time while standing in front of an optics table is difficult.

Question: what causes your interferogram to walk? There are definitely equivalent reasons, but the one I can think of is that the # of data points is not the same going from interferogram to interferogram: is not an integer.

Question: it sounds like they were saying it is best to stabilize , but my picture of IP-DFG is that no matter how unstable is, it shouldn’t show up in the MIR. The thing however, is that we do see *cascaded* effects that also show up in the MIR. That we cannot filter out and would be a source of noise. So, then what they are banking on is that does not move much and can be ignored.

The GUI is accurate down to I forget what digit, but it goes to below a hertz. Given that, I’m wondering if we can measure the CW laser frequency by estimating the derivative below:

To get an accurate reading, I think you should lock the beat note first *and* stabilize the CW laser using the temperature feedback. At 1565nm, 1 GHz is about 10 Angstroms. Then, while varying the frequency to lock to, record the change in the rep-rate on the counter widget. If it helps, you can make a GUI that averages the counter widget for some time period. That should tell you what tooth you are locking the CW laser to. With that, you can determine the frequency of the CW laser up to whatever is. Since it is linear, it is to your advantage to step the beat note by the maximum step size you can while still remaining locked (so measure it at 10 MHz, and again at 50 MHz).

It might miss by too much. is on the order of 200,000 so the change in the rep-rate for a change of 40 MHz in the beat-note is on the order of 200 Hz. This means that if you miss by say .1 Hz, then you’re off by like 100 teeth. So you need to average down to 100 microhertz of uncertainty to get within one tooth.

The wavemeter already has an averaging capability and enough sig figs to do that. You need it to between .1 and .01 Angstrom. Anyways, it’s either that or points per interferogram (I still need to understand why). The DAC card we have cannot record that, so we need to know the frequency of the CW laser.

That is annoying however, as it requires that you temperature stabilize the laser, and the moment you don’t it’s off again.

Okay, so procedure goes as:

1. Estimate a CW laser frequency.
2. Quick steps:
   1. Input what wavelength region you want to target.
   2. Calculate the Nyquist window you want to have.
3. Supposing the CW frequency to be exactly right, calculate which comb teeth to lock to given the Nyquist window you want to hit.
4. Lock signal comb to its suggested rep-rate
5. Lock the local oscillator comb to its suggested rep--rate
6. Calculate / measure the rate at which the interferograms are “walking”.
7. With that, determine which teeth you actually locked to, and determine the that is actually needed.
8. Shift either the signal or LO comb to achieve that