



How we freed CD from the analog lock-in amplifier

Digital data collection is software doing the heavy lifting rather than hardware.

Making spectrophotometers as digital as possible is arguably the driving force behind our company's philosophy and achievements.

But it is really hard. You have to be confident enough to walk away from the me-too, good-enough mentality of reaching for a piece of hardware rather than conceiving and writing and verifying software. The challenges are often formidable. But the benefits include greater flexibility, electronic simplicity, and product longevity.

Giving up the lock-in amplifier for circular dichroism was a huge milestone in the maturity of OLIS CD spectrometers. The goal took many years to achieve and was accomplished by a true history-maker at OLIS, an engineer/ mathematician/ programmer, Denghui Cheng.

On the face of it, the software shouldn't be that hard, right? CD is a differential absorbance measurement. One collects two signals, takes their difference, and calls the result the answer, right? Not quite.

The abs(L) and abs(R) signals from the modulator are not instantaneously generated, so that point 1 is caused by left and point 2 is caused by right circularly polarized light. No. Instead, the modulator changes left to right 50,000 times per second with sinusoidal oscillations that take 1/50,000 second. And, along each sinusoidal curve, left and right circularly polarized light are present in amounts that total 100%.

Thus, at the peak, it is 100% + 0%; at the valley it is 0% + 100%; and along the wave to each maximum, the ratio is continuously changing.

The intensity from each signal acquired has to be tagged, sorted, processed to achieve a given abs(L) and abs(R) answer. Everything is synchronized/ timed to match the 50 kHz modulation of the photoelastic modulator.

The competition didn't have Dick DeSa championing this project and they didn't have Denghui Cheng writing the code. So they continue to use the 1960s era lock-in amplifier. And you never have the perfect answer generated from perfect data or the peace of mind that comes with knowing you have the most elegant, direct, and correct equipment.