**continuous spectrum**

“A spectrum having no lines or bands, especially a spectrum of radiation **distributed over an uninterrupted range of wavelengths**.”

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“(Physics / General Physics) a spectrum that **contains or appears to contain all wavelengths** but not spectrum lines over a wide portion of its range. The emission spectrum of incandescent solids is continuous; bremsstrahlung spectra consisting of a large number of lines may appear continuous.”

Collins English Dictionary – Complete and Unabridged © HarperCollins Publishers 1991, 1994, 1998, 2000, 2003

**multivariate analysis**

“A generic term for any statistical technique used to analyze data from **more than one variable**.”

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I found these common definitions on the internet. It is highly likely that the defense will consider referencing these.

From Uzi’s email”

“1. irradiation by a band rather than by a singular wavelength. So, for example, if we find a statement saying that they irradiate with a band of wavelengths between 620-650 nm... The fact that an LED emits a band is not enough. We need to show that irradiating with a band of frequencies is done on purpose to get a desired result.

2. irradiation over a continuous spectrum. Please try to provide your interpretation to this term. The way Bruce interprets this term is that as opposed to "irradiation over a 'range'", which can be a series of wavelengths like: 620, 700, 710, 830, 820, 940 - just a group of discrete wavelengths within the range 620-940 nm, irradiation over a continuous spectrum could be: 620, 650, 680, 710... We need to show that they found the irradiation over a continuous spectrum to be advantageous and serving a desired goal.

3. performing multivariate analysis to obtain the concentration. “

All three above are done by necessity. I hope the explanation below makes sense and can be used to our advantage.

The absorbance of a substance (analyte) in response to **continuous spectrum** (see definition) irradiation is also naturally spread over a **continuous spectrum** (see definition) with magnitude that that is unique to and characterizes the substance. If the substance is irradiated by energy existing only at discrete wavelengths, then the substance can only and will only absorb energy at these discrete wavelengths with the same magnitude that characterizes the substance. At present only lasers can radiate at ‘discrete’ wavelengths (a couple nm). Lamps and LEDs emit a continuous spectrum but LEDs do not emit over the wideband the sun does or a lamp does.

In order to apply **multivariate analysis** (see definition) in spectrophotometry and for other reasons, it is necessary to detect absorbance at discrete wavelengths (over a few nm, the fewer the better). So it is irrelevant weather the irradiating source emits a continuous spectrum or discrete. It’s important that the irradiation spans at least the range of absorbance spectrum of the substance. Emitting at discrete wavelengths has certain advantages, such as affording higher intensity irradiation (results in higher signal-to-noise ratio without tissue heating). However sources that emit at discrete wavelengths in near infrared are not commercially available. So we had (at Biocontrol) and they have no choice but to use a continuous spectrum source. On the detection side, we used a spectrometer to decompose radiation to discrete wavelengths (a few nm to be exact, again the fewer the better) while they may use optical filters to do this. Regardless, the bottom line is that the absorbance needs be determined (after measuring transmittance through or reflectance from the tissue) at discrete wavelengths (each will be a variable in multivariate analysis). The number of discrete wavelengths within the absorbance band of interest is determined by how closely they have to be spaced so that the discrete absorbance spectrum of the substance is a good representation of the continuous spectrum absorbance (relates to accuracy of the concentration estimate). This is similar to sampling in time theory (see Niquist theorem). Unfortunately there is a trade-off here because complexity and cost increase with the number of wavelengths.

The transmitted or reflected radiation at each wavelength is usually sampled over time. Averaging the radiation at each wavelength over time is one way to reduce noise. Additional processing may be used further to reduce noise and/ or other disturbances (offset, drift, etc) before applying multivariate analysis. The partial-least-squares regression algorithm we used (type of multivariate analysis) required a reference at each wavelength and was complicated to compute and even more so to obtain the reference (required individual calibration). The algorithm simplifies to a ratio (just a comparison to reference) in traditional blood oxymetry.