All About MaestroNano

Technical, Marketing & Operational characters

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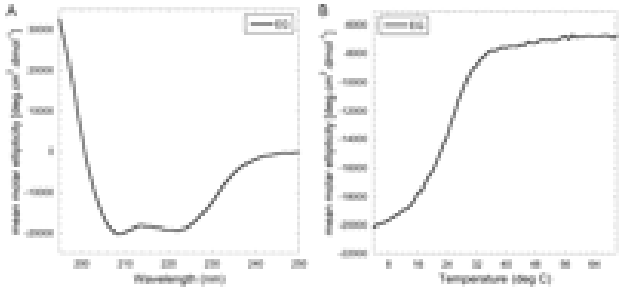
Introduction

There are some kinds of micro-scale spectrophotometers in the market already, but MaestroNano is definitely the most special one. Most micro-scale spectrophotometers measure whole wavelength spectrum from 200nm to 850nm; need calibration time to time; and need installed software in computer to operate.

MaestroNano provides a solution for most-used functions economically for users. Measuring three most useful wavelengths only, rarely calibration needed, and embedding operating system make this outstanding instrument to offer a much lower price compared with other similar products.
These important factors of MaestroNano will be introduced term by term in following paragraphs.

Simplified Function

Almost all micro-scale spectrophotometers are available for detecting whole wavelength spectrum. In theory, this is an outstanding advantage to substitute traditional spectrophotometer. In practical, however, most biological researchers used some specific wavelength such as 260nm more often than other wavelength.



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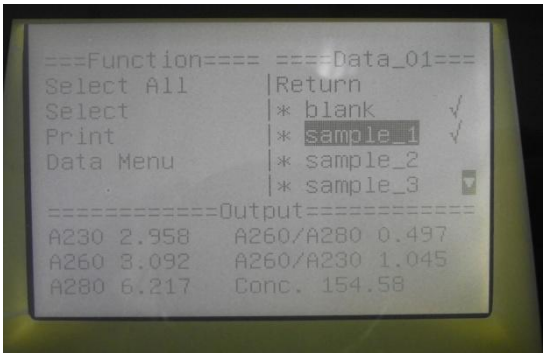
Why do researchers rarely measure other wavelength? The most important reason is to prevent contamination. As everyone may know, many micro-scale spectrophotometers emphasized that they have the ability to measure BCA, Braford, and many other assays. But the truth is: these assays all need to mix with colorful reagents. These colorful reagents are easy to contaminate joint of optical fiber and affect the accuracy of measurement. For this reason, some institutions even restrict users not to measure any assays except general DNA/RNA solution.



It is a little ironic phenomenon. Institutions and labs spend a lot of money to purchase instruments which can support whole wavelength measurement, but just use few functions in 90% time.

Maestrogen observed this problem and provides an innovative solution. Maestro-Nano uses the most useful wavelength: 260nm, 280nm, 230nm for measuring ssDNA/dsDNA/RNA/Protein.

This simplified instrument satisfies most demands of experiments and offers a much more economic price.

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Measuring Capability

The similar situation mentioned in “Simplified Function” section also happened in range of measuring concentration.

Famous brands of micro-scale spectrophotometer all announce very huge capability in samples’ concentration. More than 10,000 ng/ul dsDNA as maximum and 2ng/ul dsDNA as minimum are common specifications.

But in real world, it is difficult to meet the case which requires to measure the concentration for more than 1,000ng/ul. Again, users spend a lot of money but just use few functions. More important, to support a wide measuring range, some micro-scale spectrophotometers sacrifice reproducibility and repeatability. About sacrificing reproducibility and repeatability, there are more discussions in “No Calibration” section.

MaestroNano focuses on the most useful range of concentration, 2~2000ng/ul, that satisfies most of the experiments. Without providing a huge measuring range, MaestroNano also keeps high reproducibility and repeatability and rarely needs calibration.

Repeatable and Reproducible

Introduction of GR&R

Concentration (ng/ul) / SD

Reference dsDNA	NanoDrop 1000	NanoVue
-0.1	0.72 / 0.53	1.14 / 1.83
2.53	3.99 / 0.82	5.06 / 0.82
11.73	11.30 / 0.37	8.04 / 1.31
14.7	16.43 / 0.41	14.86 / 0.76
149.4	149.65 / 0.98	142.8 / 0.54
296.9	296.07 / 3.60	284.5 / 0.33
745	705.13 / 1.85	704.4 / 16.15
1481	1417.87 / 17.42	1344.80 / 90.45
3550	3275.19 / 7.15	3655.60 / 822.79

Until now, the analyses of micro-scale spectrophoto--meter in market are all using standard deviation (SD). SD is an easy way to understand how much the error is, but it can't show where the error come from. In measurement, errors may come from operation, samples, instruments

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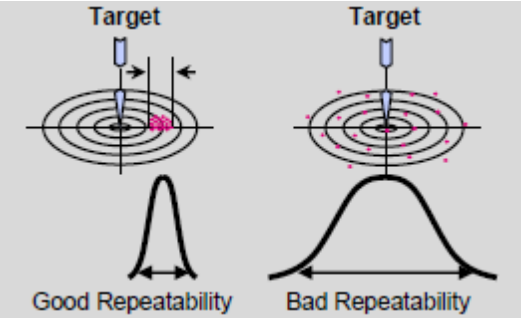
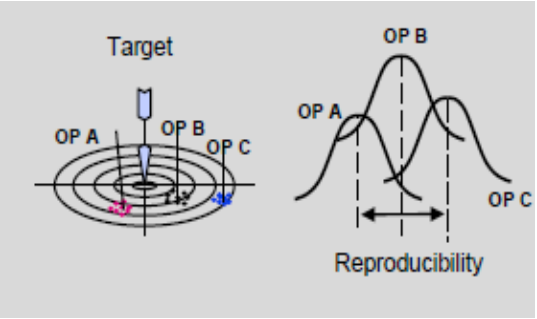
and etc. The most important factor we care is error from instrument and operation. However, only using SD can't really exclude errors from other factors. It would be a blind spot in analyzing performance of micro-scale spectrophotometer.

For this reason, Maestrogen introduces **Gauge Repeatability and Reproducibility(GR&R)** concept into analysis of MaestroNano. GR&R is a general tool in high-end instruments, which focuses on analyzing the errors caused by instrument and operation. It provides a quantitative index to reveal how precise this instrument is. In the real world, there is no existing measuring device being able to give exactly the same measurement reading all the time for the same parameter. GR&R is a method which tries to exclude other factors' effects and focuses on two key factors. To be simplified, SD is a summary of all errors; GR&R is to split these errors and shows the percentage of errors caused by instrument and operation.

Key factor of GR&R

In GR&R's definition, accuracy of instrument could be measured by two main factors: *repeatability* and *reproducibility*.





Repeatability is the ability of the same gauge to give consistent measurement readings no matter how many times the same operator of the gauge repeats the measurement process. Reproducibility, on the other hand, is the ability of the same gage to give consistent measurement readings regardless of who performs the measurements. The evaluation of a gage's reproducibility, therefore, requires measurement readings to be acquired by different operators under the same conditions.

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How to read GR&R

In GR&R formulation, the final presented index is %(R&R). This index means the percentage of repeatability and reproducibility caused errors compare to total errors. For example, total errors might be 10, but errors caused by operators and instruments might be only 1. The other 9 is caused by samples, environment, or other random factors. Using GR&R to analyze data, mathematic formula could identify the real errors caused by real factors is 1 instead of 9. So, when we will get 10% GR&R, it means there is only 10% errors caused by instruments and operators.

Generally, % GR&R located between 0~10% means this instrument is good in repeatability and reproducibility; 10~30% is acceptable; more than 30% is unacceptable.

GR&R Judgment

1. %GR&R < 10% → the gage is good.
2. 10% < %GR&R < 25% → the gage may also be acceptable.
3. %GR&R > 25% → the gage must to be improved.

GR&R of MaestroNano

MaestroNano's % GR&R is 9%, good in repeatability and reproducibility. Another V brand enjoyed 23.68% GR&R. V brand is still acceptable but not as good as MaestroNano.

Brand Name	Maestrogen	V Brand
GR&R	9.81%	23.68%

Source	StdDev (SD)	Study Var (6 * SD)	%Study Var (%SV)
Total Gage R&R	14.008	84.048	9.81
Repeatability	10.916	65.496	7.64
Reproducibility	8.778	52.671	6.15
Operator	0.001	0.006	0.00
Operator*Part	8.778	52.671	6.15
Part-To-Part	142.167	853.002	99.52
Total Variation	142.855	857.132	100.00

Source	StdDev (SD)	Study Var (6 * SD)	%Study Var (%SV)
Total Gage R&R	24.898	149.388	23.68
Repeatability	3.943	23.658	3.75
Reproducibility	24.582	147.492	23.38
Operator	0.001	0.006	0.00
Operator*Part	24.582	147.492	23.38
Part-To-Part	100.743	604.458	95.82
Total Variation	105.142	630.852	100.00

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Even using SD to test MaestroNano, the performance is still good. All numbers of SD/concentration are less than 10%, and don't forget, there is only 9.81% error caused by instrument and operation.

Sample Concentration (ng/ μ L)	Measurement Result (ng/ μ L)	Deviation(%)
5	5.4375	+8.8
50	52.395	+4.8
75	71.900	-4.1
300	307.83	+2.6
500	508.25	+1.7
900	883.10	-1.9
1500	1487.55	-0.8
2100	2123.48	+1.1

No Calibration

Many users of micro-scale spectrophotometer always feel frustrated about calibration. Although manufacturers announced they just need calibration once in half year. In real experience, users have to re-calibrate every 3 months instead of announced 6 months.

MaestroNano only needs calibration once in several years. Why can it do that? The reason is simple. As mentioned in "Measuring Capability" section, general micro-scale spectrophotometers have to satisfy huge range of concentration. So, they need two optical pathlengths to measure samples. (Longer path lengths for lower concentrations and shorter path length for higher concentrations.) In these cases, spectrophotometers have to adjust its distance to measure concentration for deciding which pathlength is the best. However, moving path length time to time always has errors, because for the device to control path length, it's impossible to create the same path length every time. Except that, after being used for period of time, the device would be tired and can't adjust exact pathlengths perfectly. This is not mistake but a natural restriction in mechanical design. When we are talking about calibration, its true

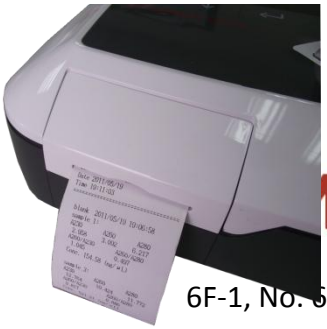
meaning is to re-adjust path length.

MaestroNano shrinks measuring range to 2~2000 ng/ul, which is mostly used and can be afforded by one pathlength. MaestroNano does not have device to change path length, and without adjusting path length, there is no need to calibrate any mechanical device.

For MaestroNano, the only possibility needed calibration is from Xe lamp. Xe lamp is responsible to emit every wavelength we want to measure, having lifetime more than 1 million tests (equal to 10 years roundly). Xe lamps can work normally for long time but its intensity may become weaker after 3~5 years operation. At that time, Maestrogen will update calculation formula to fit this change. So, MaestroNano still needs some calibrations, but only once per 3~5 years.

PC, Printer, and Easy-to-use Interface

From above sections, MaestroNano is a simplified instrument which provides necessary and useful functions. Because of this reason, unlike other micro-scale spectrophotometer, MaestroNano serves users by easy-to-use interface. This interface is embedded in a micro-processer being constructed inside MaestroNano. Users do not need another PC to operate measurement. Besides, MaestroNano also constructs an embedded printer, that users can print out measuring results immediately. There is no need to cost another fee to purchase thermal printer or install printing software.



In primary test, testers admired "User interface of MaestroNano is easy to understand, I even needn't to read user manual." Just follow guideline in

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software and read user manual when it is necessary. Users enjoy the wonderful experiences in using MaestroNano.

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