BK-S430 NIR

SPECTROPHOTOMETER

User Manual



Preface

Thank you for purchasing this instrument.

This manual will show you how to use the instrument and software.

Please read this manual carefully before using Prolab.

Prolab is suitable for:

• BK-S430 NIR Spectrophotometer

The model "BK-S430" will be abbreviated as "S430"

Special Statement

Please read this manual carefully before installation or operation. The company will not take responsible for any trouble or damage due to unproper use.

The company has the final interpretation of this manual. Modifications of the manual due to improvements of the instrument will not be announced.

The company will conduct 12 months free repair from the date of delivery if the instrument is in strict accordance with the instructions and the transport safety specification. (Vulnerability and consumable parts are not included)

Please use our original packaging when returning the instrument for service with accessories and the warranty card.

Any chapteror images of this manual are not allowed to borrow, copy and translate to other languages without permission of the company.

Notice

- 1. The instrument is suitable for analysis in laboratory. If the instrument is needed outside the lab, please make the field work environment meets the environmental requirements of the laboratory.
- 2.Pleaseuse the original package when moving the instrument.
- 3.Pleasewait 30 minutes after turning on the instrument to make it stable.
- 4.When the instrument is on, the temperature of the vents on top left corner is high. Please keep the air circulating and away from the vents surface.
- 5. When the instrument is on, the temperature of the vents on top left corner is high. Please keep the air circulating and away from the vents surface.
- 6. Please make sure the fans on the left side and top left corner operate normally. If the fans are not functioning, please turn off the instrument for repairs.
- 7.When an error occurred by wrong operation or other machine or instrument error, shut down the instrument immediately. When the software is not operating properly, Start TaskManager to end the "Prolab.exe" process, then restart the software and the instrument.
- 8.DO NOT loose the screws in the monochromator. Keep the environment clean.
- 9.Cut the power before opening the instrument. Pay attention to the high-voltage electrical components on the left rear of the instrument.
- 10.Cover the instrument with dust proof if the instrument is not used for a long time.

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1 Instrument Overview

1.1 Theory

The principle of spectrophotometric analysis is to show the substances absorb phenomenon on different wavelengths and do qualitative and quantitative analysis of the substances.

This instrument is measuring base on relative measurement. Choose a certain substance (Distilled water, air or the sample) as reference solution, set its transmittance to 100%. The transmittance of the sample being tested is relative to the reference solution. The transmittance and concentration of the test substance is related. Within a certain range, it is consistent with Lambert - Beer law.

T :Transmittance

A: Absorbance

C: Concentration

K: Absorption coefficient of the solution

L: Length of the liquid layer in the optical path

I: Intensity of light transmitted through the test sample on the photoelectric converter

Io: Intensity of light transmitted through the reference sample on the photoelectric converter

This instrument is widely used in medicine and health, clinical testing, biochemical, petrochemical, environmental monitoring, food production and quality control departments for qualitative and quantitative analysis. It is also as a teaching demonstration and laboratory equipment, and post-secondary institutions and related courses.

The S430 Near-Infrared Spectrometer is a grating-type near-infrared spectrometer. Wavelength range is 1000nm-1800nm. This instrument is mainly used for non-destructive testing of liquid samples. The analysis process is very convenient, Just put the cuvette filled with samplesinto the instrument sample compartment, click on the PC software to get the sample spectral data. The spectrum data files can be opened in other analysis softwares.

S430NIR spectrophotometer can be widely used in oil, alcohol, beverages and other liquid quality of fast nondestructive analysis.

1.2 Appearance



Fig 1.2.1Appearance



1. Sample compartment lid 2.Power switch 3. Fuse 4.Power socket 5.USB Port Fig 1.2.2Left view

1.3 Performance

Wavelength Range	900-2500 nm
Wavelength Accuracy	±0.2nm
Wavelength Reproducbility	≤0.05nm
Absorbance Noise	<50uA
Baseline flatness	±0.001A
Resolution	8nm
Stray Light	<0.1%
Light Source	>10000 hours
Scanning time	<1 minute
Communicate Port	USB2.0
Size	360×460×240mm
Weight	12kg

1.4 Packing List

Main body	1 pc
Power cable	1 pc
User manual	1 сору
Certification	1 сору
Fuse (2A)	2 pcs
10mm Quartz rectangular cuvette	1 set (2 pcs)
2mm Quartz rectangular cuvette	1 set (2 pcs)
Warranty	1 сору
Flash disk	1 pc
Software copy (in the flash disk)	1 сору
USB cable	1 pc
Dust cover	1 pc

2 Environmental Requirements of Software

Please read the manual of Windows XP or higher version before reading this section. Windows XP is recommended.

When the operating system is Windows Vista or higher version, please run the software under administrator account. Otherwise the software may not run properly.

Please change the setting in Power Options"Put the computer to sleep" to "Never". Otherwise it may cause an error while running Prolab.

2.1 PC Requirements

Hardware	Requirements
CPU	Intel 2.5GHz or same level CPU
Memory	No less than 2G
Hard drive	No less than 1G space
USB port	USB2.0
Monitor	Resolution 1024*768 or above
	Color 16bit or above

2.1.1 Hardware Requirements

2.2 Install Prolab

- Boot your computer.
- Insert the Prolab disk, then open "My computer".
- Select your CD Rom in the browser.
- Double click "Setup" to install.
- Follow the steps and finish setup, then restart the computer.

Prolab S430 NIR Spectrop	hotometer Setup	×
	Welcome	
	Welcome to the installer for Prolab S430 NIR Spectrophotometer 0.3.1.323.	
	It is strongly recommended that you exit all Windows programs before continuing with this installation.	
	If you have any other programs running, please click Cancel, close the programs, and run this setup again.	
	Otherwise, click Next to continue.	
	< <u>Back</u> <u>N</u> ext > <u>C</u> ancel	

Click "Next" to continue.

nolab S430 NIR Spectrophotometer Setup	×
User Information Enter your user information and click Next to continue.	
Name:	
Company:	
< <u>B</u> ack <u>N</u> ext > <u>C</u> ano	el

Input name and company, then click "Next" to continue.

🌄 Prolab S430 NIR Spectrophotometer Setup	\times		
Shortcut Folder			
Where would you like the shortcuts to be installed?			
The shortcut icons will be created in the folder indicated below. If you don use the default folder, you can either type a new name, or select an existin from the list.	't want to ng folder		
Shortcut Folder:			
LENGGUANG\Prolab S430 NIR Spectrophotometer\0.3.1.323	~		
 Install shortcuts for current user only Make shortcuts available to all users 			
< <u>B</u> ack <u>N</u> ext >	<u>C</u> ancel		
Prolab S430 NIR Spectrophotometer Setup			
	×		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed?	×		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed?	×		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a different either type in a new path, or click Change to browse for an existing folder	ent location,		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a different either type in a new path, or click Change to browse for an existing folder Install Prolab S410 NIR Spectrophotometer to:	ent location,		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a different either type in a new path, or click Change to browse for an existing folder Install Prolab S410 NIR Spectrophotometer to: C:\Program Files (x86)\LENGGUANG\Prolab S430 NIR Spectrop	ent location, r. C <u>h</u> ange		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a different either type in a new path, or click Change to browse for an existing folder Install Prolab S410 NIR Spectrophotometer to: C:\Program Files (x86)\LENGGUANG\Prolab S430 NIR Spectrop	ent location, r. Change		
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Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be installed in the folder listed below. To select a differentiation of the software will be blow. To select a differentiation of the software will be blow. To select a differentiation of the software will be blow. To select a differentiation of the software will be blow. To select a differentiation of the software will be blow. To select a differentiation of the software will be blow. To select a drive: 81.83 GB	ent location, r. Change		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a differentiate the type in a new path, or click Change to browse for an existing folder Install Prolab S410 NIR Spectrophotometer to: C:\Program Files (x86)\LENGGUANG\Prolab S430 NIR Spectrop Space required: 18.5 MB Space available on selected drive: 81.83 GB	ent location, r.		
Installation Folder Where would you like Prolab S430 NIR Spectrophotometer to be installed? The software will be installed in the folder listed below. To select a different either type in a new path, or click Change to browse for an existing folder. Install Prolab S410 NIR Spectrophotometer to: C:\Program Files (x86)\LENGGUANG\Prolab S430 NIR Spectrop Space required: 18.5 MB Space available on selected drive: 81.83 GB	ent location, r. Change		

Click "Change" to change the install path. Click "Next" to confirm.

🛃 Prolab S430 NIR Spectrophotometer Setup 🛛 🗙		
Ready to Install		
You are now ready to install Prolab S430 NIR Spectrophotometer 0.3.1.323	-	
The installer now has enough information to install Prolab S430 NIR		
Specirophotometer on your computer.		
The following settings will be used:		
Install folder: C:\Program Files (x86)\LENGGUANG\Prolab S430 NIR		
Spectrophotometer/0.3.1.323\		
Shortcut folder: LENGGUANG\Prolab S430 NIR Spectrophotometer\0.3.1.32	3	
Please click Next to proceed with the installation.		
< Back Next > Can	col	



3 Before Use

3.1 Connect to PC

Please use the USB cable to connect the instrument and PC. Driver installation will automatically start when first time connecting. Please run the software after driver installation is done.

3.2 How To Connect

1. Plug in USB cable

Connect the instrument and PC with USB cable while the PC is on.

2. Turn on the instrument.

Turn on the instrument then run Prolab. The instrument will check if connected.

There will be a dialog pop out as below if not connected or connection error.



"Abort": Exit the software.

"Retry": Check again.

"Ignore": Continue running Prolab. Other functions are available.

3. Initialization

The software will automatically start initializing and adjusting.

4. Interface.



Click above to create a new measurement. Then select "Photometric", "Wavelength Scan", "Time Scan" or "Quantitaion" mode.

5. Shutting down

Close the software first, then turn off the instrument.

/! If you turn off the instrument first, there will be an error in Prolab. You need to run task manager to end the software.

4 Functions

4.1 Modes

There are 4 modes:

1. Photometric

- (1) Measure the photometric data of the sample.
- (2) Data display as Trans./Abs..
- (3) Photometric data supports up to 26 wavelengths.
- (4) support up to 10 user-defined calculation formula.
- (5) Data printout available.

2. Wavelength Scan

- (1) Get the spectrum of the sample.
- (2) Display as Trans./Abs..
- (3) Repeat scan available.
- (4) Spectrum processing.
- (5) Data printout available.

3. Time Scan

- (1) Get the spectrum of sample varying by time.
- (2) Display as Trans./Abs..
- (3) Repeat scan available.
- (4) Spectrum processing.
- (5) Data printout available.

4. Quantitation

- (1) Supports single-wavelength, dual wavelength and three-wavelength quantitative analysis.
- (2) Supports 1 to 3 times curve fitting.
- (3) Data decimal can be changed.
- (4) Programmable optical gate control.
- (5) Supports data printout.

4.2 Interface

4.2.1Modules



4.2.2 Modules Intro

1. Menu & Toolbar



Menu & Toolbar



- 1) Provides instrument controls and settings.
- 2) Tool bar are shortcuts for common features.

2. Document Browser

Document Brower shows files saved in Wavelength Scan, Time Scan and Quantitative Analysis mode. Double click to open a file.

File Type Wl. Sca	an 🔻 📷
Keyword	
wl-test01	
wl-test02	
wl-test03	
wl-test04	
wl-test05	

- 1) Double click a file to open/reset spectrum.
- 2) Right click a file to open, rename or delete.
- 3) Input keywords to search.



3. Spectrum Window & Information Window

- 1) Information window shows current data and settings of the instrument.
- 2) In spectrum window, you can use mouse to zoom in and out. Press the left mouse button, drag the mouse from top left to bottom right to draw a square, then release the button. Spectrum in that square will be zoomed in. Drag the mouse the opposite way to zoom out.
- 3) Click "Peaks" to show the peaks in the spectrum.

4. Status Window

Status window shows the current status of the instrument.

4.2.3 lcons

lcon	Function
	New Measurement
	Open Spectrum
	Show/Hide Status
	Show/Hide Spectrum Information
	Wavelength scan / Time scan
(Photometric window
	Quantitation window
	Back to original coordinate
	Auto coordinate
 +−]′ ↓	Y-axis enlarge 2 times
+_	Y-axis reduce 2 times
	Get/Cancel Axis Data
	Zoom In/Out
۵	Show/Hide Peaks
100%	Show/Hide Grid
	Start/Stop

	Set wavelength
??	Set 100%
100	0%
	Set baseline
+- ×÷	Spectrum Properties
	Print Data
()	Trans. / Abs.
5	Move sample rack to "Sample" position
R	Move sample rack to "Reference" position
	Current status online/offline

5 Software Operation

5.1 Photometric

Photometric work flow



5.1.1 Create Measurement

Create a new measurement.

Select "Files"->"Create Method" or click I be enter Create Method Window.

1. Measurement summary:

0	Create Measurement Method	
[General Instrument Custom Formula Report	
	Measurement: Photometric Operator: Photometric Wavelength Scan Time Scan Quantitation Version Number: Memo:	
	Default Open Save OK Cancel	
)	Measure Mode: Choose "Photometric".	ļ
2)	Operator: Input operator's name.	
)	Serial Number: Shows the serial number of the instrum	ent.
.)	Version Number: Shows the version of the instrument.	
)	Memo: Enter a description or notes on measuring cond	ditions.
)	Click Default to reset.	
)	Click Open to open saved parameters.	

8) Click Save to save the parameters.

2. Instrument Tab:

Create Measurement Method	
General Instrument Custom Formula Rep	ort
Data Mode: Abs.	
Wavelength: 1500 Add	
No. WI. A 1000 B 1500	
C 1800 Delete	
Clear	Replicate: 1
Delay: 2 s	Cycle Time: 1 s
Integral: 2 s	
Default Open Save	OK Cancel

1)	Data Mode: Data display as Trans. or Abs.
2)	Wavelength: Input wavelength in Wavelength: 1500, then click
	Add to add it in the table.
3)	Change wavelength:Select the wavelength in the table 8 546,
	then change the value here Wavelength: 1800. Click Edit to
	finish.
4)	Delete wavelength: Select the wavelength in the table B 546. Click
	Delete to delete it.
5)	Clear: Click Clear to delete all wavelengths.
6)	Delay: Delay time before measuring. Usually for stabilization.

- 7) Integral: Data integral time.
- 8) Slit: Slit of the instrument. (759S,756S,723S all fixed at 2nm)
- 9) Light source: Shows the switch wavelength of deuterium lamp / tungsten lamp. (Not for Photometric mode./Not for 723S)
- 10) Lamp status: Switch deuterium lamp / tungsten lamp (Not available here).
- 11) Gain: Set a gain to measure sample (Not available here).
- 12) Replicate: Set the number of repeat measurements. The instrument will only scan once when it's 1.
- 13) Cycle time: Set a repetition interval.

3. Custom Formula Tab:

Create Measurement Method			×			
General Instrument Custom Formula Report						
Title: F3						
Formula: A*B						
Character						
QWERTYUIOP7	8	9	Add			
A S D F G H J K L 4	5	6	Edit			
Z X C V B N M - 1	2	3	Delete			
+ - * / () Clear	0	•	Clear			
List]				
Title Formula		⊻ U:	sed			
Formula1 A+B	_	Dis	play			
Formula2 A-B		• 1	Fitle			
 Formula 						
Default Open Save OK Cancel						
		÷	l.			

- 1) Title: Input formula title.
- 2) Formula: Use the keyboard below to input formula.

- 3) Add formula: Input formula here Formula: A*B and click Add to add it in the list.
- 4) Change formula: Select the formula you want to change

	_List								
	Title	Formula							
	Formula1	A+B							
	Formula2	A-B							
	F3	A*B							
			,edit i	t here	Formula: A*B	_and cli	ick	to) finish.
5)	Delete f	ormula:	Select	the	formula	you	want	to	delete
	List								
	Title	Formula							
	Formula1	A+B							
	Formula2	A-B							
	F3	A*B							
			, then	click	Delete to	delete i	t.		
6)	Clear: Clic	Clear	to dele	te all fo	ormula.				

- 7) Used:Check to calculate after measurement.
- 8) Display: Display title or formula.

4. Report Tab:

General Instrumen	Custom Formula Re	port
Export: Print Rej	port	
Option		
General		
✓ Date	Peak Data	Calibration
Spectrum	Spectrum Data	Standard Data
Method		✓ Sample Data
		Clear
Default	Open Save	OK Cancel

- 1) Export: Choose "Print Report" or "Save as Microsoft (R) Excel file".
- 2) General-Date: Add output date.
- 3) General-Method: Show output method.
- 4) Other check box not available in Photometric mode.

5.1.2Start a Measurement

- 1. Create Photometric measurement as 2.3.1.1.
- 2. Put the reference sample in the sample cell and click to set 100% and 0%.
- 3. Put sample in the sample cell and click to start measuring.
- There will be a popout window after the first measurement. Input file name and click OK (or leave it) to save. Data will be saved in this file unless you create a new measurement.



5.1.3Data Processing

- 1. Click to show current method.
- 2. Click to print out data.

5.2 Wavelength Scan

Wavelength Scan work flow



5.2.1Create a Measurement

Select "Files"->"Create Method" or click it o enter Create Method Window.

1. General Tab:

Create Measurement I	Method		×
General Instrume	ent Monitor Processing Re	eport	
Measurement: Operator: Serial Number: Version Number Memo:	Wavelength Scan Photometric Wavelength Scan Time Scan Quantitation :		
Default	Open Save	[OK Cancel

- a) Measure Mode: Choose "Wavelength Scan".
- b) Operator: Input operator's name.
- c) Serial Number: Shows the serial number of the instrument.
- d) Version Number: Shows the version of the instrument.
- e) Memo: Enter a description or notes on measuring conditions.
- f) Click Default to reset.
- g) Click Open to open saved parameters.
- h) Click Save to save the parameters.

. mouun								
Create Measureme	Create Measurement Method							
General Instru	iment Monitor Processing	Report						
Data Mode:	Abs.							
Wl. Min:	1000 nm							
Wl. Max:	1800 nm							
Speed:	High 🔻							
Interval:	1 • nm							
Delay:	0.0 s	Replicate:	1					
		Repeat Mode:	Automatic 🔻					
		Cycle Time:	1 🗘 s					
Default	Open Save		OK Canc	el				
			16.					

2. Instrument Tab:

- 1) Data mode: Data display as Abs., Trans. or Energy.
- 2) WL.Min: Input the start wavelength.
- 3) WL.Max: Input the ending wavelength.
- 4) Speed: Select the scan speed. The faster the more noise appears.
- 5) Interval: Shows data sampling interval according to the scan speed.
- 6) Delay: After pressing the Measure button, measurement isstarted following the delay time set here.
- 7) Slit: Slit of the instrument.
- 8) Replicate: Set the number of repeat measurements. The instrument will only scan once when it's 1.
- 9) Cycle time: Set a repetition interval.

3. Monitor Tab

Create Measurement Met	hod		×
General Instrument Y Axis Max: 10 Min: 0 ✓ Auto Zoom	Monitor Processing	Report	
Default	Open Save		OK Cancel

- 1) Y Axis: Enter the max and min point of Y axis. The max point should be larger.
- 2) Auto Zoom: Y axis will automatically set by spectrum data.

4. Processing Tab:

Create Measurement Method	×
General Instrument Monitor Available Savitzky-Golay Smooth	Processing Report Selected Selected Savitzky-Golay Smooth
Median Smooth Derivative	- Order = 3 Points = 7 Times = 1
Peak Finding Y Axis Threshold:0.1000 X Axis Threshold: 1	Modification: OK
Default Open	Save OK Cancel

1) Available:Savitsky-Golaysmooth,Mean smooth, Median smooth and Derivative are available for data processing.

- a) Click a method in the "Available" box then click is to put it in the Selected box.
- b) Click a method in the "Selected" box then click _____to remove it.
- 2) Selected: Final data will be calculated with methods in the Selected box. You can set parameters for each method.
- 3) Modification: Click the
 to unfold the parameters of each method, click to change it in "Modification".
- 4) Peak Finding: Automatically find peaks by giving threshold when the scan is complete.
- 5. Report Tab:

Create Measurement Me	thod				
General Instrument	Monitor Processing	Report			
Export: Print Rep	oort	•			
Option					
General					
✓ Date	Peak Data	 Calibration 			
Spectrum	Spectrum Data	✓ Standard Data			
Method		🗹 Sample Data			
Data Segment Add Clear					
Default	Open Save	OK Cancel			

- 1) Output: Print Report or Save as CSV file.
- 2) Output options: Choose the printout data.Check the content in "Properties" button on the left after the scan.
- 3) Add Data: When "Spectrum Data" is checked, you can choose data section to printout.Set the start wavelength, end wavelength and interval in the pop out window, then click OK.Click the "+"to see the data section. Up to 9 sets of data.

Set Data Segment1					
Min:	1000	nm			
Max:	1800	nm			
Interval:	1	nm			
ОК	Ca	ancel			



4) Clear Data: Clear current data section.

5.2.2Start a wavelength scan

- 1. Create a new measurement.
- 2. Put reference sample in the sample cell and click to adjust baseline.
- 3. Put sample in the sample cell and click to start scanning.
- 4. There will be a popout window after the first measurement. Input file name and click OK (or leave it) to save.



5. Click to stop the scan.

5.2.3Data Processing

- 1. Click to show the method detail.
- 2. Click to print out data.
- 3. Click to reset original coordinate.
- 4. Click to automatically zoom Y axis.
- 5. Click to zoom in Y axis 2 times.
- 6. Click to zoom out Y axis 2 times.
- 7. Click / K to get/cancel axis data of the cursor.
- 8. Click to zoom as set.

- 9. Click / to show/hide peaks.
- 10. Click to show/hide grid.



- 12. Click to switch between Trans. and Abs.
- 13. Click to run spectrum comparison.
- 14. Click $\stackrel{+-}{\times}$ to run spectrum calculation.
- 15. Click to run Spectrum derivation.
- 16. Click to run Spectrum Smoothing.
- 17. Click to find peaks.

5.2.4Model

For users who need to build models for PCA, Prolab will automatically save wavelength data as .DX files in the Prolab directory/DX folder. You can also save wavelength data as .CSV files in Printout data.

5.3 Time Scan



Time scan work flow

5.3.1Create a new measurement

Select "Files"->"Create Method" or click is to enter Create Method Window.

1. General Tab:

Create Measurement	Method ent Monitor Processing Report	×
Measurement: Operator: Serial Number: Version Number	Time Scan Photometric Wavelength Scan Time Scan Quantitation	
Memo:		×
Default	Open Save	OK Cancel

- a) Measure Mode: Choose "Time Scan".
- b) Operator: Input operator's name.
- c) Serial Number: Shows the serial number of the instrument.
- d) Version Number: Shows the version of the instrument.
- e) Memo: Enter a description or notes on measuring conditions.

f) Click Default to reset.

- g) Click Open to open saved parameters.
- h) Click Save to save the parameters.

2. Instrument Tab:

Create Measure	ment Method		×
General Ins	trument Monitor Processing	Report	
Data Mode	: Abs.		
Wavelengt	h: 1500 nm		
Unit:	S 👻		
Time:	60 🌲 s		
Interval:	0.1 s		
Delay:	0.0 💂 s	Replicate: 1	-
		Repeat Mode: Au	tomatic 🔻
		Cycle Time: 1	S
Default	Open Save	C	K Cancel

- 1) Data mode: Data display as Abs.,or Trans.
- 2) Wavelength: Input time scan wavelength.
- 3) Unit: Set time unit to sec or ms.
- 4) Time: Set the scan time.
- 5) Interval: Fixed at 0.1 sec.
- 6) Delay: Delay time before scan.
- 7) Slit: Fixed at 8nm.
- 8) Replicate: Set the number of repeat measurements. The instrument will only scan once when it's 1.
- 9) Cycle time: Set a repetition interval.

3. Monitor Tab

Create Measurement I	Method				×
General Instrume	ent Monitor	Processing	Report		
Y Axis					
Max:	100				
Min					
Min:	0				
✓ Auto Zoom					
Default	Open	Save		ОК	Cancel

- 1) Y Axis: Enter the max and min point of Y axis. The max point should be larger.
- 2) Auto Zoom: Y axis will automatically set by spectrum data.
- 4. Processing Tab:

Create Measurement Method	×
General Instrument Monitor Proces	ssing Report
Available Savitzky-Golay Smooth Mean Smooth Median Smooth Derivative	> Selected > Order = 3 Points = 7 Times = 1
Peak Finding Y Axis Threshold:0.1000 X Axis Threshold:1	Modification: CK
Default Open Save	OK Cancel

- 1. Available:Savitsky-Golaysmooth,Mean smooth, Median smooth and Derivative are available for data processing.
 - a) Click a method in the "Available" box then click is to put it in the Selected box.
 - b) Click a method in the "Selected" box then click <--- to remove it.
- 2. Selected: Final data will be calculated with methods in the Selected box. You can set parameters for each method.
- 3. Modification: Click the to unfold the parameters of each method, click to change it in "Modification".
- 4. Peak Finding: Automatically find peaks by giving threshold when the scan is complete.
- 6. Report Tab:

Create Measurement Me General Instrumen	thod t Monitor Processing	Report
Export: Print Re	port	▼
Option		
General ✓ Date ✓ Spectrum ✓ Method	✓ Peak Data Spectrum Data	 Calibration Standard Data Sample Data
Data Segment		Add
		Clear
Default	Open Save	OK Cancel

- 1) Output: Print Report or Export to CSV file.
- 1) Output options: Choose the printout data.Check the content in "Properties" button on the left after the scan.
- Add Data: When "Spectrum Data" is checked, you can choose data section to printout.Set the start wavelength, end wavelength and interval in the pop out window, then click OK.Click the "+" to see the data section. Up to 9 sets of data.

Set Data Segn	nent1	×
Min:	0	s
Max:	60	s
Interval:	0.1	s
ОК		Cancel

Data Segment		1	Data Segment	
Begment1	Add	\Box	 Segment1 Min: 1000 Max: 1800 Inteval: 1 Numbers: 801 	Add
	Clear			Clear

3) Clear: Clear current segment

5.3.2 Start a Time Scan

- 1. Create a new time scan measurement as 2.3.3.1.
- 2. Put reference sample in the sample cell, then click to set 100%.
- 3. Click to set 0%.
- 4. Put sample in the sample cell, then click to start scan.
- 5. There will be a pop-out window after the first measurement. Input file name and click OK (or leave it) to save.

Input	×
Please input file name:(default is system time)
	OK Cancel
	OK Cancel

6. Click to stop the scan.

5.3.3Data Processing

- 1. Click to show detail of current method.
- 2. Click to print out data.
- 3. Click to reset original coordinate.
- 4. Click to automatically zoom Y axis.
- 5. Click to zoom in Y axis 2 times.
- 6. Click to zoom out Y axis 2 times.
- 7. Click / Kontended to get/cancel axis data of the cursor.
- 8. Click to zoom as set.
- 9. Click / to show/hide peaks.
- 10. Click to show/hide grid.

- 11. Click to move sample cell.
- 12. Click to switch between Trans. and Abs.
- 13. Click to do spectrum comparison.
- 14. Click $\overset{+-}{\times}$ to do spectrum calculation.
- 15. Click to do spectrum derivation.
- 16. Click to do spectrum smoothing.
- 17. Click $\stackrel{??}{\frown}$ to run peak finding.

5.4 Quantitation

Quantitation work flow



5.4.1Create a measurement

Select "Files"->"Create Method" or click it o enter Create Method Window.

1. General Tab:

Create Measurement I	fethod		×
General Instrume	ent Monitor Processing	Report	
Measurement: Operator: Serial Number: Version Number	Time Scan Photometric Wavelength Scan Time Scan Quantitation		
Memo:			•
Default	Open Save		OK Cancel

- a) Measure Mode: Choose "Time Scan".
- b) Operator: Input operator's name.
- c) Serial Number: Shows the serial number of the instrument.
- d) Version Number: Shows the version of the instrument.
- e) Memo: Enter a description or notes on measuring conditions.
- f) Click Default to reset.
- g) Click Open to open saved parameters.
- h) Click Save to save the parameters.

2. Quantitation Tab:

Treate Measurement Method
General Quantitation Instrument Standard Sample Report
Measurement
Method: Wavelength VII. Numbers: 1
Unit: %
Calibration
Type: Conc = f(Abs) 🔻
Order: Linear 🔻
Custom Coef Force Zero
A0: 1 A2: 1 A1: 1 A3: 1
Default Open Save OK Cancel

- 1) Method: Quantitation method. Only wavelength available now.
- 2) WL Number: Number of wavelengths to analyse with.
- 3) Unit: Concentration unit.
- 4) Type: The type of fomula to display.
- 5) Order: Linear, Quadratic and Cubic available.
- 6) Custom Coef: Check the box to customize equation as "Conc = $A0 + A1 * X^1 + A2 * X^2 + A3 * X^3$ ".
- 7) Force Zero: Check the box to force the (0,0) point fits the equation.

3. Instrument Tab:

Create Measurement	Method	×
General Quantita	tion Instrument Report	
Data Mode: At)S₊ ▼	
Ratio	: Wavelength:	
No.1: 1	* 1500 nm	
No.2: 1	* 1500 nm	
No.3: 1	* 1500 nm	
Delay: 2 Integral: 2	s s	Replicate:1Repeat Mode:Automatic Cycle Time:11s
Default	Open Save	OK Cancel

- 1) Data mode: Choose Abs. or Trans. to display value.
- Wavelength: Input test wavelengths based on WL numbers in Quantitation tab. When WL number is 3, the number of 3 wavelengths need to be increasing or decreasing.
- 3) Delay: Delay time before scan.
- 4) Integral: Data integral time.
- 5) Slit: Fixed at 8nm.
- 6) Replicate: Set the number of repeat measurements. The instrument will only scan once when it's 1.
- 7) Cycle time: Set a repetition interval.

4. Report Tab:

Export: Print Repo	Instrument Standar	d Sample Report
Export: Print Rep		
	ort	
Option		
General		
✓ Date	Peak Data	Calibration
Spectrum	Spectrum Data	Standard Data
Method		✓ Sample Data
	A	
		ear
Default	pen Save	OK Cancel

- 1) Export: Print Report or Export to file.
- 2) Date: Export with date.
- 3) Spectrum: Export with spectrum.
- 4) Method: Export with method detail.
- 5) Calibration: Export with equation.
- 6) Standard Data: Export with standard data.
- 7) Sample Data: Export with sample data.
- 8) Others are not available in Quantitation.

5.4.2 Biuld Calibration Curve

1. In the Standards window, you can modify sample name, description and concentration; add or delete sample; check the value of samples.

Standard Data							
No.	Name	2	Memo	Conc.	Abs.	Use	Cell
1				1	0.145	1	-
2				2	0.269	V	-
3				3	0.34	V	-
4				4	0.466	V	-
Meas	sure	dit	Insert	Delete	Build		

Edit 1) To change sample name, description and concentration: Click then double click in the table to modify the content you want. Then click OK

to confirm.

- Measure a standard sample: Click to select a sample in the table, then 2) Measure button. The instrument will start measurement. click
- Edit Insert There will be another Add Sample: Click 3) then click OK line in the standards window. Click to finish.
- Edit and click a line you want to delete, then 4) Delete Sample: Click Delete OK Click to finish. click
- Edit 5) Choose the sample data needed in curve calculation: Click then click the check mark in Use row if you want to use this data for calculation.
- Edit and set sample cell of samples in Cell Set sample cell: Click 6) OK colume. "-" means do not move sample cell. Click

to finish.

Build to build the curve of standard sample when finishing Click 2. measurement.



5.4.3 Measuring unknown samples

When the regression curve is created, you can start measuring the sample. Operate the test sample in samples window as below. There are functions in the sample window: Measure, Modify, Delete and Clear.

		Sample	e Data				-
		No.	Name	Memo	Abs.	Conc.	Γ
		1			0.0005	0.01	
		2			0.0005	0.01	
		3			0.0005	0.00	
		4					
		5					
		6					
		7					
		8					
		9					
		10					
		Measur	e Edit	Delete	Clear		
1)	Chai	nge san	nple name &	& note: Click	Edit	outton, then c	louble click th
	fram	e you v	vant to mod	lify. Click	ок to co	onfirm the m	odification an
	back	to test	sample win	dow.			
2)	Mea	sure sa	mple value	: Click a sar	nple value	frame, then	click

- 2) Measure sample value: Click a sample value frame, then click button to measure the sample. The value of the sample will be in "Abs." and "Conc." column.
- 3) Delete sample: Click Edit button, then click the line you want to

	delete and click Delete button to delete the sample. Click OK to
	confirm the modification and back to test sample window.
4)	Clear sample list: Click Edit button, then click Clear button. Click
	OK to confirm the modification and back to test sample window.

5.4.4Data Processing

- 1. Click to show detail of current measurement.
- 2. Click to print out data.

5.5 General Operation

5.5.1 Wavelength

Wavelength	When the instrument is not measuring (shows Ready
Wavelength: 200 nm	below), click $\stackrel{\bigstar}{\longleftrightarrow}$ to open wavelength dialog. Input the
OK Cancel	wavelength you want then click OK to go.
Wavelength range:	

• S430: 1000nm~1800nm

5.5.2Set 100%

When the instrun	nent is not measurir	ng (shows	Ready	below),	click	🎽 to s	et
100%. Status shows	Adjust Full Data	Set 100	below.	When i	t shows	Ready	,
means it is done.							

5.5.3Set 0%

When the instru	ment is not measuri	ing (shows	Ready	below),	click	to set
100%. Status shows	Adjust Zero	Set Zero	below.	When it	t shows	Ready ,
means it is done.						

5.5.4 Move sample rack

When the instrument is not me	asuring (shows	Ready below), click	5 R _{to}
move sample rack. Status shows means it is done.	Shifting Sample Cell	below. When it sho	ows Ready ,

5.5.5Switch T/A



5.5.6Locate file

File Type Wl. Scan 🔹 📻		
Keyword		
wl-test01		File Type WI. Scan 🔻 📻
wl-test02		Keyword 03
wl-test03		wl-test03
wl-test04	N P	
wl-test05		
WI-Test-06		
WI-Test-07		
WI-Test-10		

To locate test files, you can input keyword in keyword blank.

5.5.7Data management

Click File-Data management to enter Data management. In data management you can quickly delete, export, hide in batch.

	Type Waveleng Status	s All 👻	Refresh
	Keyword		
No.	Name	Saved Time	Status
139	759s13013-100%	2013-09-03	Hide
140	759s13014-0%	2013-09-04	Hide
141	759s13014-100%	2013-09-04	Hide
142	759s13014-100%_01	2013-09-04	Hide
143	7595-13017-0%	2013-09-11	Hide
144	7595-13017-100%	2013-09-11	Hide
145	wave-test2	2013-09-27	Hide
146	wl-test01	2013-09-17	Display
147	wl-test02	2013-09-17	Display
148	wl-test03	2013-09-17	Display
149	wl-test04	2013-09-17	Display
150	wl-test05	2013-09-17	Display
151	WI-Test-06	2014-01-21	Display
152	WI-Test-07	2014-01-21	Display
153	WI-Test-10	2013-10-18	Display
Sel	ect All Batch Export Batch	Print Change Status	Delete

1. Refresh: Select type, status and input keyword, then click the fitting files.

to show

2. Batch Export: Select the files you need, then click Batch Export to export CSV file. This will export all data.

- 3. Batch Print: Select the files you need, then click Batch Print to print one by one. It will print all data in the file.
- 4. Change status: Switch between Display/Hide. Hidden files won't be seen in the list outside Data management.
- 5. Delete: Select the files you want to delete, then click Delete to delete those files.

5.5.8Characteristic Peak

Click Data Processing - Characteristic Peak to enter Characteristic Peak dialog.

🙆 Characte	ristic Peak	۲.		×
Paramete	er Spect	rum		
I	MPOR	TANT:	Please i	nsert the reference in Cell 4 WI. Para.
	No.	WI.	Cell	Wavelength: 361
	1	241	1	
	2	288	1	Cell No.:
	3	361	1	
	4	451	1	Add Edit
	5	537	1	
	6	641	1	Delete
	7	808	2	Data Mode: Abs.
				Range: ±3 nm 💌
				Baseline Measure
Rea	ady			

- 1. WL List: The wavelengths and sample cell position.
- 2. WL Para.: Modify wavelength and sample cell position here.
- 3. Data mode: Display data in Abs. or Trans.
- 4. Range: Choose a scan range around testing wavelength.
- 5. Baseline: Do baseline scan around every testing wavelength according to Range value. Scan sample cell position 4 as default:
- 6. Measure: Start scanning peaks.

5.5.9Arithmetic

Arithmetic is to do addition, subtraction, multiplication and division operations of the

same type of spectrum. Click to enter Arithmetic.



1. Functions: Select arithmetic, calculate, save and export.

Button	Function
+ •	Select addition, subtraction, multiplication or division
Calculate	Click to calculate the two spectrums.
Save to BMP	Click to save a BMP file.
Print	Click to print.

- 1. Spectrum 1 & Files 1: Shows the select spectrum in files 1.
- 2. Spectrum 2 & Files 2: Shows the select spectrum in files 2.
- 3. Spectrum type: Click to browse the same type of spectrum.
- Results: Show the last result.
 Result spectrum = [Target spectrum 1] +/-/×/÷ [Target spectrum 2].

5.5.10 Spectrum Compare

This function is to compare the same type of spectrum. Click it to enter Compare.

1. Interface:



- a) Type: Choose the spectrum type.
- b) Files: Shows the certain type of spectrums. Hold Ctrl to select multiple spectrums.
- 2. Click OK to compare selected spectrums.



- a) Using different colors to distinguish different spectrums in spectrum window.
- b) You can check or uncheck a spectrum in the selected box.
- c) Functions: Save and Print spectrum compare.

5.5.11 Find Peak

Find Peak	This function is to quickly find peaks of spectrum. Click
Y Axis Thres 0.100000 X Axis Thres 1 OK Cancel	to set threshold according to current spectrum. Higher peaks need larger Y axis threshold; wider peaks need larger X axis threshold.
	Click to show peaks. The icon turns to . Click it

to hide peaks. Spectrum information below will show peak info.

5.5.12 Smooth

Smooth	×
Type:	Savitzky-Gola 🔻
Order:	3
Points:	7
Times:	1
ОК	Cancel

Smooth is to reduce the noise of spectrum. Click to set smoothing parameters. Select type, Smoothing order, Number of points and Number of times then click "OK" to see the effect.

Туре	Smoothing order	Number of points	Number of times
Savitsky-Go	The highest power	Set the number of points	Set the number of
lay	of the polynomial	to be used in	smoothing operations.
		calculation.(odd number)	
Mean		Set the number of points	Set the number of
		to be used in calculation.	smoothing operations.
Median		Set the number of points	Set the number of
		to be used in calculation.	smoothing operations.

5.5.13 Derivative

Derivative	×
Order:	1
ОК	Cancel

Derivative operation on spectrums is to enhance the resolution of peaks. Derivation can distinguish various disturbances affecting the shape of the spectrum peaks. Usually combining the smoothing operation.

Click to open Derivative parameters window. Set Derivative order and click "OK" to see the result.

5.5.14 Instrument Parameter

This is to change the save path, file name and spectrum type. Click "Settings"

1	Setting Wind	ows	
1	Option		
→"Options"	Adjust Da	ark Current	to open option window.
1. Gen	eral tab		
		Instrument Parame	eter 🔀
		General Save	Spectrum Lamp Status
		-Set Default M	ethod
		Default Me	ethod
		O New Meth	od
			ОК
			OK Cancel

- 1) Default Method: Instrument use default parameters.
- 2) New method: Instrument uses specified parameters.
- 2. Save Tab:

Instrument Paramet	ter 🛛 🗙
General Save	Spectrum Lamp Status
✓ Automatic I Start: 1 Digit: 2	Increase after Scan X:\XXX_01.XXX
✓ Reset After	Rename
	OK Cancel

- 1) Automatic Increase after Scan: Automatically add a number suffix to file names.
- 2) Start: Set the start number.
- 3) Digit: Set number digits.
- 4) Reset after rename: Auto reset number when using another name.
- 3. Spectrum Tab:

Instrument Paramet	er	X
General Save	Spectrum Lamp Status	
Curve and Point Curve Color Serie Width 1	BackGround Point Color Point Width 4 Point Height 4 Point Style	
	Rectangle Default OK Cancel	

- 1) Curve color: Sets curve color.
- 2) Serie width: Sets curve width.
- 3) Point color: Sets dot color.
- 4) Point width: Sets dot width.
- 5) Point height: Sets dot height.
- 6) Point style: Sets dot shape as rectangle, circle, triangle, down triangle, cross, diagcross, star and diamond.

Instrument Parameter	
General Save Spectrum Lamp Status	
Curve and Point BackGround Gird Color Panel Color Grid Width 1 Wall Color Wall Transparent Grid Style Dot	90 80 70 60 50 40 30 20 40 0 20 40 60 80 10 0 20 40 60 80 100
Default OK Cancel	

- 1) Grid color: Sets the table color in "Spectrum information" window.
- 2) Grid width: Sets the curve width in "Spectrum information" window.
- 3) Grid style: Sets table style as solid, dash, dot, dashdot, dashdotdot and clear in "Spectrum" tab.
- 4) Panel color: Sets the background color in "Spectrum information" window.
- 5) Wall color: Sets the coordinate board color.
- 6) Wall Transparent: Check it to make the board transparent.
- 4. Auto Reference Tab:



When this item is checked, the reference data is corrected before each measurement in "wavelength scan".

5.5.15 Rename & Delete Files

Right click on a file in file browser. You can delete or rename in the pop-out menu.

wl-t	wl-test01	
wl-t	Wi testor	
wl-t	Open	
	Rename	
wl-t	Delete	
wl-tes	เบร	

6 Appendix

6.1 Quantitative analysis wavelength method

6.1.1 Single Wavelength



Abs. A₁ is the value on the curve at λ_1 .

6.1.2 Double Wavelengths



 A_1 and A_2 are the Fluorescence at λ_1 and $\lambda_2.$

A=A₂ - A₁

6.1.3 Triple Wavelengths



 A_1 , A_2 and A_3 are the Fluorescence at λ_1 , λ_2 and $\lambda_3.$

$$= 2^{-\frac{(1-2)\times 3+(2-3)\times 1}{1-3}}$$

(It has to be $\lambda_1 > \lambda_2 > \lambda_3$ or $\lambda_1 < \lambda_2 < \lambda_3$)

6.2 DETAILS ON QUANTITATIVE

Prolab provides 3 calibration types: Linear working curve, Quadratic working curve and Cubic working curve. All of them are not forced through the 0 coordinates.

6.2.1 Linear Working Curve (1st order)

The calculation formula is as follow:

$$= 1 \times K_0$$

Where,

C : Concentration of each sample (input value)

A : Abs. of each sample (measured value)

 $K_1 \mbox{ and } K_0$ are calculated by the least squares

method.

Suppose there are n data points (A_n, C_n) , then

$$K_{1} = \frac{\sum_{i=1}^{n} A_{i}C_{i} - \frac{1}{n}\sum_{i=1}^{n} A_{i} \cdot \sum_{i=1}^{n} C_{i}}{\sum_{i=1}^{n} A_{i}^{2} - \frac{1}{n}(\sum_{i=1}^{n} A_{i})^{2}}$$
$$K_{0} = \frac{\sum_{i=1}^{n} C_{i}}{n} - K_{1} \times \frac{\sum_{i=1}^{n} F_{i}}{n}$$

6.2.2 Quadratic Working Curve (2nd order)

The calculation formula is as follow:

$$= _{2} \times ^{2} + _{1} \times + _{0}$$

Where,

C: Concentration of standard sample

A : Abs. of each sample (measured value)

Kn are calculated by the least squares method

Suppose there are n data points(A_n , C_n), then:

$$\begin{split} \mathsf{K}_{2} &= \frac{\mathsf{S}\big(\mathsf{A}^{2}\mathsf{C}\big)\mathsf{S}(\mathsf{A}\mathsf{A}) - \mathsf{S}(\mathsf{A}\mathsf{C})\mathsf{S}(\mathsf{A}\mathsf{A}^{2})}{\mathsf{S}(\mathsf{A}\mathsf{A})\mathsf{S}\big(\mathsf{A}^{2}\mathsf{A}^{2}\big) - [\mathsf{S}\big(\mathsf{A}\mathsf{A}^{2}\big)]^{2}} \; (\mathsf{Formula F5-5}) \\ \mathsf{K}_{1} &= \frac{\mathsf{S}(\mathsf{A}\mathsf{C})\mathsf{S}\big(\mathsf{A}^{2}\mathsf{A}^{2}\big) - \mathsf{S}\big(\mathsf{A}^{2}\mathsf{C}\big)\mathsf{S}(\mathsf{A}\mathsf{A}^{2})}{\mathsf{S}(\mathsf{A}\mathsf{A})\mathsf{S}\big(\mathsf{A}^{2}\mathsf{A}^{2}\big) - \big[\mathsf{S}(\mathsf{A}\mathsf{A}^{2})\big]^{2}} \; (\mathsf{Formula F5-5}) \\ \mathsf{K}_{0} &= \frac{\sum_{i=1}^{n}\mathsf{C}_{i}}{\mathsf{n}} - \mathsf{K}_{1}\frac{\sum_{i=1}^{n}\mathsf{C}_{i}}{\mathsf{n}} - \mathsf{K}_{2}\frac{\sum_{i=1}^{n}\mathsf{F}_{i}^{2}}{\mathsf{n}} \; (\mathsf{Formula F5-7}) \end{split}$$

6.2.3 The correlation coefficient

The correlation coefficient R represents how the regression curve fitting. Suppose there are n data points(,):

$$= \frac{\Sigma_{=1} - \frac{\Sigma_{=1} \cdot \Sigma_{=1}}{\sum_{n=1}^{\infty} \sum_{n=1}^{\infty} \sum_{n=1}^$$

6.3 Derivative Operation on Spectrum

The derivative of a function of a real variable measures the sensitivity to change of a quantity (a function or dependent variable) which is determined by another quantity (the independent variable).



Derivative of the function

There are many ways of derivative operation on spectrum. Since the x-axis(time axis or the wavelength axis, etc.) of the original spectral data are equally spaced, then

First order derivative:

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{y_{i+1} - y_i}{\Delta x}$$

Second order derivative:

$$\frac{d^2y}{dx^2} = \frac{y_{i+1} - 2y_i + y_{i-1}}{\Delta x^2} \text{ (Formula F7-2)}$$

Where:

y: photometric value

x: wavelength, time, etc.

Derivative spectra not only can eliminate baseline drift or flat background interference, but also can provide a higher resolution than the original spectrum.



Fig. 1

Fig. 2

Fig. 3

In Fig.1,there is a clear alternation of peaks. In Fig.2, the acromion is higher after derivative. Second order derivative spectrum is clearer. In Fig.3, the original spectrum two curves are seriously overlapping, but in n=2/4 the peaks are clearer.

Higher order derivative can eliminate the low order background curves. The spectrum shape is complicated after derivative, but it raises the resolution and sensitivity.

6.4 Smoothing

The basic idea of smoothing is to map a smooth point, then depicte a number of points around the smooth point to be "fit" or "average" or "sort" in order to obtain the best estimate of the value of the smooth point to eliminate random noise. With modern analytical instruments increasing speed and automation, multiple accumulate and smoothing technology has become a common method of noise reduction.

Prolab provide 3 smoothing methods: Savitsky-Golay, Mean and Median.

6.4.1 Savitzky–Golay

A **Savitzky–Golay filter** is a digital filter that can be applied to a set of digital data points for the purpose of smoothing the data, that is, to increase the signal-to-noise ratio without greatly distorting the signal. This is achieved, in a process known as convolution, by fitting successive sub-sets of adjacent data points with a low-degree polynomial by the method of linear least squares. When the data points are equally spaced an analytical solution to the least-squares equations can be found, in the form of a single set of "convolution coefficients" that can be applied to all data sub-sets, to give estimates of the smoothed signal, (or derivatives of the smoothed signal) at the central point of each sub-set.

6.4.2 Mean smoothing

Median smoothing is to sort the selected data (the number of data points is odd), then take the intermediate value as the smoothed value.

6.4.3 Median smoothing

Median smoothing is to sort the selected data (the number of data points is odd), then take the intermediate value as the smoothed value.



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