

Development of Software for a Diode-Based Fluorosensor

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Abstract

Measuring fluorescence signatures in the clinic in order to diagnose cancer requires advanced technology that can be operated easily and quickly. At the Department of Physics of the Lund Institute of Technology a diode-based fluorosensor was built and used for tissue diagnostics. The existing software for this equipment was not adequate to fulfil the needs for easy and fast operating. Therefore new software has been developed to make these clinical measurements faster and more comfortable for both the patient and the operator.

The software has been developed in the language Lab View and is built up in three modes for measuring both in the clinic and in the lab, and for analyzing spectra from old measurements. The measurements are highly automated and are automatically saved in the clinical mode. The emission from the diode laser is also controlled from the computer with a mechanical shutter.

This software completes the diode fluorosensor and makes it an easily operated compact device with promising possibilities of being a useful device for tissue diagnostics in real time in the clinic and for easy operation in the lab.

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1. Introduction

Cancer is a serious disease that strikes a great part of the population. Today there are several methods of treating cancer but there is a strong need to start the treatment early. If the tumour is not found and treated in an early state the person might die. Therefore it is important to find ways of detecting precancerous cells.

Today cancer is diagnosed mainly by biopsies. Biopsy has several disadvantages: it takes time to get the results and it is an invasive method. Often the tumour is surgically removed and then the doctor needs to know if there is any tumour left. Using biopsy in this case means that the operation will take a longer time because of the waiting-time for the answer from the biopsy. If there were a method for diagnosing cancer in real time the operation would not be so long or the doctor would not have to risk removing more tissue than necessary. Often it is not totally clear where the tumour is located and biopsies may be taken from different places. Since biopsy is an invasive method you might not be able to take all the tests needed because of the risk of damaging the organ. If there were a non-invasive method for diagnosing cancer as many tests as needed could be taken without damaging any organs.

It has been found that tissue diagnosis can be done with fluorescence spectroscopy where fluorescence is detected either from fluorophores within the tissue itself or from a sensitizer that accumulates in the malignant cells [Ref 1]. This optical method has advantages such as yielding results in real time and being non-invasive. The light is brought to the tissue through thin fibres that can be guided to the organ with endoscopes.

A diode fluorosensor has been developed at the Department of Physics of the Lund Institute of Technology in 1999 [Ref 2]. See figure 1. This device, mainly containing a diode laser and a spectrometer, has sufficient performance to be used to study fluorescence for diagnosing cancer in the clinic. However the existing software for the spectrometer did not fulfil the needs for these clinical measurements.

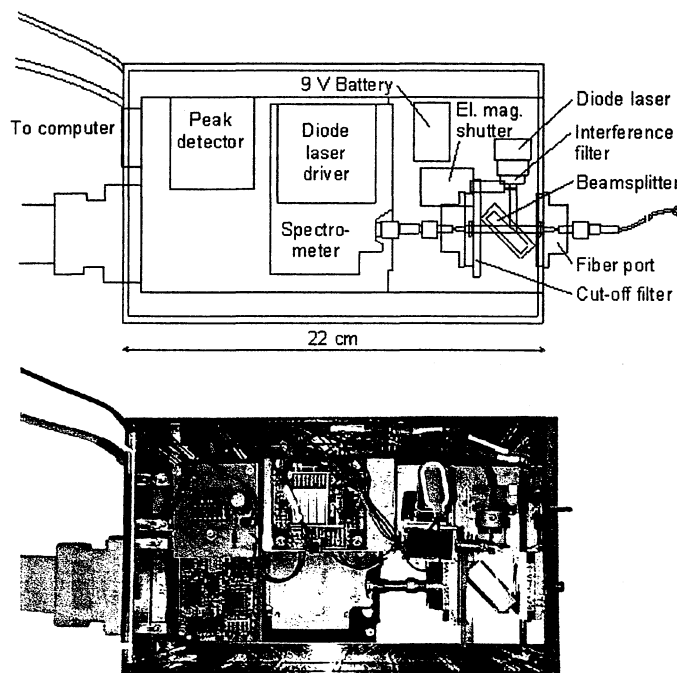


Figure 1 The diode fluorosensor

2. Problem description

The purpose of this master thesis is to make the diode fluorosensor more useful in the clinic, and also in the lab, by developing a user-friendly interface and make the measurements highly automated. This includes developing new software and hardware for controlling the diode fluorosensor from a computer.

The assignment was to develop the software in Lab View, a graphical language specially made to control external devices. The interface is of high importance; it has to be user-friendly. This means that there should not be more buttons than are necessary and it should be easy to operate without the user's guide. The software shall be used for measurements in the clinic and in the lab and also for studying spectra from old measurements. This should be taken care of in three different modes, each specialised for its own purpose. To save time and simplify the measuring in the clinic, and to minimise the risk of human mistakes the measurements should be highly automated and all measurements should be automatically saved onto a disk in the clinical mode. The filestructure for autosaving should be easy to follow and there should be a possibility for changing the filestructure. The files with the data should contain all necessary information about the measurement and they should be built up in a way that makes it easy to analyse the data. To be able to vary all the parameters and make a lot of different measurements in the lab mode, there should be possibilities for controlling everything either manually or automatically and all the saving of data should be manually controlled. The laser should be controlled by the computer, and to make this as safe as possible, in both modes there should be clear indications for when the measurement starts, runs and finishes. This also makes it easier for the user to know if a measurement is running or not. The ambient light and the fluorescence of the fibre should be taken care of and subtracted from the measurements. There should also be a possibility to view up to ten spectra from old measurements. In all three modes the spectra in recorded should be printable.

The diode laser runs continuously and a long exposure to tissue can induce fluorophore bleaching. Further in the case of using exogenous sensitizers, the laser emission can cause unwanted treatment. The laser should thus only be on during the short time when a spectrum is accumulated and the assignment therefore also included controlling the laser emission from the computer.

The software should be built to control two different spectrometers used in the diode fluorosensor: Ocean optics USB2000 and Ocean optics S2000.

3. Fluorescence spectroscopy

The electrons in an atom are placed at different energy levels according to rules of quantum mechanics. If energy is added to the atom the atom is excited, which means that the electrons move to a higher energy level. This only happens if the energy is high enough to 'lift' the electron up to another energy level. When the atom collides with others, energy is lost and the electron falls down a bit. The atom wants to return to the lowest energy state and does so by sending out light. This light is called fluorescence and the wavelength of the fluorescence light is always longer than the one of the exciting light. This is due to energy losses in collisions.

The position of the energy levels differs between different atoms. The wavelength of the fluorescence light depends on these positions and thereby the atoms can be recognised by their fluorescence spectrum.

There are specific energy levels also in molecules and therefore it is possible to distinguish also between different types of molecules with fluorescence spectroscopy. See figure 2.

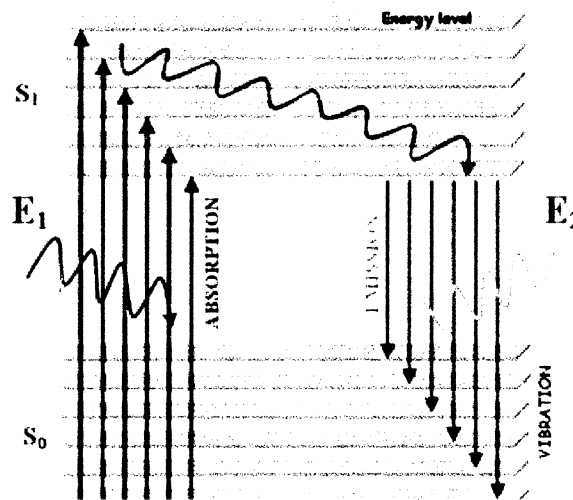


Figure 2 Fluorescence of a molecule

Every type of tissue contains individual concentrations of different fluorophores and this makes them fluoresce differently and by just illuminating the tissue with a laser and study the fluorescence different tissue types can be distinguished. This is not always easy since there might be very little difference between the concentration of fluorophores in the different types of tissue. To make it easier to tell the tissue types apart a tumour sensitizer that has a very typical fluorescence spectrum can be added. This sensitizer is selectively gathered in certain cells where for example the pH is different, the amount of blood-vessels is large or the metabolism is different from other cells.

δ -amino levulinic acid, ALA, is a molecule often used as a sensitizer in tissue diagnostics. This molecule is a part of the so called haem-cycle in the cell. In this cycle protoporphyrin is produced and it is actually this molecule that has the typical spectrum that makes it possible to find the tumour.

Tissue diagnostics by fluorescence spectroscopy is an easy-to-use method to find tumours. The only requirement is a laser in the UV-blue range, a spectrometer and a detector and it is

fairly easy to get a signal. The light can be conducted to the places of examination by a fibre which makes it possible to find tumours at all places reachable with an endoscope. Of course measurements of the skin and during open surgery are particularly straight forward. One disadvantage with the method is that the signals are broad and therefore it might be hard to tell signals apart.

4. Discussion

When measuring fluorescence in the clinic it is desirable to make the measuring process as fast and simple as possible for the patient's comfort and for the concerns of the operator. Advanced technology seems to frighten people and therefore it is important to make the equipment look simple and reliable even though it is advanced. A highly automated measurement gives the operator more time to explain the procedure to the patient, which makes him or her feel more comfortable. It is often a stressful situation at the clinic with many patients and little time. For this reason it is also appreciated to have a highly automated measurement system to minimise the risk for human mistakes.

The equipment has to be easy to operate so that a person without much knowledge of physics and computers can handle it – it has to be 'doctor safe'. The fluorosensor is to help the doctor with his or her work and therefore it cannot be too complicated to operate because then it will cause problems instead of helping.

4.1 Autosaving

Measuring in the clinic is different from time to time. There could be a lot of patients one day, or only a few, you can make measurements on a patient once or several times a day and the patients can have one or several lesions. All the different cases require different filestructures for saving the data. Two cases are more common than the others and that is the case when a few patients with many lesions are measured on several times a day and when only one measurement is made at one lesion at several patients. In the first case it is desirable to be able to save the measurements from each lesion separately. In the second case one measurement equals one patient and therefore it is good to be able to save data for each patient separately.

According to these two common cases two filestructures for autosaving have been chosen for this master thesis; the EAPstructure and the Patientstructure. In both cases, the filestructure is saved in a folder named with the present date.

4.1.1 EAP

In this structure each examination (E) has its own folder and every examination is separated into areas (A) and in each areafolder the measured points (P) are saved.

This structure is good if there are patients with many lesions. If measurements are performed on more than one occasion on the same patient during the same day, one examinationfolder is made for each time.

4.1.2 Patient

In this structure each patient has his or her own folder, in which data from different measurement points are saved. It is possible to continue measurements on the same patient later the same day and have these measurements saved in the same folder.

This structure is good if the patients has only one lesion and measurements are made once or a few times the same day.

None of the above described filestructures is optimal for all measurements and therefore it is possible to change the filestructure to make it suitable for the needs.

The way the data files are built up is described in detail in Appendix 1.

4.2 Background

While measuring with the diode fluorosensor a lot of background light will be detected both from the light in the room and from fluorescence in the fibre. These background signals are of the same order of magnitude as the signal we study and are therefore not desirable and should be subtracted from the measurements.

To get rid of the background light from the room the measurements can simply be made in a dark room. This is possible in the lab, but not in the clinic. Then it is undesirable to arken the room every time a measurement is performed. Therefore the system must be able to take care of the background light from the room. This is done by measuring the ambient light that goes trough the tissue and into the fibre when the fibre is held at the measuring position before the laser is turned on. This background is then subtracted from the measurement.

There will always be some fluorescence from the fibre induced by the laser. This background is almost constant over a series of measurements since it is due to the fibre material itself. Therefore it is not nessesary to measure it before every measurement as in the case of the room background. This fibre background has to be measured in a dark room or for example, by putting the fibre into a tightly sealed box. Before each series of measurements the fibre background has to be measured and it is saved and subtracted from all measurements.

4.3 Laser control

To be able to make fast and highly automated measurements the laser has to be controlled from the computer. This can be done in at least two ways: by turning it on and off with the laser driver or by cutting the beam with a mechanical shutter.

The easiest way to do this is to turn the laser on and off with the laser driver. This is done by sending a logical signal from the serial port at the computer to one of the inputs at the laser driver. Unfortunately, the laser driver does not work perfectly and there is still some incoherent light coming out from the laser even though it is set to give zero light out. On the other hand, it can be an advantage not to connect the diode laser to any external devices and thus minimize the possibility of having electrical transients, which could damage the sensitive diode laser. Therefore, this way of controlling the laser beam is not the most advantageous.

Instead an electromagnetic mechanical shutter is used. This is also run by a logical signal from the serial port at the computer. This shutter needs current and it takes space but on the other hand it works well and cuts the laser beam off efficiently.

4.4 Spectrometers

The Department of Physics of the Lund Institute of Technology uses two different spectrometers in the diode fluorosensors, and the software should be able to control both of these. This could be done either in one program or by making two different programs. With one program there could be a dialogue box when starting up, asking which spectrometer to

use but since the changes between the spectrometers are rare this should probably just be annoying. Another way of solving it could be to make an extra button in the program but to minimize the number of buttons in the program, and therefore make it more user-friendly, it has been chosen to make two different programs.

5. Development process

The process of developing the new software and hardware started by using the fluorosensor to get to know its functions. An older system was also used in the clinic to get to know what clinical measurements are like. Then some of the existing software was studied.

5.1 User interface

The user interface was chosen to be similar to the existing software since the users are familiar with this. The buttons and the graphs were made big to make it easier to click on them and to see the results. To maximise the usability the number of buttons was reduced to a minimum. See figure 3. Settings, which are not changed often, were put in submenus. The Lab mode and the Clinical mode were made as similar as possible. To make it easier to see the difference between the modes they were given different colours. The sub-windows in the modes have the same colour as the mode. The user interface is described more in detail in Appendix 1.

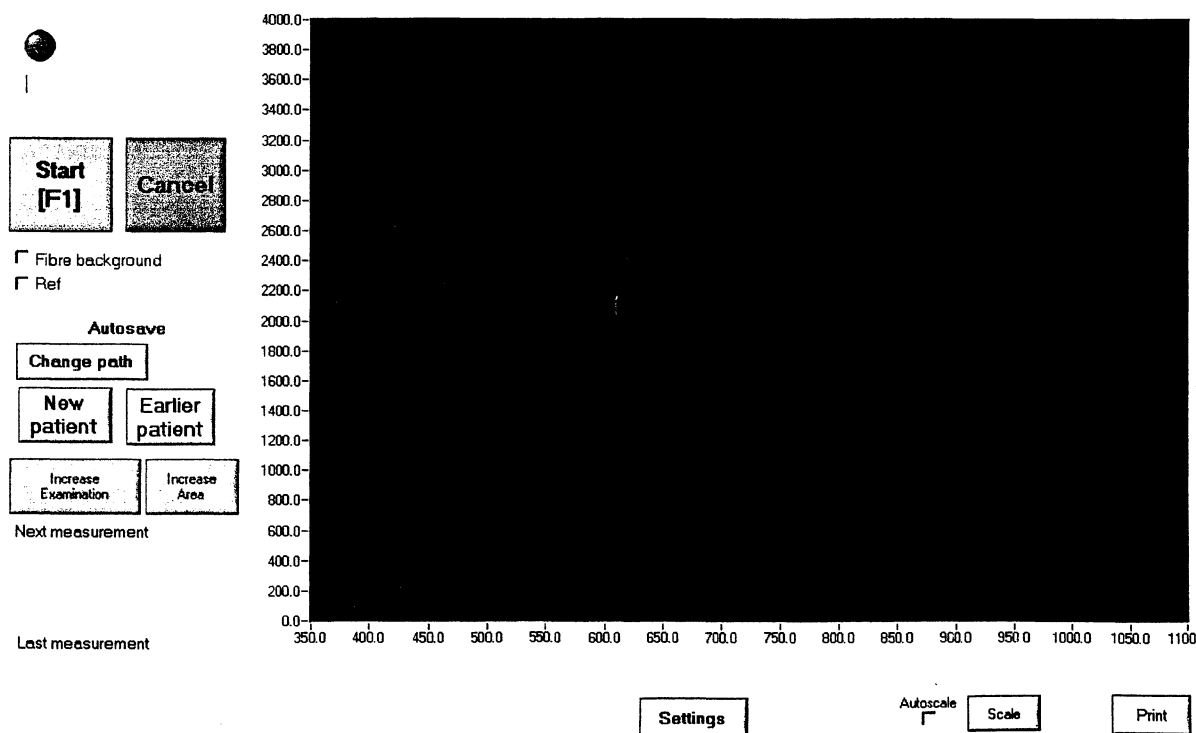


Figure 3 User interface, Clinical mode

5.2 Software

The software was made in the graphical language Lab View. The three modes are three separate sub-programs and it is possible to shift between these in a fourth one. Accordingly, there are two sub-programs running simultaneously. The sub-programs are built up by many sub-routines and they are all described in detail in Appendix 2. Routines made by Ocean Optics for getting data from the spectrometers are used. Description of those can be found in Appendix 3.

Every sub-program is built up with at least four loops. The first of the loops is a start-up one, where the variables get their start-values. Then two loops run simultaneously, one checks if

the user has pressed any button, if so a parameter is set so the other loop can do the things associated with the choice of the user. The last loop is for shuttingdown; here can some of the variables be saved.

5.3 Hardware

For controlling the light from the diode laser a mechanical shutter was built. It is controlled by a signal from pin 3 at the serial port. The current, a few hundred mA, to the shutter is taken from the USB port on the computer. See figure 4.

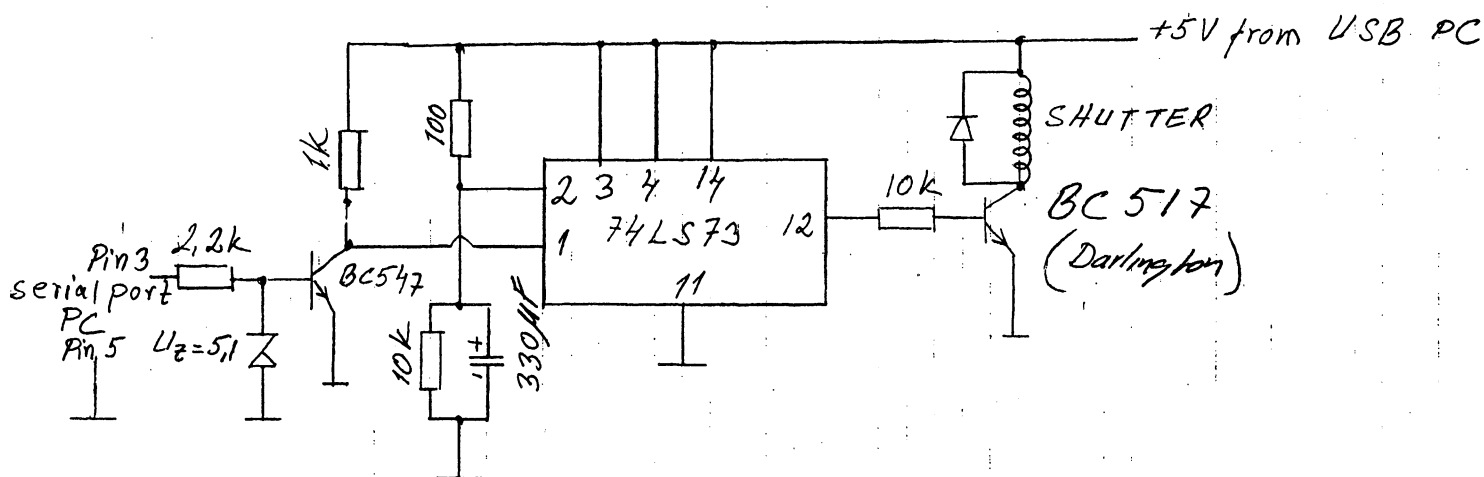


Figure 4 Electronics for the shutter

5.4 User tests

Several usertests were made to develop a working, user-friendly program and a user's guide. To develop the user's guide about ten students were asked to read the guide and then perform certain measurements. The results of these tests caused a lot of changes in the user's guide and the user interface where buttons were resized and the texts were changed. It also resulted in finding bugs in the program.

The system was tested in a clinic in Vilnius where measurements on about 100 patients were made. See figure 5 and figure 6. These measurements resulted in a few changes in the system, but above all, it showed that the system was performing well.



Figure 5 Test measurements in Vilnius

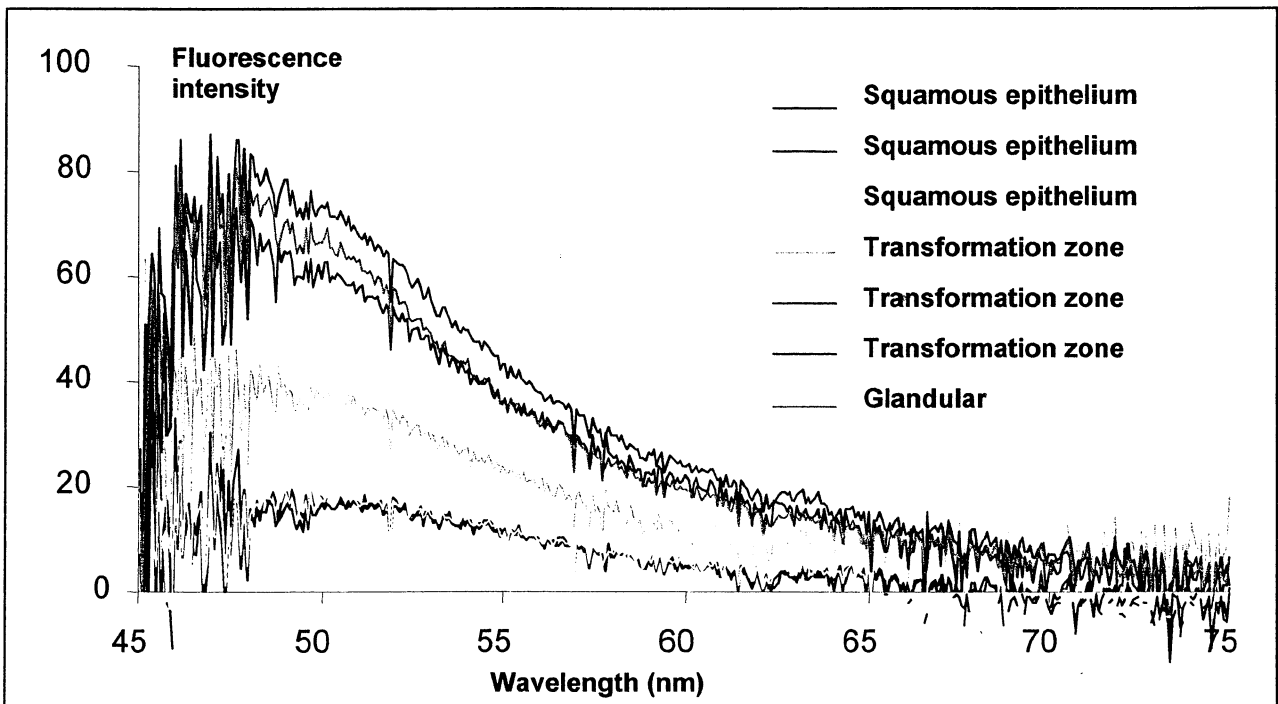


Figure 6 Typical fluorescence spectra of cervix

6. Results and conclusions

This master thesis resulted in software and hardware for controlling the diode fluorosensor. The software supports three measurement modes: measurements in the clinic, in the lab and for studying spectra from old measurements. The hardware is a mechanical shutter with which the laser output beam can be controlled.

The software and hardware developed comply with the requirements put on this master thesis and will contribute to making it easier to do measurements in the clinic, and in the lab, with the diode fluorosensor. There are still some improvements that can be made both in the software and in the hardware. The software has two file-structures for saving the measurements. This is due to the fact that there are different kinds of measurements and that different users prefer different filestructures. The user interface would be much more user-friendly if only one file-structure was used. The program cannot handle the two different spectrometers perfectly, there is a sub-routine for this, but it does not seem to work. When changing spectrometer it is required to go into a document and change some parameters. This could be improved. In the future it would be interesting to try to integrate analysis of the data into the program, with for example multivariate analysis or neural networks. Then there could be something such as a green or red lamp indicating if it is cancer or not. Adding this feature to the program could lead to making the device an important instrument in the operational theatre where the doctor in real time can tell if the whole tumour is removed or not. Also, it would be possible to use the instrument as a biopsy-guiding tool.

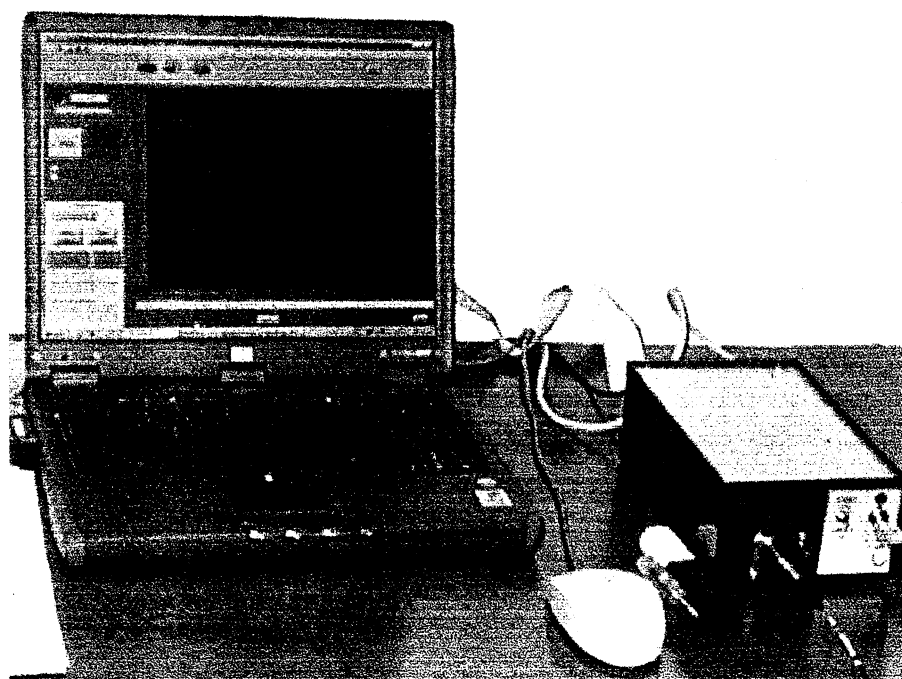


Fig 7 Diode fluorosensor and computer

7. References

1. G.A. Wagnières, W.M. Star and B.C. Wilson, *In vivo* fluorescence spectroscopy and imaging for oncological applications, *Photochem. Photobiol.* **68**, 603-632 (1998).
2. U. Gustafsson, S. Pålsson and S. Svanberg, Compact fibre-optic fluorosensor using a continuous wave violet diode laser and an integrated spectrometer, *Rev. Sci. Instrum.* **71**, 3004-3006 (2000).
3. Lars Bengtsson, *LabVIEW från början*, (Studentlitteratur, Lund 200)
4. Klaus Dembowski, *Pc Verkstan* ', (Pagina AB, Göteborg 1996)

8. Appendices

1. User's guide
2. Code documentation
3. Documentation of code from Ocean Optics

9. Acknowledgements

I would like to thank my supervisors Sara Pålsson and Sune Svanberg. They have been very helpful, enthusiastic and supportive.

I would also like to thank Petter Weibring who has helped me a lot with LabView and Åke Bergquist who has made the mechanical shutter for me.

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User's Guide

Software for a Diode-Based Fluorosensor

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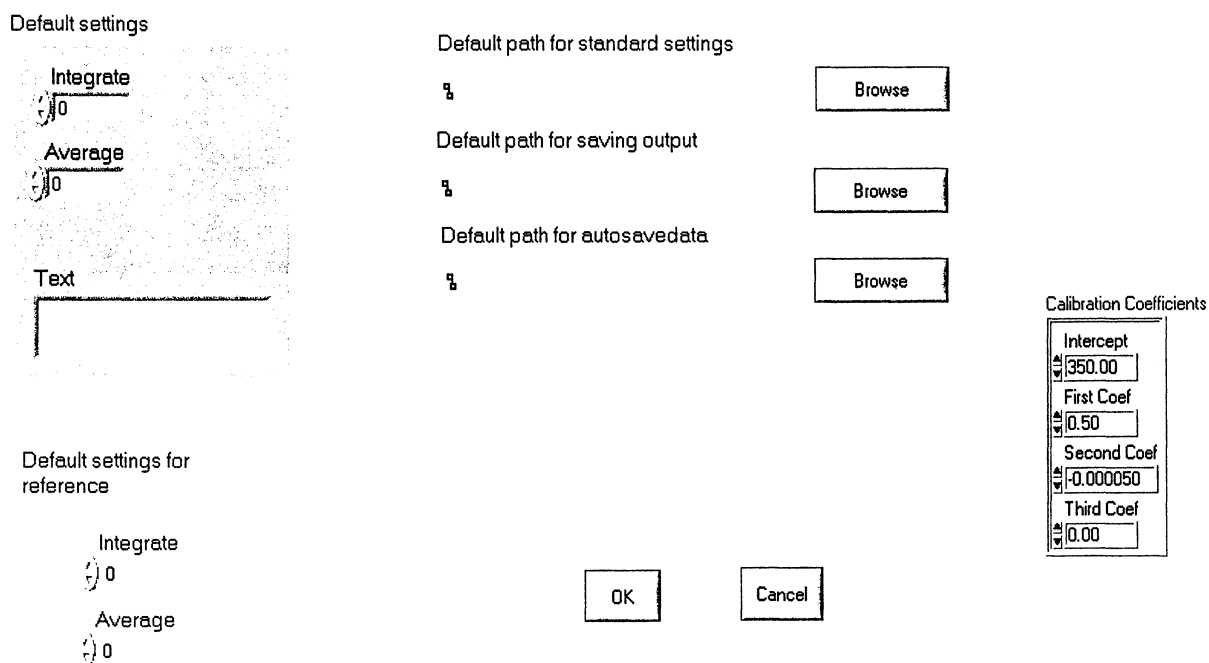
This program was made to study optical spectra with the USB2000 spectrometer from OceanOptics and to control a laser diode. It was made to be used in the lab and for diagnosing cancer in the clinic.

You are strongly recommended to read through the whole guide before using the program.

Before running the program

A few things need to be done before running this program.

To decide default values and paths for autosaving in clinical mode, run the program *Change default*. In that program you can decide the clinical mode *default settings* and where to save them (*default path for standard settings*). The default settings are: *Integrate* which is the time in ms to integrate the signal from the spectrometer, *Average* which is the number of measurements to average and *Text* which is the text displayed after 'Standard settings:' in the status bar. You may also change the *default settings for reference* and they are *Integrate* and *Average*. Along with your USB2000 spectrometer you will get some calibration coefficients. These shall be put in the square named *Calibration Coefficients*. The spectra will be autosaved at the path *Default path for autosaving output*. Some data, like the last measurement and where to save the next measurement, are saved at *Default path for autosavedata*. The program *Change default* can be run anytime you would like to change some default settings or paths. The first time you run the program *Change default* you will get error number 7, this is due to the fact that the program tries to display the selected values of the parameters which are not defined yet. The same error will occur the first time the program is run but you may ignore these errors.



Change default

Structure

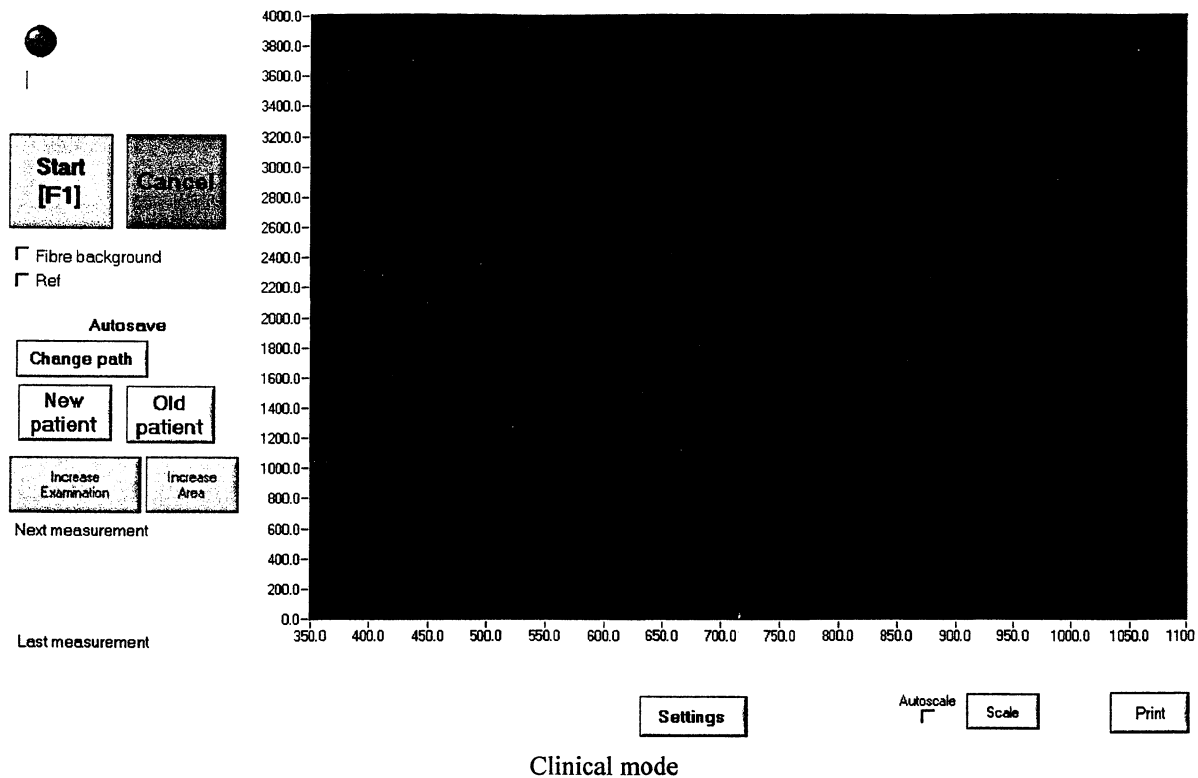
The program has three modes: clinical, lab and view spectra. To move between modes, press the buttons at top of the screen. Only one mode can be selected at the same time. At the top of the screen there is also a button for quitting the program.



Top of the screen

Clinical mode

The clinical mode is used to study fluorescence for diagnosing cancer in the clinic. In this mode all the measurements will be autosaved and the measuring is automatic. This means that the program starts and stops both the laser and the spectrometer and the background of the room is automatically measured before every fluorescence measurement.



Settings

Pressing this button opens a new window in which it is possible to change the settings. They can be changed manually by changing *Integration time* and *Average* or a standard setting can be selected by pressing the button *Get standard settings*. The current settings can be saved as standard settings by pressing the button *Save settings as standard*. *Current settings* shows which standard setting is selected at the moment. When you start the program the settings are the same as the ones selected last time the program was used.

Integration time [ms]

Average

Get standard settings

Current settings:

Save settings as standard

OK Cancel

Settings

Print

Prints the graph, the settings and where the spectrum has been autosaved. The spectrum is printed black on white background on the computer's standard printer.

Graph

Presents the data from the spectrometer. The background is subtracted unless the measurement is a fibre background. The last measurement is shown.

Status bar

Shows information about the selected settings and the status of measurements and printing.

Warning lamp and text

During the measurement the warning lamp is blinking and the text 'laser on' is shown.

Progress bar

The progress bar shows how the measurement is progressing. When the bar is filled the measurement is ready.

Start

Pressing this button, or F1, starts the measurement. A signal marks the beginning and end of the measurement. First the background of the room is measured and then the laser is turned on and the fluorescence is measured. When the measurement is finished the laser is turned off and the measurement is saved.

Fibre background

If *Fibre background* is selected pressing the start button means measuring the fibre background. This background is **not** the same as the room background. Fibre background is **measured in the dark** (for example in a box) and contains the fibrefluorescence. This background needs to be measured once in a while. When the measurement is ready *Fibre background* is unselected. The last measured fibre background will automatically be subtracted from the measurements. If you change the file path or the settings you will be reminded to measure the fibre background.

NOTE! There are two different backgrounds: *room background* and *fibre background*. Room background is the background in the room which is all the light that reaches the spectrometer which is not laser induced fluorescence. This background is automatically measured each time a measurement is made. Fibre background is the background from the fibre. Fibre background is measured each time *Fibre background* is selected and *Start* button is pressed.

Reference

To check the system quickly it is common to do a reference measurement. If *Reference* is selected the settings you have selected as *default settings for reference* in *Change path* will be used and the measurement will be saved in a directory called *Ref*.

Cancel

Pressing the button *Cancel* turns the laser off and aborts the current measurement.

Autosave

The spectrum is automatically saved. Every spectrum is saved as an own document and there are basically two ways to build the file structure in which the spectra are saved. In the default way the documents are saved in the directory *Default path for autosaving output\date\EXXX\AYYY* and named *EXXXAYYYPPZZZ_Date_Time.txt*. E stands for examination, A stands for area and P stands for point. XXX, YYY and ZZZ are numbers that increase.

- Path
 - Date
 - Ref
 - Ref1_Date_Time.txt
 - E001
 - E002
 - EXXX
 - A001
 - A002
 - AYYY
 - EXXXAYYYBG001_Date_Time.txt
 - EXXXAYYYP001_Date_Time.txt
 - EXXXAYYYP002_Date_Time.txt

In the other way the documents are saved in the directory *Default path for autosaving output\Date\Patient* and named *PXXX_Date_Time.txt*.

- Path
 - Date
 - Ref
 - Ref1_Date_Time.txt
 - Patient
 - Another patient
 - BG001_Date_Time.txt
 - P001_Date_Time.txt

Change path

Pressing this button opens a new window in which the directory for autosave and the document name can be changed.

Path

Add folders to path

Default

Date Examination Area Other:

Document name

Default: EXXXAYYYPZZZ

Examination, EXXX Area, AYYY Point, PZZZ Other:

XXX starting at YYY starting at ZZZ starting at

Prefix to document name JE

Add to document name

Number starting at

Next measurement:

C:\2002-01-24\A001\JEE001A001P001.txt

Change path

Path is the base directory for autosaving spectra. Default is the path selected as *Default path for autosaving output* in *Change default*. The path is changed either by pressing the button *default path* (which means selecting *Default path for autosaving output*) or the button *Browse*. Different directories can be added to the path, default is *Date*, *Examination* and *Area* added. If default is not selected you can select to add *Date*, *Examination*, *Area* and/or *Other*. If *Other* is selected, the adjacent text box should be written in.

The default document name is EXXXAYYYPZZZ. If the default document name is not selected, the name can be built up using *Examination*, *Area*, *Point* and/or *Other*. If *Other* is selected, text can be written in the adjacent text box, and this text becomes the name or a part of the name. Below *Examination*, *Area* and *Point* it is possible to select where to start counting XXX, YYY, ZZZ respectively. This makes it possible to continue an old set of measurements.

The document name can also have a prefix which can be selected. By default, *_Date_Time* is added to the document name. Other things to add to the document name can be selected from a list. If the adding includes a increasing number the startvalue of this number can be selected. In *Next measurement* the path and name for the next measurement are shown.

When you start the program the directory for autosave is the same as the one selected last time the program was used.

Increase Examination

If *Examination* is added as a folder to the path this button can be pressed. Pressing this button creates a new examination folder for autosaving. It also turns A, P and Number to 001.

Increase Area

If Area is added as a folder to the path this button can be pressed. Pressing this button creates a new area folder for autosaving. It also turns P and Number to 001.

New patient

Pressing this button opens a window where you can select the name of the patient folder in which the measurements are to be saved.

Earlier patient

Pressing this button makes it possible to continue measurements on an earlier patient. You select which patient to continue measurements on and these measurements will be saved in the same directory as the old measurements. The numbering of the points will continue from the last measured one. This is only if you continue measurements in the same day. If you want to continue measurements from another day they will be saved in a new directory under today's date starting with number 001.

NOTE! When working in *Clinical mode* you can **either** use the buttons *Increase Examination* and *Increase Area* **or** *New patient* and *Earlier patient* depending on which of the above described systems for autosave you would like to use.

Next measurement

The name of the next measurement is shown in the area *Next measurement*. By selecting *Ref*, *Room background* or *Change path* the name of the next measurement will be changed.

Last measurement

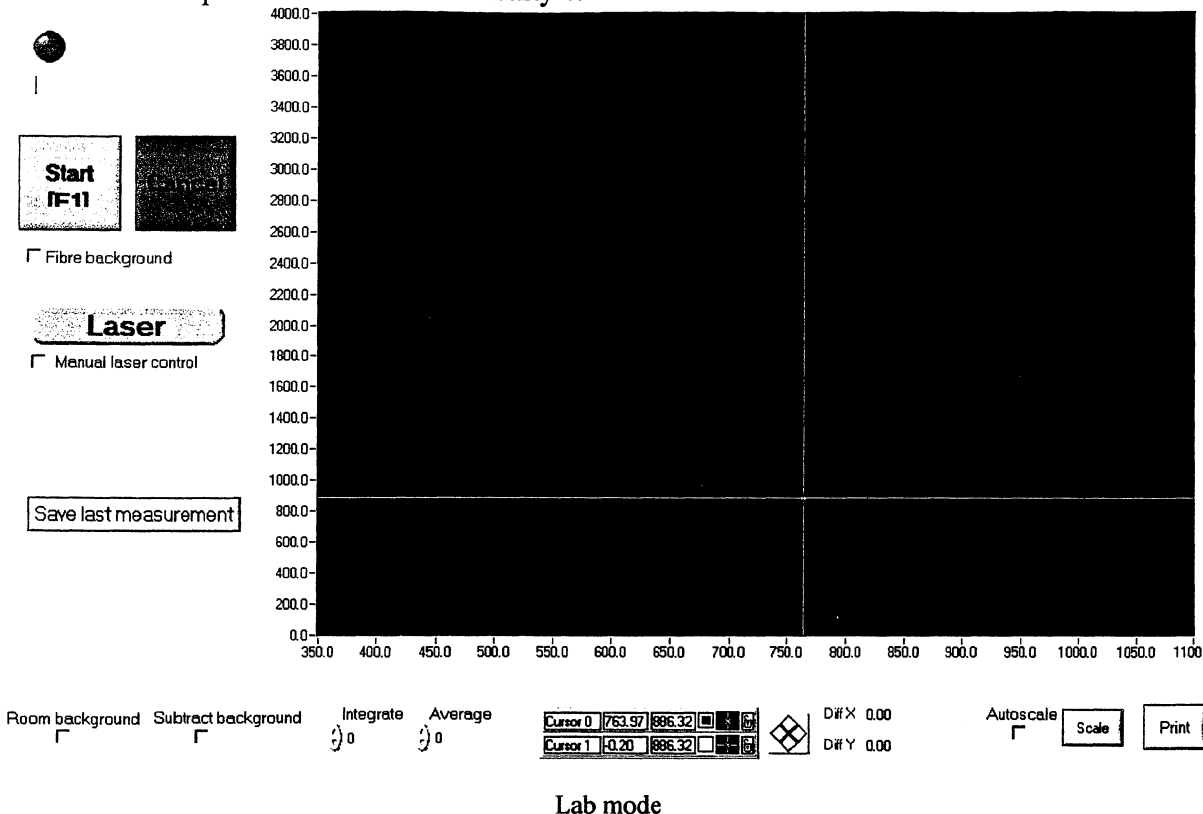
The name of the last measurement is shown in the area *Last measurement*. If no measurements are made the area is empty.

[F2]

The button [F2] at the keyboard changes the position of the mechanical shutter.

Lab mode

This mode is made for studying fluorescence in the lab. You can change all the parameters separately and you can chose whether to run the laser manually or to let the program run it. In this mode the spectra are not automatically saved.



Warning lamp and text

During the measurement the warning lamp is blinking and the text 'measuring' will be shown.

Progress bar

The progress bar shows how the measurement progress. When the bar is filled the measurement is ready.

Start

Pressing this button starts the measurement. A signal marks the beginning and end of the measurement. If *Room background* is selected the measurement starts with measuring the room background. If *manual laser control* is not selected the laser will be turned on and off by the program like in clinical mode.

Fibre background

If *Fibre background* is selected pressing the start button means measuring the fibre background. When the measurement is finished *Fibre background* is unselected. The last measured fibre background will be subtracted from the measurements if *Subtract background* is selected.

Cancel

Pressing the button *Cancel* turns the laser off and aborts the current measurement.

Laser

If *Manual laser control* is selected this button controls the laser. Pressing the button turns the laser on and pressing it again turns it off. The button blinks when the laser is on. If *Manual laser control* is unselected, this button is disabled but it still shows whether the laser is on or not.

Manual laser control

You can choose whether to turn the laser on and off yourself or to let the program do it automatically like in the clinical mode. When *Manual laser control* is selected *Room background* is unselected.

Save last measurement

Pressing this button makes it possible to select a directory and file name for saving the last measurement. The measurement will be saved with the background subtracted. The last fibre background will also be saved. It is saved in the same folder as the measurement and is named BG_Date_Time.txt.

Room background

If *Room background* is selected the room background will automatically be measured when *Start* is pressed like in clinical mode.

Subtract background

If *Subtract background* is selected the last measured fibre and room backgrounds will be subtracted from the spectrum shown in the graph. When saving spectra the background will always be subtracted.

Integrate

The time in ms to integrate the signal from the spectrometer for each measurement. This can be changed.

Average

The number of measurements to average. This can be changed.

Cursor

Two cursors can be used. From the menus you can select the style and colours of them. It is possible to lock the cursor to the curve. The cursors are moved by pressing the buttons at the right of the cursor legend.

Diff X, Diff Y

Shows the difference in x and y co-ordinates between the two cursors.

Autoscale

If *Autoscale* is selected the scale will adjust to the spectrum.

Scale

Makes it possible to change the scale of the graph. Pressing *Scale* unselects *Autoscale*.

Print

Prints the graph and the settings. The spectrum is printed black on white background on the computer's standard printer.

Graph

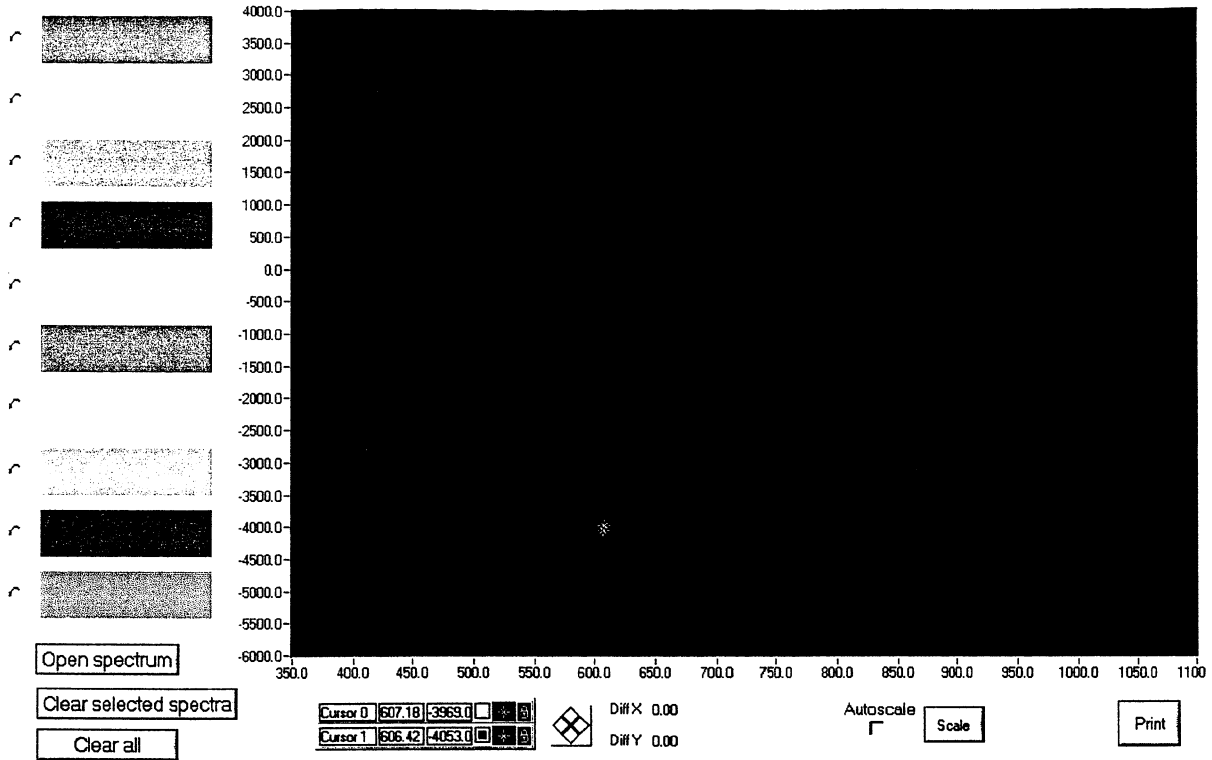
Presents the data from the spectrometer. The background is subtracted if *Subtract background* is selected. The last measurement is shown.

[F2]

The button [F2] at the keyboard changes the position of the mechanical shutter.

View spectra

In this mode you can study up to ten spectra at the same time.



View spectra

List of spectra

In the coloured boxes the names of the selected spectrum will appear. The colour of the box is the same as the colour of the spectrum in the graph. At the left you can mark each spectrum and that means that the spectrum is selected.

Open spectrum

Pressing *Open spectrum* makes it possible to select a spectrum to open. The name of the selected spectrum will appear in the first available box from the top. If all boxes are full you can not press *Open spectrum*.

Clear selected spectrum

Deletes the marked spectrum.

Clear all

Clears all spectra.

Cursor

Two cursors can be used. From the menus you can select the style and colours of them. It is possible to lock the cursor to a spectrum. The cursors are moved by pressing the buttons to the right of the cursor legend.

Diff X, Diff Y

Shows the difference in x and y co-ordinates between the two cursors.

Autoscale

If *Autoscale* is selected the scale will adjust to the spectrum.

Scale

Makes it possible to change the scale of the graph. Pressing *Scale* unselects *Autoscale*.

Print

Prints the graph and the settings. The spectra are printed in colour on white background on the computer's standard printer.

Graph

Shows the spectra that has been selected in *Open spectrum*. Note that the background has been subtracted from all spectra.

Document structure

When saving data the program creates a document with the following structure:

First comes the original name of the document then the date and time. After that comes the name of the fibre background and then the settings. Then comes the first wavelength and then the wavelength step. Then follows the data (2048 rows) with both backgrounds subtracted and at the end of the document the room background (also 2048 rows). The document is saved as a text document (.txt).

```
File name: C:\Measurements\Output\2001-11-05\sven\P001_2001-11-05_11_57.txt
Date and time: 2001-11-05 11:57
Fibre background: C:\Measurements\Output\2001-11-05\sven\BG001_2001-11-05_11_57.txt
Settings: Settings: Integrate:4000[ms] , Average:2 Standard settings: No standard settings chosen
First wavelength: 332
Wavelength step: 0.377991
Data:
245
245
157
154
```

Example, the first 11 rows in a document

The fibre backgrounds are saved in a similar way. Instead of the name of the fibre background is the name of the next measurement to be made. There is of course no room background saved in the document.

```
File name: C:\Measurements\Output\2001-11-05\sven\BG001_2001-11-05_11_56.txt
Date and time: 2001-11-05 11:56
Spectra: C:\Measurements\Output\2001-11-05\sven\P001_2001-11-05_11_56.txt
Settings: Settings: Integrate:4000[ms] , Average:2 Standard settings: No standard settings chosen
First wavelength: 332
Wavelength step: 0.377991
Data:
-245
-245
-154
-149
```

Example, the first 11 rows in a fibre background document

The reference measurements are also saved in a similar way but there is a blank row instead of the name of the fibre background document. There is no room background saved in this document.

File name: C:\Measurements\Output\2001-11-05\Ref\Ref3_2001-11-05_12_03.txt
Date and time: 2001-11-05 12:03

Settings: Settings: Integrate:4000[ms] , Average:5 Standard settings: Default settings for reference measurements

First wavelength: 332

Wavelength step: 0.377991

Data:

0

0

89

88

Example, the first 11 rows in a reference document

Bugs

One bug has been found in the program and that bug makes it necessary to change settings manually when you shift between spectrometers. This is done in a document called OOIDRV.INI found under Windows in the computer. Here you change the parameters *ADC Type*, *IRQ* and *BaseAddress*. For the USB2000 spectrometer these parameters should be *USB2000*, 7 and 768, for S2000 the parameters should be *DAQ700*, 11 and 6336.

Code Documentation

Software for a Diode-Based Fluorosensor

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Autosave.llb

This library contains routines for autosaving.

Titles and descriptions

Autosave current.vi

This is a global which contains information about current measurement.

Autosave last default.vi

This is a global which contains information about last default measurement.

Autosave last fibre background.vi

This is a global which contains data from the last fibre background.

Autosave last room background.vi

This is a global which contains data from the last fibre background.

Autosave last.vi

This is a global which contains information about last measurement.

Autosave Ref.vi

This is a global which contains information about settings for reference measurements and date and number for last reference measurement.

Build next measurement.vi

Updates *Autosave current*, *Autosave last* and *Autosave last default*. Is called after each measurement.

Change cluster.vi

Changes a dialogue cluster to a global cluster.

Change current.vi

Changes *Autosave current* when *ok* button has been pressed in *Change path.vi*.

Change path.vi

Allows the user to change the path and name of next measurement. Changes *Autosave current*.

Get name and path.vi

Gives the name, complex name and complete path of the document described by the input cluster.

Get next fibrebackground name.vi

Gives the name of the next fibrebackground.

Get next Ref name.vi

Gives the name of the next reference measurement.

Increase Area.vi

Increases *Area* 1 step and updates *autosave current*. Called when *A+* has been pressed.

Increase Examination.vi

Increases *Examination* 1 step and updates *autosave current*. Called when *E+* has been pressed.

Make new dir.vi

Creates the directory described by the input parameter *Path*.

Name new patient.vi

Makes it possible for the user to choose a name for a new patient folder.

New patient.vi

Updates *current* for measurements on a new patient.

Next earlier patient.vi

Updates *Current* for continuing measurements on an earlier patient.

Earlier patient.vi

Makes it possible for the user to choose to continue measurements on an earlier patient. Returns the name of the next measurement.

Save.vi

Saves the data from the last measurements and the room- and fibre-backgrounds belonging to it.

Save fibre background.vi

Saves the fibre background.

Save ref.vi

Saves last reference measurement.

Select earlier patient.vi

Makes it possible for the user to choose an earlier patient for continuing measurements on.

Update current.vi

Updates *Autosave current* in case of new date.

Update fibre background.vi

Updates *Date*, *Number*, *Time* and *Saving number and time* in *Autosave last fibre background*.

Update last default.vi

Updates *Last default* in case of new date.

Update ref.vi

Updates *Autosave Ref*.

Detailed description

Autosave current.vi

This is a global which contains information about current measurement. Type: global cluster.

Autosave last default.vi

This is a global which contains information about last default measurement. Type: global cluster.

Autosave last fibre background.vi

This is a global which contains data and information from the last fibre background. Types: *Last fibre background* Graph, *Last fibre cluster* global cluster.

Autosave last room background.vi

This is a global which contains data from the last fibre background. It also contains the date, time and number of the measurement. A string with the number and the time with ':' changed to '_' is also saved here. Types: *Last room background* Graph, *Date* String, *Number* U16, *Time* String, *Saving number and time* String.

Autosave last.vi

This is a global which contains information about last measurement. Type: global cluster.

Autosave Ref.vi

This is a global which contains information about settings for reference measurements and date and number for last reference measurement. Type: *Ref integrate* U16, *Ref average* U16, *Number* U16, *Date* String, *Number date and time* String.

Build next measurement.vi

Icon



Input parameters

None

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Autosave last.vi

Autosave last default.vi

Default path for saving output.vi

Description

Updates Autosave current, Autosave last and Autosave last default. Is called after each measurement.

The code

If current measurement was a default measurement *Autosave last default* should be updated. Sequence 0 checks if current measurement was default and if true *Autosave last default* is updated. Else nothing is done.

In the next sequence is *Autosave last* given the value of *Autosave current*.

The date can be a part of the file-structure for autosaveing. If so it is important to know if it is a new date since current measurement. If so and if the date is a part of the file-structure *the E, A, P* and *Number* has to start again from the value 1. Otherwise add 1 to *P* and *Number*. In sequence 2 it is checked if today's date is the same as *the date* for current measurement. If true 1 is added to *P* and *Number*. If false it is checked if the date is a part of the file-structure. If true *E, A, P* and *Number* is given the value 1 and *the date* is updated. If false 1 is added to *P* and *Number*.

Change cluster.vi

Icon



Input parameters

Name	Type	Description
Input cluster	Dialogue cluster	

Output parameters

Name	Type	Description
Output cluster	Global cluster	

Callers

Change path.vi

SubVIs

None

Description

Changes a dialogue cluster to a global cluster.

The code

The information in the input cluster is copied to the output cluster and today's date is added.

Change current.vi

Icon



Input parameters

Name	Type	Description
Cluster	Dialogue cluster	

Output parameters

None

Callers

Change path.vi

SubVIs

Autosave current.vi

Change cluster.vi

Description

Changes *Autosave current* when *ok* button has been pressed in Change path.vi.

The code

Copies the contents of *Cluster* to *Autosave current* and adds today's date.

Change path.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Disable examination	U8	0 if the new path contains E else 2. Will determine whether or not to disable button E+.
Next measurement	String	The name of next measurement.
Disable area	U8	0 if the new path contains A else 2. Will determine whether or not to disable button A+.

Callers

Clinical mode.vi

SubVIs

Change cluster.vi

Change current.vi

Get name and path.vi

Autosave current.vi

Autosave last default.vi

Default path for saving output.vi

Description

Allows the user to change the path and name of next measurement. Changes *Autosave current*.

The code

The program updates the name and path for the next measurement while the user presses the buttons until cancel or ok is pressed. Some choices are sometimes disabled:

If Add default folders to path is chosen it is not possible to change Date, Examination and Area

If *Default document name* is chosen it is not possible to change *EXXX*, *AYYY*, *PZZZ* and *Other*

If *Other* is not chosen it is not possible to print in the area besides *Other*

XXX starting at is only possible to change if *EXXX* is chosen and possible to change, the same goes for *YYY* and *ZZZ*

It is only possible to change the prefix if *Prefix to document name* is chosen

It is only possible to change *Number starting at* if *Add to document name* is chosen to be anything with number in it

If the path is the same as *Default path for saving output* and if *Add default folders to path* and *Default document name* are chosen all is default and the values of *XXX*, *YYY*, *ZZZ* and *Number* should be default.

The code is built up of four squares.

The left-most one is the start-up which gives the variables the values of *Autosave current*.

The loop in the middle checks if any button has been pressed and changes *index*. *Index* is changed in the following way:

Index	Event
0	Nothing has happened
1	<i>Browse</i> is pressed
2	<i>Standard path</i> is pressed
3	<i>Add to document name</i> is changed
4	<i>Choose default document name</i> is changed
5	<i>Choose document name</i> is changed
6	<i>Add default folders</i> is changed
7	<i>Prefix to document name</i> is changed
8	<i>Examination in document name</i> is changed
9	<i>Area in document name</i> is changed
10	<i>Point in document name</i> is changed
11	Something else has happened

The loop at the top performs different things according to the value of *index* :

0. Nothing is done
1. Makes it possible for the user to choose a new path. Updates *Path* in *Cluster* if a new path is chosen.
2. Gives *Path* in *Cluster* the same value as *Default path* for saving output.
3. Makes it possible to change *Number* if *Add to document name* contains number, makes it impossible otherwise.
4. If *Default document name* is chosen the current values of *Examination in document name*, *Area in document name*, *Point in document name*, *Choose document name*, *XXX Starting at*, *YYY Starting at* and *ZZZ Starting at* are saved in *Last document name*. *Examination in document name*, *Area in document name* and *Point in document name* gets the value true and *Choose document name* gets the value false and these are no longer possible to change. If also all is default *XXX Starting at*, *YYY Starting at*, *ZZZ Starting at* and *Number starting at* gets the next default value, else they all get the value 1 and they are no longer possible to change. If *Default document name* is not chosen *Examination in document name*, *Area in document name*, *Point in document name*, *Choose document name*, *XXX Starting at*, *YYY Starting at* and *ZZZ Starting at* are given the values saved in *Last document name* and they are all being able to change.
5. It is possible to write a document name only if *Choose document name* is chosen.
6. If *Add default folders to path* is chosen the current values of *Date*, *Examination*, *Area*, *XXX Starting at*, *YYY Starting at* and *ZZZ Starting at* are saved in *Last document name*. *Date*, *Examination* and *Area* gets the value true and these are no longer possible to change. If also all is default *XXX Starting at*, *YYY Starting at*, *ZZZ Starting at* and *Number starting at* gets the next default value, else they all get the value 1. If *Add default folders to path* is not chosen *Date*, *Examination*, *Area*, *XXX Starting at*, *YYY Starting at* and *ZZZ Starting at* are given the values saved in *Last document name* and they are all being able to change. If also *Default document name* is chosen *XXX Starting at*, *YYY Starting at*, *ZZZ Starting at* and *Number starting at* gets the value 1.
7. It is possible to write a prefix only if *Prefix to document name* is chosen.
8. It is possible to change *XXX Starting at* only if *Examination in document name* is chosen and *Default document name* is not chosen.
9. It is possible to change *YYY Starting at* only if *Area in document name* is chosen and *Default document name* is not chosen.
10. It is possible to change *ZZZ Starting at* only if *Point in document name* is chosen and *Default document name* is not chosen.
11. Builds name and path out of current values in *Cluster* and presents it in *Next measurement*.

The loops in the middle continues until any of the buttons *ok* and *cancel* is pressed.

The rightmost square changes *Autosave current* if *ok* has been pressed and makes *disable area* 0 if the new path contains A else 2 and *disable examination* 0 if the new path contains E else 2. *Next measurement* (the output) is given the chosen name of next measurement.

Get name and path

Icon



Input parameters

Name	Type	Description
Input cluster	Global cluster	

Output parameters

Name	Type	Description
Document name	String	The name of the document described by the input cluster
Complex name	String	'Path:' The path of the document described by the input cluster 'new line' 'Document name:' Document name.
Path	Path	The complete path including document name.
Path	String	The complete path including document name.

Callers

Change path.vi
Clinical mode.vi
Delete last.vi
Get next name.vi
Increase area.vi
Increase examination.vi
Save.vi

SubVIs

None

Description

Gives the name, complex name and complete path of the document described by the input cluster.

The code

Builds in 13 steps the names and path according to the data in input cluster.

Get next fibrebackground name.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next fibre background name	String	The path including the name of the next fibre background

Callers

Clinical mode.vi

SubVIs

Autosave current.vi
Autosave last fibre background.vi
Get name and path.vi

Description

Gives the path, including the name, of next fibre background.

The code

Fibre backgrounds in the same catalogue gets increasing numbers.

Get next Ref name.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next Ref name	String	The name of the next reference measurement

Callers

Clinical mode.vi

SubVIs

Autosave Ref.vi

Description

Gives the name of next reference measurement.

The code

Reference measurements are saved in a date catalogue with increasing numbers. If the date is not the same as for last reference measurement the number starts over from 1, otherwise the number increases.

Increase Area.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next measurement	String	Name of next measurement

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Get name and path.vi

Description

Increases *Area* 1 step and updates *autosave current*. Called when *A+* has been pressed.

The code

When *Area* is increased *Point* and *Number* shall start over from 1 again. In sequence 1 *Area* is increased 1 step and *Point* and *Number* are given the value 1. In next sequence is *Get name and path* called to get the name of the next measurement.

Increase Examination.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next measurement	String	Name of next measurement

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Get name and path.vi

Description

Increases *Examination* 1 step and updates *autosave current*. Called when *E+* has been pressed.

The code

When *Examination* is increased *Area*, *Point* and *Number* shall start over from 1 again. In sequence 1 *Examination* is increased 1 step and *Area*, *Point* and *Number* are given the value 1. In next sequence is *Get name and path* called to get the name of the next measurement.

Make new dir.vi

Icon



Input parameters

Name	Type	Description
Path	Path	The path to the new directory

Output parameters

None

Callers

Clinical ending.vi

Default shut down.vi

Save background lab.vi

Save fibre background.vi

Save lab.vi

Save reference.vi

Save.vi

SubVIs

None

Description

Creates the directory described by the input parameter *Path*.

The code

Checks if the directories in the path exists. If they do not exist they are created.

Name new patient.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Cancel?	Boolean	True if <i>Cancel</i> has been selected. False if <i>OK</i> has been selected.
Name	String	The name of the new patient.

Callers

New patient.vi

SubVIs

Default path for saving output.vi

Description

Makes it possible for the user to choose a name for a new patient folder.

The code

The existing patients in today's directory are shown. While not pressing *Ok* or *Cancel* the user can give the new patient a name.

New patient.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next measurement	String	The path, including the name, for the next measurement.

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Default path for saving output.vi

Get name and path.vi

Name new patient.vi

Description

Updates *current* for measurements on a new patient.

The code

If a new patient name has been chosen *Current* is given the values for autosaving measurements from the chosen patient. Otherwise nothing happens. Returns the path of the next measurement.

Next earlier patient.vi

Icon



Input parameters

Name	Type	Description
Path	Path	The path to the file of the earlier patient

Output parameters

None

Callers

Earlier patient.vi

SubVIs

Autosave current.vi

Default path for saving output.vi

Description

Updates *Current* for continuing measurements on an earlier patient.

The code

If the date is the same as it was when the measurements in the directory described by the input parameter *Path* was made *Number and P* in *Current* gets the value of the last measurement in the directory plus one, else it gets the value 1 and the measurements will be saved in a new directory.

Earlier patient.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Next measurement	String	The path, including the name, of the next measurement

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Get name and path.vi

Next earlier patient.vi

Select earlier patient.vi

Description

Makes it possible for the user to choose to continue measurements on an earlier patient. Returns the name of the next measurement.

The code

Lets the user choose an earlier patient to continue measurements on. If an earlier patient is chosen *Current* is updated and the next measurement is returned.

Save.vi

Icon



Input parameters

Name	Type	Description
Graph	Graph	The data from last measurement
Settings information	String	Information about current settings

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Autosave last fibre background.vi

Autosave last room background.vi

Get name and path.vi

Make new dir.vi

Description

Saves the data from the last measurements and the room- and fibre-backgrounds belonging to it.

The code

First is the file to be saved built up. The file starts with some information about the measurement and then follows the data and the room background. The data is saved with both room and fibre background withdrawn. After this the saving starts with making the file in which the data are to be saved. Then the data is saved and the file is closed.

Save fibre background.vi

Icon



Input parameters

Name	Type	Description
Graph	Graph	The data to be saved
Settings information	String	Information about the current settings

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Autosave last fibre background.vi

Get name and path.vi

Make new directory.vi

Description

Saves the fibre background.

The code

The string to be saved, with information about date, time and settings, is first built up and then saved.

Save ref.vi**Icon****Input parameters**

Name	Type	Description
Graph	Graph	The data to be saved
Settings information	String	Information about the current settings

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave Ref.vi

Default path for saving output.vi

Make new dir.vi

Description

Saves last reference measurement.

The code

The string to be saved, with information about date, time and settings, is first built up and then saved.

Select earlier patient.vi**Icon****Input parameters**

None

Output parameters

Name	Type	Description
Cancel?	Boolean	True if <i>Cancel</i> has been chosen and false if <i>OK</i> has been chosen.
Path	Path	The selected path

Callers

Earlier patient.vi

SubVIs

Default path for saving output.vi

Description

Makes it possible for the user to choose an earlier patient for continuing measurements on.

The code

A dialogue box is opened where the user can choose one of the existing files. The dialogue box starts in the folder with today's date. If there is no such folder it starts in *Default path for saving output*.

Update current.vi

Icon



Input parameters

None

Output parameters

None

Callers

Clinical start up.vi

SubVIs

Autosave current.vi

Description

Updates *Autosave current* in case of new date.

The code

If the date today is not the same as *the date* in *Autosave current*, *the date* in *Autosave current* is updated. If also the date is a part of the path *E, A, P* and *Number* shall start over from 1.

Update fibre background.vi

Icon



Input parameters

None

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave current.vi

Autosave last fibre background.vi

Description

Updates *Date, Number, Time* and *Saving number and time* in *Autosave last fibre background*.

The code

Fibre backgrounds in the same catalogue gets increasing numbers.

Update last default.vi

Icon



Input parameters

None

Output parameters

None

Callers

Clinical start up.vi

SubVIs

Autosave last default.vi

Description

Updates *Last default* in case of new date.

The code

If the date today is not the same as *the date* in *Last default*, *the date* in *Last default* is updated. If also the date is a part of the path *E and A* gets the value 1 and *P and Number* gets the value 0. This makes the next default measurement start on number 1.

Update ref.vi

Icon**Input parameters**

None

Output parameters

None

Callers

Clinical mode.vi

SubVIs

Autosave Ref.vi

Description

Updates Autosave Ref.

The code

Updates *Date* and *Number* in *Autosave Ref*. If it is another date then last time a reference measurement was made *Date* is updated an *Number* is set to 1. Else *Number* is increased one step.

Clinical.IIb

This library contains routines used in clinic mode.

Titles and descriptions

Background off.vi

Subtracts room- and fibre-backgrounds from the measurement.

Choose standard settings.vi

Allows the user to choose a file from which standard settings are read.

Clinical settings.vi

Allows the user to change settings, choose a standard setting or save settings as standard.

Clinical status text.vi

Builds up a string with current information about settings and status.

Empty graph.vi

Makes an empty graph.

Print single graph.vi

Prints the graph and the information in the *status bar*.

Save standard settings.vi

Allows the user to choose a place to save and a name to call the current settings. Returns the chosen path as a string.

Sound off.vi

Plays a sound used to indicate the end of the measurement.

Detailed description

Background off.vi

Icon



Input parameters

Name	Type	Description
Graph in	Graph	The graph from which the backgrounds are to be subtracted

Output parameters

Name	Type	Description
Graph out	Graph	Graph with backgrounds subtracted

Callers

Clinical mode.vi

SubVIs

Autosave last fibre background.vi
Autosave last room background.vi

Description

Subtracts room- and fibre-backgrounds from the measurement.

The code

Adds the two backgrounds and subtracts them from the *Graph in* and puts the result in *Graph out*.

Choose standard settings.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Current setting:	String	The name of the current settings
Integration time [ms]	I16	The chosen integration time
Average	I16	The chosen number of measurements to average
Cancel?	Boolean	True if <i>cancel</i> has been pressed. False else.

Callers

Clinical settings.vi

SubVIs

Default path for standard settings.vi

Description

Allows the user to choose a file from which standard settings are read.

The code

Reads *Integrate* and *Average* from chosen file if cancel has not been pressed in the file-dialogue box.

Clinical settings.vi

Icon



Input parameters

Name	Type	Description
Integration time [ms]	I16	
Average	I16	
Current settings:	String	The name of chosen standard settings

Output parameters

Name	Type	Description
Integration time [ms] out	I16	
Average out	I16	
Current setting: out	String	The name of chosen standard settings

Callers

Clinical mode.vi

SubVIs

Choose standard settings.vi

Save standard settings.vi

Description

Allows the user to change settings, choose a standard setting or save settings as standard.

The code

The program updates *Integration time*, *Average* and *Standard settings* while the user presses the buttons until *cancel* or *ok* is pressed.

The program is built of four squares, the leftmost is the start-up where initial values are saved in case of cancel. The loop at the bottom checks if *choose standard* or *save settings as standard* has been pressed and changes *Index*. *Index* gets the value 1 if *save settings as standard* is pressed and the value 2 if *choose standard* is pressed. The loop continues until *cancel* or *ok* is pressed.

The loop at the top performs different things according to the value of *Index*:

0. No button is pressed. Checks if *Integration time* or *Average* is changed, if so the settings are no longer standard.
1. *Save settings as standard* is pressed. *Save standard settings.vi* is called to save the settings as standard.
2. *Choose standard* is pressed. *Choose standard settings* is called to let the user choose standard settings. If the choosing has not been cancelled the new values are presented.

Clinical status text.vi

Icon



Input parameters

Name	Type	Description
Current settings in	String	The name of the current settings
Status text	String	Information text presented first in the status bar
Integrate in	I16	The current integration time
Average in	I16	The current measurements to average

Output parameters

Name	Type	Description
String	String	A string built this way: Status text, 'Integrate [ms]' The integration time, 'Average' The number of measurements to average, 'Standard settings' standard settings.

Callers

Clinical mode.vi

SubVIs

Default path for standard settings.vi

Description

Builds up a string with current information about settings and status.

The code

Builds a string of the input information. If the chosen standard setting is saved at the default place for saving standard settings only the name of the standard setting will be shown.

Empty graph.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Graph	Graph	Empty graph

Callers

Clinical mode.vi

SubVIs

None

Description

Makes an empty graph.

The code

Gives all the data in the graph the value 0.

Print single graph.vi**Icon****Input parameters**

Name	Type	Description
Status bar	String	Information about the graph to add to the print
Graph	Graph	The graph to be printed
X max	DBL	Minimum value of the x-scale
X min	DBL	Maximum value of the x-scale
Y max	DBL	Minimum value of the y-scale
Y min	DBL	Maximum value of the y-scale

Output parameters

None

Callers

Clinical mode.vi

SubVIs

None

DescriptionPrints the graph and the information in the *status bar*.**The code**

The front panel is printed at completion. (Chosen from the Operate menu).

Save standard settings.vi**Icon****Input parameters**

Name	Type	Description
Integration time [ms]	I16	The current time to integrate
Average	I16	The current number of measurements to average
Current settings	String	The name of the current settings

Output parameters

Name	Type	Description
Current settings	String	The name of the current settings

Callers

Clinical mode.vi

SubVIs

Default path for standard settings.vi

Description

Allows the user to choose a place to save and a name to call the current settings. Returns the chosen path as a string.

The code

Two sequences build up the program, in the first the array to be saved is built. In the second the user chooses a place to save and a name for the settings. If cancel is not pressed in the file-dialogue box the new settings are saved and the new path is returned, else the old chosen settings are returned.

Sound off.vi**Icon****Input parameters**

None

Output parameters

None

Callers

Clinical mode.vi

Lab mode.vi

SubVIs

None

Description

Plays a sound used to indicate the end of the measurement.

The code

Calls a sub vi that plays the contents of the file Musica Exclamation.wav.

Default.lib

This library contains routines for saving and changing the default paths for saving.

Titles and descriptions**Calibration coefficients.vi**

This is a global which contains the calibration coefficients of the spectrometer.

Change default.vi

Makes it possible for the user to change default paths for saving, calibration coefficients, settings for reference measurements and default settings. Should be run before the main program is run the first time.

Default path for autosave data.vi

This is a global which contains the path where the autosave data is saved. The autosave data is the information about last measurement, last default measurement and current measurement.

Default path for saving output.vi

This is a global which contains the path where the output data is saved.

Default path for standard settings.vi

This is a global which contains the path where the standard settings are saved.

Default settings.vi

This is a global which contains the settings the program has when it starts.

Default shut down.vi

Saves the default paths and settings at *Default path for saving default*.

Default start up.vi

Gets the default paths and settings from memory and puts it into the global variables.

Detailed descriptions

Calibration coefficients.vi

This is a global which contains the calibration coefficients of the spectrometer.

Change default.vi

Icon



Input parameters

None

Output parameters

None

Callers

None

SubVIs

Autosave Ref.vi

Calibration coefficients.vi

Default path for autosave data.vi

Default path for saving output.vi

Default path for standard settings.vi

Default settings.vi

Default shut down.vi

Default startup.vi

Description

Makes it possible for the user to change default paths for saving, calibration coefficients, settings for reference measurements and default settings. Should be run before the program is run the first time. Text is the text displayed after 'Standard settings:' in the status bar.

The code

Gets the current values of default paths, calibration coefficients and settings and displays these. Allows the user to browse for new paths and to change the default settings and calibration coefficients while neither *ok* nor *cancel* has been pressed. The chosen paths, calibration coefficients and settings are shown. If *cancel* is pressed

nothing is done, if *ok* is pressed the given values of the default paths, calibration coefficients and settings are saved.

Default path for autosave data.vi

This is a global which contains the path where the autosave data is saved. The autosave data is the information about last measurement, last default measurement and current measurement. Type: Path.

Default path for saving output.vi

This is a global which contains the path where the output data is saved. Type: Path.

Default path for standard settings.vi

This is a global which contains the path where the standard settings are saved. Type: Path.

Default settings.vi

This is a global which contains the settings the program has when it starts. The settings used last time the program was run are saved here. *Integrate* is DBL and describes the time to integrate each measurement, *Average* is DBL and is the number of measurements to average, *Text* is String and it is the text displayed after 'Standard settings:' in the status bar.

Default shut down.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

Change default.vi

SubVIs

Autosave Ref.vi

Calibration coefficients.vi

Default path for autosave data.vi

Default path for saving output.vi

Default path for standard settings.vi

Default settings.vi

Make new dir.vi

Description

Saves the default paths and settings at *Default path for saving default*.

The code

Opens the file. If the file exist (error not equal to 7) close it and make a new, else make a new. Then save.

Default start up.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

Change default.vi

SubVIs

Autosave Ref.vi

Calibration coefficients.vi

Default path for autosave data.vi

Default path for saving output.vi

Default path for standard settings.vi

Default settings.vi

Description

Gets the default paths and settings from memory and puts it into the global variables.

The code

Opens the files where the default paths and settings has been changed and puts the contents into global variables.

Lab.lib

This library contains routines used in lab mode.

Titles and descriptions**Save background lab.vi**

Saves the last measured fibre background and information about the settings.

Save lab.vi

Saves the graph and the fibre background belonging to it.

Detailed description**Save background lab.vi****Icon****Input parameters**

Name	Type	Description
Graph	Graph	The background to be saved
Settings information	String	Information about the settings
Path spectra	Path	The path to the spectra belonging to the background

Output parameters

None

Callers

Save lab.vi

SubVIs

Autosave last fibre background.vi
Get name and path.vi
Make new dir.vi

Description

Saves the last measured fibre background and information about the settings.

The code

Builds up a string with the data from the background and information about the settings. Saves the string at the same place as the measurement belonging to the background.

Save lab.vi

Icon



Input parameters

Name	Type	Description
Settings information	String	Information about the setting
Graph	Graph	The graph to be saved
Path	Path	The path where to save the data.

Output parameters

None

Callers

Lab mode.vi

SubVIs

Autosave last fibre background.vi
Autosave last room background.vi
Get name and path.vi
Make new dir.vi
Save background lab.vi

Description

Saves the graph and the fibre background belonging to it.

The code

Updates the path where to save the fibre background. Saves the background. Then the string to be saved with the data from the measurement and information about the settings are built and saved.

Laser.lib

This library contains a routine used for running the laser.

Titles and descriptions

Laser on/off.vi

Turns the laser on or off.

Detailed description

Laser on/off.vi

Icon



Input parameters

None

Output parameters

None

Callers

Clinical mode.vi

Lab mode.vi

SubVIs

None

Description

Turns the laser on or off.

The code

The laser is not actually turned on and off, it is only a switch that changes and lets the laser light out into the fibre or not. This switch is turned by sending a pulse to the serial port. The address to which the pulse is sent is 3F8.

Main.llb

This library contains routines used in the main program.

Titles and descriptions

Cancel measurement.vi

This is a global containing information about whether the button *Cancel* has been pressed or not.

Changed mode.vi

This is a global containing information about whether the mode has been changed or not.

Clinical ending.vi

Saves the current, last and last default measurement, last fibre background and last room background.

Clinical mode.vi

Runs a window from which clinical measurements can be made.

Clinical start up.vi

Gets the current, last and last default measurement, last fibre background and last room background from file.

Lab mode.vi

Runs a window from which measurements in the lab can be made.

Quit program.vi

This is a global which is true if the button *Quit* at the top of the main screen is true, else false.

View spectra.vi

Runs a window where up to ten graphs can be shown.

Detailed description

Cancel measurement.vi

This is a global containing information about whether the button *Cancel* has been pressed or not.

Changed mode.vi

This is a global containing information about whether the mode has been changed or not.

Clinical ending.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

SubVIs

Autosave current.vi

Autosave last default.vi

Autosave last fibre background.vi

Autosave last room background.vi

Autosave last.vi

Default path for autosave data.vi

Make new dir.vi

Description

Saves the current last and last default measurement, last fibre background and last room background.

The code

The file where to save the information is opened, if it already exists it is closed and a new is made else (errorcode = 7) a new directory and file are made.

Clinical mode.vi

Icon



Input parameters

Name	Type	Description
Integrate in	I16	The time to integrate
Average in	I16	The number of measurements to integrate
Current settings in	String	The name of the current settings

Output parameters

Name	Type	Description
Integrate	I16	The last chosen time of integration
Average	I16	The last chosen number of measurements to integrate
Current settings	String	The name of the last chosen settings

Callers

Main.vi

SubVIs

Autosave current.vi
Autosave last default.vi
Autosave last fibre background.vi
Autosave last room background.vi
Autosave last.vi
Background off.vi
Build next measurement.vi
Change path.vi
Changed mode.vi
Clinical settings.vi
Clinical status text.vi
Empty graph.vi
Get coefficients.vi
Get graph.vi
Get name and path.vi
Get next fibre background name.vi
Get next Ref name.vi
Increase Area.vi
Increase examination.vi
Laser on/off.vi
New patient.vi
Offset off.vi
Earlier patient.vi
Print single graph.vi
Quit program.vi
Save fibre background.vi
Save Ref.vi
Save.vi
Set scale.vi
Sound off.vi
Update fibre background.vi
Update Ref.vi

Description

Runs a window from which clinical measurements can be made.

The code

The program consists of five squares. The leftmost is the start up where the variables gets their start values. At the right there are four squares, the first one from the top enable and disable buttons. It also turns the laser on and off and runs the progress bar. The second one from the top performs different things depending on which button has been pressed. The third one from the top checks if any button has been pressed or changed. The last one at the right takes care of the button *Cancel* and turns off the laser if the button is pressed.

The third loop on the right checks if any button has been pressed and changes *index*. *Index* is changed in the following way:

Index	Event
0	Nothing has happened
1	<i>Run</i> is pressed
2	<i>Print</i> is pressed
3	<i>Settings</i> is pressed
4	<i>Increase Examination</i> is pressed
5	<i>Increase Area</i> is pressed
6	
7	<i>Change path</i> is pressed
8	<i>New patient</i> is pressed
9	<i>Earlier patient</i> is pressed
10	<i>Background</i> is changed
11	<i>Reference</i> is changed
12	<i>Scale</i> is pressed
13	<i>Autoscale</i> is changed
14	Settings or file path might have been changed

The loop in the square above performs different things according to the value of *index* :

0. Nothing is done

1. If neither *Background* or *Reference* is chosen an ordinary measurement is made (case 0). Buttons are disabled, warning texts and lamps are shown, the room background is measured, the laser is turned on and the measurement is made. The backgrounds are withdrawn and the spectrum is displayed and saved. The laser is turned off and the warning texts and lamp are changed. Finally *current* and *last default* are updated. If *Background* is chosen (case 1) a measurement of the fibre background is made. Buttons are disabled, warning texts and lamps are shown, the laser is turned on and the measurement is made. The offset is withdrawn and the spectrum is displayed and saved. The laser is turned off and the warning texts and lamp are changed. Finally, *fibre background* and *last measurement* are updated. If *Reference* is chosen (case 2) a measurement with settings chosen for reference measurements is made. Buttons are disabled, warning texts and lamps are shown, the laser is turned on and the measurement is made. The spectra is displayed and saved. The laser is turned off and the warning texts and lamp are changed.
2. Buttons are disabled and while they are the loop is waiting then the graph is printed and buttons are enabled again.
3. Buttons are disabled and *Clinical settings.vi* are called and *Status bar* is updated. Finally buttons are enabled again.
4. Buttons are disabled, *Increase examination.vi* is called and buttons are enabled again.
5. Buttons are disabled, *Increase Area.vi* is called and buttons are enabled again.
6. This case does not exist.
7. Buttons are disabled, *Change path.vi* is called and if neither *Background* nor *Reference* are chosen *Next measurement* is updated and buttons are enabled again.
8. *New patient.vi* is called and *Increase Examination* and *Increase Area* are disabled.
9. *Earlier patient.vi* is called and *Increase Examination* and *Increase Area* are disabled.
10. If *Background* is chosen *Reference* is set to false and *Next measurement* is updated. If *Background* is not chosen *Next measurement* is updated, how depends on whether *Reference* is true or not.
11. If *Reference* is chosen *Background* is set to false and *Next measurement* is updated. If *Reference* is not chosen *Next measurement* is updated, how depends on whether *Background* is true or not.
12. *Autoscale* is set to false and *Set Scale.vi* is run.
13. If *Autoscale* is true autoscaling is enabled at the graph else it is disabled.
14. The user is asked if he/she wants to measure the fibre background. If the answer is yes the fibre background measurement is made else nothing happens.

Clinical start up.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

SubVIs

Autosave current.vi

Autosave last default.vi

Autosave last fibre background.vi

Autosave last room background.vi

Autosave last.vi

Default path for autosave data.vi

Update current.vi

Update last default.vi

Description

Gets the current, last and last default measurement, last fibre background and last room background from file.

The code

Gets the saved current, last and last default measurement, last fibre background and last room background saved at default path for autosave data. Current and last default are updated.

Lab mode.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

SubVIs

Autosave last fibre background.vi

Autosave last room background.vi

Cancel measurement.vi

Changed mode.vi

Default path for saving output.vi

Empty graph.vi

Get coefficients.vi

Get graph.vi

Laser on/off.vi

New patient.vi

Offset off.vi

Print single graph.vi

Quit program.vi
 Save lab.vi
 Set scale.vi
 Sound off.vi

Description

Runs a window from which measurements in the lab can be made.

The code

The program consists of five squares. The leftmost is the start up where the variables gets their start values. At the right there are four squares, the first one from the top enable and disable buttons. It also turns the laser on and off and runs the progress bar. The second one from the top performs different things depending on which button has been pressed. The third one from the top checks if any button has been pressed or changed. The last one at the right takes care of the button *Cancel* and turns off the laser if the button is pressed.

The third loop on the right checks if any button has been pressed and changes *index*. *Index* is changed in the following way:

Index	Event
0	Nothing has happened
1	<i>Laser on/off</i> is changed
2	<i>Manual laser control</i> is changed
3	<i>Save last measurement</i> is pressed
4	<i>Run</i> is pressed
5	<i>Subtract last background</i> is changed
6	<i>Set scale</i> is pressed
7	<i>Autoscale</i> is changed
8	<i>Print</i> is pressed

The loop in the square above performs different things according to the value of *index* :

0. Nothing is done
1. Turns the laser and the blinking of the button on or off. *Cancel* is enabled if the laser is on, else disabled.
2. If *Manual laser control* is true *Room background* is set to false.
3. The user may choose a directory where to save the last measurement. If a directory is chosen the last measurement is saved. If *Background off* is chosen the backgrounds are first subtracted, else they are set to be zero.
4. If *Fibre background* is not chosen buttons are disabled, warning lights and text is shown and there is a start sound. If *Room background* is true a measurement of the room background is made and put into *Last room background*. Else an empty graph is put into *Last room background*. Then if *Manual laser control* is not chosen the laser is turned on and then the measurement is made and if *Manual laser control* is not chosen the laser is turned off. The graph is presented and the backgrounds are subtracted if *Subtract background* is chosen. Then the buttons are enabled again and the warning signs are changed. If *Fibre background* is chosen a measurement of the fibre background is made. Buttons are disabled and the warning signs are turned on. Then if the laser is not chosen to be manually controlled the laser is turned on. The measurement is made and put into *Last fibre background*. The laser is turned off if it is not manually controlled and the spectra is displayed. Buttons are enabled and warning signs are turned off.
5. If *Subtract background* is chosen and the last measurement is not empty the last measured fibre and room backgrounds are subtracted from the measurement. Else the last measurement is shown.
6. *Autoscale* is set to false and *Set Scale.vi* is run.
7. If *Autoscale* is true autoscaling is enabled at the graph else it is disabled.
8. The graph is printed.

Quit program.vi

This is a global which is true if the button *Quit* at the top of the main screen is true, else false. Type: boolean.

View spectra.vi

Icon



Input parameters

None

Output parameters

None

Callers

Main.vi

SubVIs

Changed mode.vi

Default path for saving output.vi

Empty graph.vi

Print multiple graphs.vi

Quit program.vi

Set scale.vi

Show graph.vi

Description

Runs a window where up to ten graphs can be shown.

The code

The program consists of three squares. The leftmost is the start up where the variables gets their start values. At the right there are two squares, the one on the top performs different things depending on which button has been pressed. The one on the bottom checks if any button has been pressed or changed and changes *index*. *Index* is changed in the following way:

Index	Event
0	Nothing has happened
1	<i>Autoscale</i> is changed
2	<i>Set scale</i> is pressed
3	<i>Print</i> is pressed
4	<i>Open spectrum</i> is pressed
5	<i>Clear selected spectra</i> is pressed
6	<i>Clear all</i> is pressed

The loop in the square above performs different things according to the value of *index* :

0. Nothing is done

1. If *Autoscale* is true autoscaling is enabled at the graph else it is disabled.
2. *Autoscale* is set to false and *Set Scale.vi* is run.
3. *Print multiple graphs.vi* is called.
4. The user can choose a graph to open in a dialogue box. If a graph is chosen it is opened and put into the first free place in the list of graphs. Then it is checked if the list is full, if so *Open spectrum* is disabled.
5. If a spectrum is chosen it is replaced with a empty one and *Open spectrum* is enabled.
6. All the spectra are replaced with empty ones and *Open spectrum* is enabled.

Spectra.lib

This library contains routines for handling spectra.

Titles and descriptions

Get coefficients.vi

Returns the calibration coefficients of the spectrometer.

Get graph.vi

Gets the graph from the spectrometer.

Offset off.vi

Subtracts the offset from the graph.

Detailed description

Get coefficients.vi

Icon



Input parameters

None

Output parameters

Name	Type	Description
Calibration coefficients	Cluster	The calibration coefficients of the spectrometer

Callers

Clinical mode.vi

Lab mode.vi

SubVIs

Calibration coefficients.vi

Description

Returns the calibration coefficients of the spectrometer.

The code

Gets the calibration coefficients from the global *Calibration coefficients.vi*.

Get graph.vi

Icon



Input parameters

Name	Type	Description
Integration time	I16	The time to integrate
Calibration coefficients	Cluster	The calibration coefficients of the spectrometer
Samples to average	I16	The number of samples to average

Output parameters

Name	Type	Description
Graph	Graph	The graph

Callers

Clinical mode.vi
Lab mode.vi

SubVIs

Cancel measurement.vi

Description

Gets the graph from the spectrometer.

The code

The program OOI SCAN gets the spectra from the spectrometer. The spectra are added and when as many spectra as *Samples to average* are added an average spectrum is made. The average is made outside, since while OOI SCAN is processing no other program can be processed.

Offset off.vi

Icon



Input parameters

Name	Type	Description
Graph in	Graph	The graph from which the offset is to be subtracted

Output parameters

Name	Type	Description
Graph out	Graph	The graph with the offset subtracted

Callers

Clinical mode.vi
Lab mode.vi

SubVIs

None

Description

Subtracts the offset from the graph.

The code

Makes an average of data number 5-15 and subtracts the value from all data in the graph.

View spectra.llb

This library contains routines used in view spectra mode.

Titles and descriptions**Print multiple graphs.vi**

Prints the graphs and the information in the *input cluster*.

Set scale.vi

Makes it possible for the user to change the scale.

Show graph.vi

Builds a graph from the data in the file at the path.

Detailed description**Print multiple graphs.vi****Icon****Input parameters**

Name	Type	Description
Input cluster	Array of string	Information about the graphs to add to the print
Multiple graph	Graph	The graphs to be printed
X max	DBL	Minimum value of the x-scale
X min	DBL	Maximum value of the x-scale
Y max	DBL	Minimum value of the y-scale
Y min	DBL	Maximum value of the y-scale

Output parameters

None

Callers

View spectra.vi

SubVIs

None

Description

Prints the graphs and the information in the *input cluster*.

The code

The front panel is printed at completion. (Chosen from the Operate menu).

Set scale.vi

Icon



Input parameters

Name	Type	Description
Max X in	DBL	The current maximum value of the x-scale
Min X in	DBL	The current minimum value of the x-scale
Max Y in	DBL	The current maximum value of the y-scale
Min Y in	DBL	The current minimum value of the y-scale

Output parameters

Name	Type	Description
Max X out	DBL	The chosen maximum value of the x-scale
Min X out	DBL	The chosen minimum value of the x-scale
Max Y out	DBL	The chosen maximum value of the y-scale
Min Y out	DBL	The chosen minimum value of the y-scale

Callers

Clinical mode.vi

Lab mode.vi

View spectra.vi

SubVIs

None

Description

Makes it possible for the user to change the scale.

The code

Opens a window where the user can change the maximum and minimum values of the x and y scales while not *Cancel* or *OK* is pressed.

Show graph.vi

Icon



Input parameters

Name	Type	Description
Path	Path	The path to the graph to be shown

Output parameters

Name	Type	Description
Graph	Graph	The graph to be shown

Callers

View spectra.vi

SubVIs

None

Description

Builds a graph from the data in the file at the path.

The code

Opens the file saved at the path and builds the graph. The information about first wavelength and wavelength step is used to make the master wavelength.

Types

Two clustertypes are defined in the program: Dialogue cluster and Global cluster. Both contains information about measurements but they are used a bit different.

Dialogue cluster

The dialogue cluster is used when the user shall change parameters in Change path.vi. It is then displayed in a window.

Dialog cluster

Path

Default path

Browse

Add folders to path

Default

Examination Area Point

Document name

Default: EXXXAYYYPZZZ

Examination, EXXX

XXX starting at

0

Area, AYYY

YYY starting at

0

Point, PZZZ

ZZZ starting at

0

Other:

Prefix to document name

Add to document name

_Date_Time [Default]

Number starting at

0

Global cluster

The global cluster contains the same information as the dialogue cluster plus the date. This cluster is used for saving information about current and last measurements. It is only used inside programs and is never shown to the user.

Global cluster

Path

%

Default path

Browse

Add folders to path

Default

Date Examination Area

Document name

Default: EXXXAYYYPZZZ

Examination, EXXX

Area, AYYY

Point, PZZZ

Other:

Prefix to document name

Add to document name

_Date_Time [Default]

The Date

E

A

P

Number

0

0

0

0

Documentation of Code from Ocean Optics

**Used in Software for a Diode-Based
Fluorosensor**

Three pieces, made by Ocean Optics, has been used in the program and they are described here.

Titles and descriptions

Set configuration.vi

This VI allows you to configure the driver for a specific spectrometer-A/D combination.

Calculate wavelengths.vi

This VI computes the wavelength for each pixel in your spectrometer.

Spectral Acquisition.vi

Gets input data from the spectrometer.

Detailed description

Set configuration.vi

Icon



Input parameters

Name	Type	Description
Spectrometer Type	Enum, converted to U16	The type of spectrometer. Can be S1000, S2000BT or S2000 (S2000 is default)
A/D Type	Enum, converted to U16	The type of A/D card. Can be ADC500, DAQ700, ADC1000 or SAD500 (ADC500 is default).
IRQ	U16	The IRQ of your A/D card (7 is default).
Base Address (decimal)	U16	The base address of your A/D card. (768 is default)

Output parameters

None

Callers

Main.vi

SubVIs

None

Description

This VI allows you to configure the driver for a specific spectrometer-A/D combination. The function does not need to be called each time the program is run, as the spectrometer type, A/D card, IRQ and base address are stored in the OOIDRV.INI file each time the device driver exits. If a driver function is called, and the driver has not been initialised, a setup dialog box will appear that allows the user to select the spectrometer type, A/D card, IRQ and base address of the spectrometer system. This function finds most of its use in systems that have more than one master spectrometer, as it allows the program to switch base addresses and IRQs during program execution. If you pass values of 0 for all input parameters, a setup dialog box is displayed that allows the user to visually select spectrometer type, A/D card, IRQ and base address.

Calculate Wavelengths.vi

Icon



Input parameters

Name	Type	Description
Spectrometer Type	Boolean	True for S2000, False for S1000 or S2000BT (S2000 is default)
Master Coefficients	Cluster	Master wavelength calibration coefficients
Slave 1 Coefficients	Cluster	Slave 1 wavelength calibration coefficients
Slave 2 Coefficients	Cluster	Slave 2 wavelength calibration coefficients
Slave 3 Coefficients	Cluster	Slave 3 wavelength calibration coefficients
Slave 4 Coefficients	Cluster	Slave 4 wavelength calibration coefficients
Slave 5 Coefficients	Cluster	Slave 5 wavelength calibration coefficients
Slave 6 Coefficients	Cluster	Slave 6 wavelength calibration coefficients
Slave 7 Coefficients	Cluster	Slave 7 wavelength calibration coefficients

Output parameters

Name	Type	Description
Master Wavelength	Array of singles	Master wavelength array
Slave 1 Wavelength	Array of singles	Slave 1 wavelength array
Slave 2 Wavelength	Array of singles	Slave 2 wavelength array
Slave 3 Wavelength	Array of singles	Slave 3 wavelength array
Slave 4 Wavelength	Array of singles	Slave 4 wavelength array
Slave 5 Wavelength	Array of singles	Slave 5 wavelength array
Slave 6 Wavelength	Array of singles	Slave 6 wavelength array
Slave 7 Wavelength	Array of singles	Slave 7 wavelength array

Callers

Get graph.vi

SubVIs

None

Description

This VI computes the wavelength for each pixel in your spectrometer. The input for the VI is a set of clusters (one for each spectrometer channel) specifying the wavelength calibration coefficients for the spectrometer channels. These calibration coefficients can be found on the calibration sheet that came with your spectrometer. You only have to connect clusters to the channels that you intend to use.

Spectral Acquisition.vi

Icon



Input parameters

Name	Type	Description
Input Parameters	Cluster	Defines spectral acquisition parameters.
Error in	Cluster	Standard error in cluster

The following parameters are in the Input Parameters cluster. All of them have default values, so you only need to wire the terminals attached to values you wish to change.

Parameter	Type	Default	Function
Command	U16	0	Sends commands to the device driver 0=no command 1=display setup dialog box 9=return test data
Flash Delay	U16	0	Delay in msec between continuous strobe flashes. Ignored for S2000 prior to revision J
Sample Frequency	U16	100	Sets integration time. For the S1000 or S2000BT this parameter sets the A/D conversion frequency in kHz. For the S2000, this parameter sets the nominal integration time.
Boxcar Smoothing Width	U16	0	Width of unweighted boxcar smoothing of the spectra
Samples to Average	U16	1	Number of samples to average
Scan Dark	Boolean	False	If true, turns on the continuous strobe
Correct for Electrical Dark Signal	Boolean	False	If true, subtracts the contribution of electrical dark signal
External Trigger	U16	0	Sets external triggering options 0=no trigger 1=software trigger 2=external synchronization (S2000 only) 3=external hardware trigger (S2000 only)
Enable Master Spectrometer	Boolean	True	True enables Master spectrometer channel
Enable Slave 1 Spectrometer	Boolean	False	True enables Slave 1 spectrometer channel
Enable Slave 2 Spectrometer	Boolean	False	True enables Slave 2 spectrometer channel
Enable Slave 3 Spectrometer	Boolean	False	True enables Slave 3 spectrometer channel
Enable Slave 4 Spectrometer	Boolean	False	True enables Slave 4 spectrometer channel
Enable Slave 5 Spectrometer	Boolean	False	True enables Slave 5 spectrometer channel
Enable Slave 6 Spectrometer	Boolean	False	True enables Slave 6 spectrometer channel
Enable Slave 7 Spectrometer	Boolean	False	True enables Slave 7 spectrometer channel

Output parameters

Name	Type	Description
Return value	U16	Returns the status of the spectral acquisition. 0 if there was no error, non zero if there was an error.
Master Data	Array of singles	Spectral data from the Master spectrometer channel
Slave 1 Data	Array of singles	Spectral data from the Slave 1 spectrometer channel
Slave 2 Data	Array of singles	Spectral data from the Slave 2 spectrometer channel
Slave 3 Data	Array of singles	Spectral data from the Slave 3 spectrometer channel
Slave 4 Data	Array of singles	Spectral data from the Slave 4 spectrometer channel
Slave 5 Data	Array of singles	Spectral data from the Slave 5 spectrometer channel
Slave 6 Data	Array of singles	Spectral data from the Slave 6 spectrometer channel
Slave 7 Data	Array of singles	Spectral data from the Slave 7 spectrometer channel

Callers

Get graph.vi

SubVIs

None

Description

Gets input data from the spectrometer. Once this VI is executed, your application will not respond to any input until the spectral acquisition is complete. This may take several seconds, depending on the acquisition parameters.