

รายการอ้างอิง

- [1.] นายชนเส ศิริไตรวัฒนาพร. การพัฒนาระบบส่งข้อมูลด้วยแสงอินฟราเรดสำหรับอุปกรณ์
นิวกีฬื่อนิกส์. วิทยานิพนธ์ปริญญาโทบัณฑิต ภาควิชาวิศวกรรมเทคโนโลยี คณะ
วิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย, 2541
- [2.] นายวสันต์ อัมพูชนี. การพัฒนาส่วนเชื่อมโยงสัญญาณและโปรแกรมอิมูเลเตอร์สำหรับเครื่อง
วิเคราะห์การเรียงรังสีเอกซ์ชนิดแจกแจงพลังงาน. วิทยานิพนธ์ปริญญาโทบัณฑิต
ภาควิชาวิศวกรรมเทคโนโลยี คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย, 2545
- [3.] นายอภิรักษ์ ลอยแก้ว. การพัฒนาโปรแกรมวิเคราะห์สเปกตรัมรังสีแกมมาบนพีซี
วิทยานิพนธ์ปริญญาโทบัณฑิต ภาควิชาวิศวกรรมเทคโนโลยี คณะวิศวกรรมศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย, 2545
- [4.] S.H. Choo, Shamsudin H.M.Amin, N. Fisal, C.F. Yeong, J.Abu Bakar. Using Bluetooth
transceivers in mobile robot. Artificial Intelligence Center Room 111, Boyd Graduate
Studies Research Center The University Graduate. 2001
- [5.] โอภาส ศิริครรชิตถาวร. เรียนรู้และพัฒนาไมโครคอนโทรลเลอร์ ARM7 LPC2148 ด้วยภาษาซี.
700 เล่ม. พิมพ์ครั้งที่ 1. โรงพิมพ์วชิรวิทย์สาส์น, 2549.

ภาคผนวก

ภาคผนวก ก.1

```

#include "lpc214x.h" // Header file for Phillips LPC2148 controller
#include "uart.h" // Library for use module UART0, UART1
#include "stdio.h" // Library for use puts function(For UART1)

#define LED12 FIO0SET = 0x00600000
#define LED13 FIO0CLR = 0x00600000

//-----//
//----- Function for Initial system clock -----//
//-----//

char buf;
void init()
{
    PLL0CFG=0x24; // MSEL = 4,PSEL = 2
    PLL0FEED=0xAA; // Feed process
    PLL0FEED=0x55;
    PLL0CON=0x1;
    PLL0FEED=0xAA; // Feed process
    PLL0FEED=0x55;
    while(!(PLL0STAT & 0x400)); // Wait until PLL Locked
    PLL0CON=0x3; // Connect the PLL as the clock source
    PLL0FEED=0xAA; // Feed process
    PLL0FEED=0x55;
    MAMCR=0x2; // Enabling MAM and setting number of clocks used for Flash memory fetch (4 cclks in this case)
    MAMTIM=0x4;
    VPBDIV=0x02; // PCLK at 30 MHz
}

void delay_ms(long ms) // delay 1 ms per count @ CCLK 60 MHz
{
    long i,j;
    for (i = 0; i < ms; i++)
        for (j = 0; j < 6659; j++ );
}

void menu()
{
    FIO1CLR = 0x00FF0000;
    FIO1SET = 0x00010000;
    delay_ms(10);
    FIO1SET = 0x00810000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void collect()
{
    FIO1CLR = 0x00FF0000;
    FIO1SET = 0x00020000;
    delay_ms(10);
    FIO1SET = 0x00820000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

```

```
void one()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00110000;
    delay_ms(10);
    FIO1SET = 0x00910000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00020000;
}

void two()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x000D0000;
    delay_ms(10);
    FIO1SET = 0x008D0000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00020000;
}

void three()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00090000;
    delay_ms(10);
    FIO1SET = 0x00890000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00020000;
}

void four()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00050000;
    delay_ms(10);
    FIO1SET = 0x00850000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void five()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00010000;
    delay_ms(10);
    FIO1SET = 0x00810000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}
```

```
void six()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00120000;
    delay_ms(10);
    FIO1SET = 0x00920000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void seven()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x000E0000;
    delay_ms(10);
    FIO1SET = 0x008E0000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void eight()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x000A0000;
    delay_ms(10);
    FIO1SET = 0x008A0000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void nine()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00060000;
    delay_ms(10);
    FIO1SET = 0x00860000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void zero()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00020000;
    delay_ms(10);
    FIO1SET = 0x00820000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}
```

```
void status()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x000F0000;
    delay_ms(10);
    FIO1SET = 0x008F0000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void memory()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00130000;
    delay_ms(10);
    FIO1SET = 0x00930000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void enter()
{
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
    FIO1SET = 0x00070000;
    delay_ms(10);
    FIO1SET = 0x00870000;
    delay_ms(15);
    FIO1CLR = 0x00DF0000;
    FIO1SET = 0x00200000;
}

void key()
{
    switch(buf)
    {
        case '1':    one();
                    break;
        case '2':    two();
                    break;
        case '3':    three();
                    break;
        case '4':    our();
                    break;
        case '5':    five();
                    break;
        case '6':    six();
                    break;
        case '7':    seven();
                    break;
        case '8':    eight();
                    break;
        case '9':    nine();
                    break;
    }
}
```



```

        case '0':    zero();
                    break;
        case 'S':    status();
                    break;
        case 'M':    memory();
                    break;
        case 'm':    menu();
                    break;
        case 'E':    enter();
                    break;
        case 'c':    collect();
                    break;
        case 'R':    FIO0SET = 0x00000008;
                    break;
        case 'L':    FIO0CLR = 0x00000008;
                    break;
        default:     break;
    }
}

void isr_uart0(void) __irq
{
    char msg;
    if((msg = U0IIR) & 0x01) // Check status flag communication
    {
        switch (msg & 0x0E) // Filter message
        {
            case 0x04: while(!(U0LSR & 0x20)); // Receive Data Available
                        U1THR = U0RBR;
                        break;
            case 0x02: break; // THRE Interrupt
            default:   break; // Other
        }
    }
    VICVectAddr = 0; // Acknowledge Interrupt
}
//-----
//----- Main Program -----
//-----

void main()
{
    init(); // Initialize the system
    SCS = 0x03; // select the "fast" version of the I/O ports
    uart0_init(19200);
    uart1_init(19200); // Initial UART1 @ 9600 bps,8 bit data ,1 stop bit ,no parity bit
    U1IER = 3; // Enable rx/tx interrupt for UART1
    U0IER = 3;
    PINSEL0 |= (1<<18); // Enable RXD1(from UART1) at P0.9
    VICVectAddr0 = (unsigned)isr_uart0;
    VICVectCnt0 = 0x20 | 6; // UART0 Interrupt
    VICIntEnable = 1 << 6; // Enable UART0 Interrupt
    FIO1DIR |= 0x00FF0000; // Config. pin P1.16 to P1.23 as output
    FIO1SET = 0x00FF0000;
    FIO0DIR |= 0x0060000F; // Config. pin P0.22 and P0.21 as output
    FIO0SET = 0x00000008;
}

```

```
while (1) // Infinite loop
{
    buf = getchar();
    key();
    LED12;
    delay_ms(100);
    LED13;
    delay_ms(100);
}
}
```


ภาคผนวก ก.2

```
//-----form 1-----//
Private Counts(50000) As Long
Private PCh(50000) As Long
Private data() As String
Private SourceFile As String
Private NoPeak As Long
Private ML As Long
Private SH As Long
Private SW As Long
Private Ad As Long
Private BA As Long
Private Max As Long
Private Xpos As Long
Private Integral As Long
Private Bg As Long
Private Area As Long
Private buff1 As String
Private buff2 As String
Private buff3 As String
Private Buff(50000) As String
Private n As Long
Private m As Long
Private Adata As Long
Private o As Long
Private i As Long
Private waitt As Long
Private Aa As Long
Private Ecal As Single
Private Sub acquire_Click()
Form2.Show
Form2.Text1.SetFocus
Form2.Text1.Text = Time
End Sub
Private Sub addroi_Click()
Form6.Show
End Sub
Private Sub adjust_Click()
Form3.Text1.Text = AmpGain
Form3.Text2.Text = Zero
Form3.Text3.Text = OffSet
Form3.Combo1.Text = AdcGain
Form3.Text4.Text = HiVol
If Pos = 1 Then Form3.Option1.Value = True
If Neg = 1 Then Form3.Option2.Value = True
If Fast = 1 Then Form3.Option3.Value = True
If Slow = 1 Then Form3.Option4.Value = True
If Memory = 1 Then Form3.Option5.Value = True
If Memory = 2 Then Form3.Option6.Value = True
If Memory = 3 Then Form3.Option7.Value = True
If Memory = 4 Then Form3.Option8.Value = True
If Memory = 5 Then Form3.Option9.Value = True
Form3.Show
End Sub
Private Sub clearall_Click()
NumRoi = 1
```

```
BufCount = 0
Ad = 0
ML = 100
Area = 0
Bg = 0
Integral = 0
Label14.Caption = "-"
Label15.Caption = "-"
Label16.Caption = "-"
Label17.Caption = "-"
Label18.Caption = "-"
Label19.Caption = "-"
Call spectrum
End Sub
Private Sub Command1_Click()
PeakSearch.Enabled = True
Num = Time
Timer1.Enabled = True
MSComm1.Output = Chr(99)
Command1.Enabled = False
Command2.Enabled = True
End Sub
Private Sub Command11_Click()
Dim Ct As Integer
Dim Cm As Long
Dim Co As Long
Dim ChLeft As Integer
Dim ChRight As Integer
Dim Ch As Single
Dim Hll As Single
Dim Huu As Single
Dim EAA As Single
Dim EBB As Single
Dim A As Long
Dim C As Long
Dim Cca As Long
Dim Ccb As Long
Dim Cc As Long
Dim Cd As Long
Dim Ci As Long
Dim Cii As Long
Dim Centroid As Long
Dim BufRoi As Integer
Dim FWHM As Single
Ct = 0
BufRoi = NumRoi
If BufCount < BufRoi - 1 Then
BufCount = BufCount + 1
Label14.Caption = Ca(BufCount)
Label15.Caption = Cb(BufCount)
Call spectrum
Integral = 0
Area = 0
Cm = 1000000
For k = Ca(BufCount) To ((Cb(BufCount) - Ca(BufCount)) / 2) + Ca(BufCount)
If Counts(k) < Cm Then
```

```

    Cm = Counts(k)
    ChLeft = k 'channel Left
End If
Next k
Cm = 1000000
For k = ((Cb(BufCount) - Ca(BufCount)) / 2) + Ca(BufCount) To Cb(BufCount)
    If Counts(k) < Cm Then
        Cm = Counts(k)
        ChRight = k 'channel right
    End If
Next k
For k = ChLeft To ChRight
    Cii = Cii + (Counts(k) * k)
    Ci = Ci + Counts(k)
Next k
Centroid = Cii / Ci
Ct = Counts(Centroid)
For k = Ca(BufCount) To Cb(BufCount)
    Integral = Integral + Counts(k)
    Picture1.PSet (k, Y(k)), QBColor(13)
Next k
Co = (Counts(ChLeft) + Counts(ChRight)) / 2
Bg = (ChRight - ChLeft) * Co ' back ground Covell Method
Area = Ci * Bg
Ch = ((Ct - Co) / 2) + Co
For i = ChLeft To Centroid ' find parameter left peak
    If Counts(i) < Ch And Counts(i) > Counts(i - 1) Then
        Cca = Counts(i)
        Ccb = Counts(i + 1)
        A = i
    End If
Next i
For i = Centroid To ChRight ' find parameter right peak
    If Counts(i) > Ch And Counts(i) < Counts(i - 1) Then
        Cc = Counts(i)
        Cd = Counts(i + 1)
        C = i
    End If
Next i
If Ccb - Cca > 0 Then Hll = A + ((Ch - Cca) / (Ccb - Cca)) 'interpolation left
peak
If Ccb - Cca <= 0 Then Hll = A
If Cc - Cd > 0 Then Huu = C + ((Cc - Ch) / (Cc - Cd)) 'interpolation right peak
If Cc - Cd <= 0 Then Huu = C
EAA = Aa + (Bb * Huu)
EBB = Aa + (Bb * Hll)
FWHM = EAA - EBB
Label19.Caption = Integral
Label18.Caption = Area
Label17.Caption = FWHM & " keV"
Label16.Caption = Centroid
End If
End Sub
Private Sub Command2_Click()
Timer1.Enabled = False
MSComm1.Output = Chr(99)
Command2.Enabled = False
Screen.MousePointer = 11
Aa = 0
Call readd
Timer2.Enabled = True
End Sub
Private Sub Command3_Click()
PeakSearch.Enabled = False
Picture1.Cls
Form1.MSComm1.Output = Chr(55) '7
Call delay1
Form1.MSComm1.Output = Chr(49) '1
Do Until n = Mem + addMem
    Counts(n) = 0
    n = n + 1
Loop
Command1.Enabled = True
Command2.Enabled = False
Command5.Enabled = False
Command6.Enabled = False
Command9.Enabled = False
Command11.Enabled = False
Label14.Caption = "-"
Label15.Caption = "-"
Label16.Caption = "-"
Label17.Caption = "-"
Label18.Caption = "-"
Label19.Caption = "-"
End Sub
Private Sub Command5_Click()
On Error GoTo nexx
PeakSearch.Enabled = False
If Xpos < ML Then ML = Xpos
If ML < 10 Then
    ML = ML
Else: ML = ML - 10
End If
Ad = Xpos - ML
Call spectrum2
nexx:
End Sub
Private Sub Command6_Click()
On Error GoTo nexx
PeakSearch.Enabled = True
Ad = 0
ML = 300
Call spectrum
nexx:
End Sub
Private Sub Command9_Click()
Dim Ct As Integer
Dim Co As Integer
Dim Ch As Single
Dim Hll As Single
Dim Huu As Single
Dim EAA As Single
Dim EBB As Single
Dim A As Integer

```

```

Dim C As Integer
Dim Cca As Integer
Dim Ccb As Integer
Dim Cc As Integer
Dim Cd As Integer
Dim Centroid As Integer
Dim BufRoi As Integer
Dim FWHM As Single
    Ct = 0
    BufRoi = NumRoi
If BufCount > 1 Then
    BufCount = BufCount - 1
    If BufCount <= BufRoi Then
        Label14.Caption = Ca(BufCount)
        Label15.Caption = Cb(BufCount)
    Call spectrum
    Integral = 0
    Area = 0
For k = Ca(BufCount) To Cb(BufCount)
    If Ct < Counts(k) Then
        Ct = Counts(k)
        Centroid = k ' count max at peak
    End If
    Integral = Integral + Counts(k)
    Picture1.PSet (k, Y(k)), QBColor(13)
Next k
    Co = (Counts(Ca(BufCount)) + Counts(Cb(BufCount))) / 2
    Bg = (Cb(BufCount) - Ca(BufCount)) * Co ' back ground Covell
Method
    Area = Integral - Bg
    Ch = ((Ct - Co) / 2) + Co
For i = Ca(BufCount) To Ca(BufCount) + ((Cb(BufCount) - Ca(BufCount)) / 2)
find parameter left peak
    If Counts(i) < Ch And Counts(i) > Counts(i - 1) Then
        Cca = Counts(i)
        Ccb = Counts(i + 1)
        A = i
    End If
Next i
For i = Ca(BufCount) + ((Cb(BufCount) - Ca(BufCount)) / 2) To Cb(BufCount) ' find
parameter right peak
    If Counts(i) > Ch And Counts(i) < Counts(i - 1) Then
        Cc = Counts(i)
        Cd = Counts(i + 1)
        C = i
    End If
Next i
    If Ccb - Cca > 0 Then Hll = A + ((Ch - Cca) / (Ccb - Cca)) 'interpolation left
peak
    If Ccb - Cca = 0 Then Hll = A
    If Cc - Cd > 0 Then Hru = C + ((Cc - Ch) / (Cc - Cd)) 'interpolation right peak
    If Cc - Cd = 0 Then Hru = C
    EAA = Aa + (Bb * Hru)
    EBB = Aa + (Bb * Hll)
    FWHM = EAA - EBB
    Label19.Caption = Integral
    Label18.Caption = Area
Label17.Caption = FWHM & " keV"
Label16.Caption = Centroid
End If
End Sub
Private Sub connect_Click()
Screen.MousePointer = 11
Form4.Show
MSComm1.Output = Chr(83) 'status
Call delay1
MSComm1.Output = Chr(51) '3
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(50) '2
Call delay1
MSComm1.Output = Chr(51) '3
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(57) '9
Call delay1
MSComm1.Output = Chr(109) 'menu
Call delay1
MSComm1.Output = Chr(77) 'memory
Call delay1
MSComm1.Output = Chr(53) '5
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(69) 'enter
Call delay1
MSComm1.Output = Chr(54) '6
Call delay1
MSComm1.Output = Chr(51) '3
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(49) '1
Call delay1
MSComm1.Output = Chr(69) 'enter
Call delay1
waitt = 13
Timer3.Enabled = True
End Sub
Private Sub deleteroi_Click()
NumRoi = 1
BufCount = 0
Call spectrum
End Sub
Private Sub Enrgy_Click()
Form5.Show
End Sub

```

```

Private Sub exit_Click()
End
End Sub
Private Sub Form_Load()
Aa = 0
AmpGain = 4
Zero = 0
OffSet = 0
AdcGain = 512
Pos = 1
Neg = 0
Fast = 1
Slow = 0
HiVol = 25
Memory = 5
Mem = 256
addMem = 32
NumRoi = 1
BufCount = 0
ML = 300
SH = 2000
SW = 3000
BA = 4800
PeakSearch.Enabled = False
acquire.Enabled = False
adjust.Enabled = False
Time = 1000
MSComm1.CommPort = 5
MSComm1.Settings = "19200,N,8,1"
MSComm1.RThreshold = 1
MSComm1.PortOpen = True
remote.Checked = True
MSComm1.Output = Chr(82)
End Sub
Private Sub load_Click()
On Error GoTo nextt
CommonDialog1.ShowOpen
SourceFile = CommonDialog1.FileName
Open SourceFile For Input As #1
Input #1, f$
NumRoi = 1
Do Until EOF(1)
    Input #1, Adata
    Ca(NumRoi) = Val(Adata)
    Input #1, Adata
    Cb(NumRoi) = Val(Adata)
    NumRoi = NumRoi + 1
Loop
Close #1
nextt:
End Sub
Private Sub MSComm1_OnComm()
On Error Resume Next
'If MSComm1.CommEvent = comEvReceive Then
' Text1.Text = Text1.Text & MSComm1.Input
'End If
While MSComm1.InBufferCount > 0
Aa = Aa + 1
Buff(Aa) = MSComm1.Input
Wend
End Sub
Private Sub open_Click()
On Error GoTo nextt
PeakSearch.Enabled = True
CommonDialog1.ShowOpen
CommonDialog1.DialogTitle = "Open profile"
SourceFile = CommonDialog1.FileName
Open SourceFile For Input As #1
Input #1, f$
i = 0
Do Until EOF(1)
    Input #1, Adata
    Input #1, Adata
    Counts(i) = Val(Adata)
    Mem = i
    i = i + 1
Loop
Close #1
Call spectrum
Command5.Enabled = True
Command6.Enabled = True
Command8.Enabled = True
Command9.Enabled = True
Command10.Enabled = True
nextt:
End Sub
Private Sub PeakSearch_Click()
Dim PMax As Integer
Dim k As Integer
Dim l As Integer
Dim ChPeak As Integer
NoPeak = 1
For k = 21 To Mem - 21
    If Counts(k) > 0.036 * Max Then
        If Counts(k - 1) < Counts(k) Then
            If Counts(k) > Counts(k + 1) Then
                If Counts(k - 10) + (0.3 * Counts(k)) < Counts(k - 1) Then
                    If Counts(k + 10) + (0.3 * Counts(k)) < Counts(k + 1) Then
                        If Counts(k) > 10 Then
                            PMax = 0
                            For l = 1 To 41
                                If Counts(k - 11 + l) > PMax Then
                                    PMax = Counts(k - 11 + l)
                                    ChPeak = k - 11 + l
                                End If
                            Next l
                            If NoPeak = 1 Then
                                PCh(NoPeak) = ChPeak
                                NoPeak = NoPeak + 1
                            End If
                            If NoPeak > 1 Then
                                If PCh(NoPeak - 1) <> ChPeak Then
                                    PCh(NoPeak) = ChPeak
                                    NoPeak = NoPeak + 1
                                End If
                            End If
                        End If
                    End If
                End If
            End If
        End If
    End If
Next k

```

```

        End If
    End If
    Picture1.Line (PCh(NoPeak - 1), BA - (SH / Max) * Counts(k))-
(PCh(NoPeak - 1), BA - (SH / Max) * Counts(k) - 200), QBColor(12)
    End If
    End If
    End If
    End If
    End If
    End If
    Next k
    NoPeak = NoPeak - 1
End Sub
Private Sub Picture1_KeyDown(KeyCode As Integer, Shift As Integer)
On Error GoTo point
If KeyCode = vbKeyRight Then Xpos = Xpos + 1
If KeyCode = vbKeyLeft Then Xpos = Xpos - 1
If KeyCode = vbKeyUp Then
    SH = SH + 300
    Call spectrum
    For k = Ca(BufCount) To Cb(BufCount)
        Picture1.PSet (k, Y(k)), QBColor(13)
    Next k
End If
If KeyCode = vbKeyDown Then
    SH = SH - 300
    Call spectrum
    For k = Ca(BufCount) To Cb(BufCount)
        Picture1.PSet (k, Y(k)), QBColor(13)
    Next k
End If
If Xpos > Mem Then Xpos = 0
If Xpos < 0 Then Xpos = Mem
    Line1.X1 = Xpos
    Line1.X2 = Xpos
    Line1.Y2 = BA - (SH / Max) * Counts(Xpos + Ad)
    Line1.Y1 = BA - (SH / Max) * Counts(Xpos + Ad) - 300
Ecal = Aa + (Bb * (Xpos + Ad))
Label5.Caption = Xpos + Ad
Label22.Caption = ": " & Left(Ecal, 6) & " keV"
Label6.Caption = Counts(Xpos + Ad)
point:
End Sub
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As
Single)
On Error GoTo point
Xpos = X
If Xpos > Mem Then Xpos = 0
If Xpos < 0 Then Xpos = Mem
    Line1.X1 = Xpos
    Line1.X2 = Xpos
    Line1.Y2 = BA - (SH / Max) * Counts(Xpos + Ad)
    Line1.Y1 = BA - (SH / Max) * Counts(Xpos + Ad) - 350
Ecal = Aa + (Bb * (Xpos + Ad))
Label5.Caption = Xpos + Ad
Label22.Caption = ": " & Left(Ecal, 6) & " keV"
Label6.Caption = Counts(Xpos + Ad)

```

```

point:
End Sub
Private Sub remote_Click()
MSComm1.Output = Chr(82)
remote.Checked = True
locals.Checked = False
acquire.Enabled = True
adjust.Enabled = True
connect.Enabled = True
Command3.Enabled = True
End Sub
Private Sub locals_Click()
MSComm1.Output = Chr(76)
locals.Checked = True
remote.Checked = False
acquire.Enabled = False
adjust.Enabled = False
connect.Enabled = False
Command3.Enabled = False
End Sub
Private Sub save_Click()
On Error GoTo nextt:
CommonDialog1.DialogTitle = "save profile"
CommonDialog1.DefaultExt = ".txt"
CommonDialog1.InitDir = ""
CommonDialog1.FileName = ""
CommonDialog1.Filter = "Text file(*.txt)*.txt|Genie
2000(*.TKA)*.TKA|ascii(*.ASC)|*.ASC|GANAAS(*.SPE)*.SPE|QXAS(*.SPE)
*.SPE"
CommonDialog1.FilterIndex = 0
CommonDialog1.ShowSave
SourceFile = CommonDialog1.FileName
If SourceFile = "" Then
    Exit Sub
End If
If CommonDialog1.FilterIndex = 1 Then
Open SourceFile For Output As #1
Print #1, "Channel", "Counts"
For i = 0 To Mem
Print #1, i, Counts(i)
Next i
    Close #1
ElseIf CommonDialog1.FilterIndex = 2 Then
Open SourceFile For Output As #1
For i = 0 To Mem - 1
Print #1, Counts(i)
Next i
    Close #1
ElseIf CommonDialog1.FilterIndex = 3 Then
Open SourceFile For Output As #1
For i = 0 To Mem - 1
Print #1, Counts(i)
Next i
    Close #1
ElseIf CommonDialog1.FilterIndex = 4 Then
Open SourceFile For Output As #1
Print #1, "$MEAS_TIM:"

```



```

Print #1, "0", "0"
Print #1, "$DATE_MEA:"
Print #1, "00-00-0000", "00:00:00"
Print #1, "$DATA:"
Print #1, "0", Mem - 1
For i = 0 To Mem - 1
    If j < 9 Then
        Print #1, Counts(i),
        j = j + 1
    ElseIf j >= 9 Then
        Print #1, Counts(i)
        j = 0
    End If
Next i
Close #1
Elseif CommonDialog1.FilterIndex = 5 Then
Open SourceFile For Output As #1
Print #1, "$MEAS_TIM:"
Print #1, "0", "0"
Print #1, "$DATE_MEA:"
Print #1, "00-00-0000", "00:00:00"
Print #1, "$DATA:"
Print #1, "0", Mem - 1
For i = 0 To Mem - 1
    If j < 9 Then
        Print #1, Counts(i),
        j = j + 1
    ElseIf j >= 9 Then
        Print #1, Counts(i)
        j = 0
    End If
Next i
Close #1
End If
nextt:
End Sub
Private Sub store_Click()
On Error GoTo nextt:
CommonDialog1.DialogTitle = "save ROI"
CommonDialog1.DefaultExt = ""
CommonDialog1.InitDir = ""
CommonDialog1.FileName = ""
CommonDialog1.Filter = "ROI file(*.roi)*.roi"
CommonDialog1.FilterIndex = 0
CommonDialog1.ShowSave
SourceFile = CommonDialog1.FileName
If SourceFile = "" Then
    Exit Sub
End If
If CommonDialog1.FilterIndex = 1 Then
Open SourceFile For Output As #1
Print #1, "ca", "cb"
For BufCount = 1 To NumRoi - 1
Print #1, Ca(BufCount), Cb(BufCount)
Next BufCount
Close #1
End If
nextt:
End Sub
Private Sub Timer1_Timer()
Num = Num - 1
Label4.Caption = Time & "/" & Num
If Num = 0 Then
Command2.Enabled = False
Screen.MousePointer = 11
Aa = 0
Call delay1
Call readd
Timer1.Enabled = False
Timer2.Enabled = True
End If
End Sub
Private Sub Timer2_Timer()
buff3 = Aa
Call delay1
If Aa = buff3 Then
Call plot
Command5.Enabled = True
Command6.Enabled = True
Command9.Enabled = True
Command11.Enabled = True
Screen.MousePointer = 1
Timer2.Enabled = False
End If
End Sub
Sub spectrum()
Dim i As Integer
Dim j As Integer
Max = -1000
For i = 1 To Mem
    If Counts(i) > Max Then Max = Counts(i)
Next i
For j = 1 To Mem
    Y(j) = BA - (SH / Max) * Counts(j)
    If Y(j) > BA Then Y(j) = BA
    If Y(j) < 20 Then Y(j) = 20
Next j
Picture1.Cls
Picture1.ScaleWidth = Mem
Picture1.ScaleHeight = 5000
For i = 1 To Mem
    Picture1.PSet (i, Y(i)), QBColor(14)
Next i
End Sub
Sub spectrum2()
Dim i As Integer
Dim j As Integer
On Error GoTo point
Max = -1000
For i = 1 To Mem
    If Counts(i) > Max Then Max = Counts(i)
Next i
For j = Ad To Ad + ML * 2
    Y(j) = BA - (SH / Max) * Counts(j)

```



```

Next j

Picture1.Cls
Picture1.ScaleWidth = ML * 2
Picture1.ScaleHeight = 5000
i = 1
  For j = Ad To Ad + ML * 2
    Picture1.PSet (i, Y(j)), QBColor(14)
    i = i + 1
  Next j
point:
End Sub
Sub plot()
On Error GoTo nextt
buff1 = Join(Buff)
buff2 = Replace(buff1, "←", "⌘", 1, -1, 0)
data = Split(buff2, "⌘", -1, vbTextCompare)
A = 0
n = 1
m = 0
Do Until n = Mem + addMem
n = n + 1
  If A = 8 Then
    n = n + 1
    A = 0
  End If
A = A + 1
Counts(m) = Val(data(n))
m = m + 1
Loop
Call spectrum
nextt:
End Sub
Sub readd()
  Form1.MSComm1.Output = Chr(54) '6
  Call delay1
  Form1.MSComm1.Output = Chr(49) '1
  Call delay1
End Sub
Private Sub Timer3_Timer()
waitt = waitt - 1
If waitt = 0 Then
Command3.Enabled = True
acquire.Enabled = True
adjust.Enabled = True
Screen.MousePointer = 1
Unload Form4
Timer3.Enabled = False
End If
End Sub
//-----form 2-----//
Private NumB(7) As Integer
Private Adata As String
Private Sub Command1_Click()
On Error GoTo down
Time = Text1.Text
Form1.Label4.Caption = Time & " / " & Time

```

```

Command1.Enabled = False
Command2.Enabled = False
ProgressBar1.Value = 10
Form1.MSComm1.Output = Chr(57) '9
Call delay1
ProgressBar1.Value = 20
Form1.MSComm1.Output = Chr(50) '2
Call delay1
ProgressBar1.Value = 40
Adata = Len(Text1.Text)
  For i = 1 To Adata
    NumB(i) = Mid(Text1.Text, i, 1)
    If NumB(i) = 0 Then Form1.MSComm1.Output = Chr(48) '0
    If NumB(i) = 1 Then Form1.MSComm1.Output = Chr(49) '1
    If NumB(i) = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If NumB(i) = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If NumB(i) = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If NumB(i) = 5 Then Form1.MSComm1.Output = Chr(53) '5
    If NumB(i) = 6 Then Form1.MSComm1.Output = Chr(54) '6
    If NumB(i) = 7 Then Form1.MSComm1.Output = Chr(55) '7
    If NumB(i) = 8 Then Form1.MSComm1.Output = Chr(56) '8
    If NumB(i) = 9 Then Form1.MSComm1.Output = Chr(57) '9
  Call delay1
  Next i
  ProgressBar1.Value = 70
  Form1.MSComm1.Output = Chr(69) 'E
Call delay1
ProgressBar1.Value = 100
Command1.Enabled = True
Command2.Enabled = True
Unload Me
GoTo next1
down: MsgBox "Error input data"
next1:
End Sub
Private Sub Command2_Click()
Unload Me
End Sub
//-----form 3-----//
Private NumA(4) As Integer
Private Adata As String
Private Response As Variant
Private Gain As Integer
Private Sub Combo1_Click()
Select Case Combo1.Text
  Case "512"
    Gain = 2
    AdcGain = 512
  Case "1024"
    Gain = 3
    AdcGain = 1024
  Case "2048"
    Gain = 4
    AdcGain = 2048
  Case "4096"
    Gain = 5
    AdcGain = 4096

```

```

End Select
End Sub
Private Sub Command1_Click()
On Error GoTo next1
    If Val(Text1.Text) > 1200 Then GoTo next1
Command1.Enabled = False
Command2.Enabled = False
ProgressBar1.Value = 10
Form1.MSComm1.Output = Chr(83) 'status
Call delay1
ProgressBar1.Value = 20
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar1.Value = 30
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar1.Value = 40
    If Option1.Value = True Then Form1.MSComm1.Output = Chr(49) '1
    If Option2.Value = True Then Form1.MSComm1.Output = Chr(50) '2
Call delay1
ProgressBar1.Value = 50
    If Option3.Value = True Then Form1.MSComm1.Output = Chr(51) '3
    If Option4.Value = True Then Form1.MSComm1.Output = Chr(52) '4
Call delay1
ProgressBar1.Value = 60
Form1.MSComm1.Output = Chr(53) '5
Call delay1
ProgressBar1.Value = 70
Form1.MSComm1.Output = Chr(50) '2
Call delay1
ProgressBar1.Value = 80
Adata = Len(Text1.Text)
For i = 1 To Adata
    NumA(i) = Mid(Text1.Text, i, 1)
    If NumA(i) = 0 Then Form1.MSComm1.Output = Chr(48) '0
    If NumA(i) = 1 Then Form1.MSComm1.Output = Chr(49) '1
    If NumA(i) = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If NumA(i) = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If NumA(i) = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If NumA(i) = 5 Then Form1.MSComm1.Output = Chr(53) '5
    If NumA(i) = 6 Then Form1.MSComm1.Output = Chr(54) '6
    If NumA(i) = 7 Then Form1.MSComm1.Output = Chr(55) '7
    If NumA(i) = 8 Then Form1.MSComm1.Output = Chr(56) '8
    If NumA(i) = 9 Then Form1.MSComm1.Output = Chr(57) '9
    Call delay1
Next i
Form1.MSComm1.Output = Chr(69) 'E
Call delay1
ProgressBar1.Value = 90
Form1.MSComm1.Output = Chr(109) 'm
Call delay1
ProgressBar1.Value = 100
Command1.Enabled = True
Command2.Enabled = True
AmpGain = Text1.Text
GoTo next2
next1: Response = MsgBox("Error in put data", vbExclamation + vbOKOnly, "Error!")

```

```

next2:
End Sub
Private Sub Command2_Click()
Unload Me
End Sub
Private Sub Command3_Click()
Unload Me
End Sub
Private Sub Command4_Click()
On Error GoTo next1
    If Val(Text2.Text) > 999 Then GoTo next1
    If Val(Text3.Text) > 4000 Then GoTo next1
Command3.Enabled = False
Command4.Enabled = False
Form1.MSComm1.Output = Chr(83) 'status
Call delay1
ProgressBar2.Value = 10
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar2.Value = 20
Form1.MSComm1.Output = Chr(51) '3
Call delay1
ProgressBar2.Value = 30
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar2.Value = 40
Adata = Len(Text2.Text)
For i = 1 To Adata
    NumA(i) = Mid(Text2.Text, i, 1)
    If NumA(i) = 0 Then Form1.MSComm1.Output = Chr(48) '0
    If NumA(i) = 1 Then Form1.MSComm1.Output = Chr(49) '1
    If NumA(i) = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If NumA(i) = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If NumA(i) = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If NumA(i) = 5 Then Form1.MSComm1.Output = Chr(53) '5
    If NumA(i) = 6 Then Form1.MSComm1.Output = Chr(54) '6
    If NumA(i) = 7 Then Form1.MSComm1.Output = Chr(55) '7
    If NumA(i) = 8 Then Form1.MSComm1.Output = Chr(56) '8
    If NumA(i) = 9 Then Form1.MSComm1.Output = Chr(57) '9
    Call delay1
Next i
ProgressBar2.Value = 50
Form1.MSComm1.Output = Chr(69) 'E
Call delay1
Form1.MSComm1.Output = Chr(50) '2
Call delay1
ProgressBar2.Value = 60
Adata = Len(Text3.Text)
For i = 1 To Adata
    NumA(i) = Mid(Text3.Text, i, 1)
    If NumA(i) = 0 Then Form1.MSComm1.Output = Chr(48) '0
    If NumA(i) = 1 Then Form1.MSComm1.Output = Chr(49) '1
    If NumA(i) = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If NumA(i) = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If NumA(i) = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If NumA(i) = 5 Then Form1.MSComm1.Output = Chr(53) '5
    If NumA(i) = 6 Then Form1.MSComm1.Output = Chr(54) '6

```

```

        If NumA(i) = 7 Then Form1.MSComm1.Output = Chr(55) '7
        If NumA(i) = 8 Then Form1.MSComm1.Output = Chr(56) '8
        If NumA(i) = 9 Then Form1.MSComm1.Output = Chr(57) '9
    Call delay1
Next i
ProgressBar2.Value = 70
Form1.MSComm1.Output = Chr(69) 'E
Call delay1
Form1.MSComm1.Output = Chr(51) '3
Call delay1
ProgressBar2.Value = 80
    If Gain = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If Gain = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If Gain = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If Gain = 5 Then Form1.MSComm1.Output = Chr(53) '5
    Call delay1
ProgressBar2.Value = 90
Form1.MSComm1.Output = Chr(109) 'm
Call delay1
ProgressBar2.Value = 100
Command3.Enabled = True
Command4.Enabled = True
Zero = Text2.Text
OffSet = Text3.Text
GoTo next2
next1: Response = MsgBox("Error in put data", vbExclamation + vbOKOnly, "Error!")
next2:
End Sub
Private Sub Command5_Click()
Unload Me
End Sub
Private Sub Command6_Click()
On Error GoTo next1
    If Val(Text4.Text) > 1250 Then GoTo next1
    If Val(Text4.Text) < 25 Then GoTo next1
Command5.Enabled = False
Command6.Enabled = False
Form1.MSComm1.Output = Chr(83) 'status
Call delay1
ProgressBar3.Value = 10
Form1.MSComm1.Output = Chr(51) '3
Call delay1
ProgressBar3.Value = 20
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar3.Value = 30
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar3.Value = 40
Form1.MSComm1.Output = Chr(52) '4
Call delay1
ProgressBar3.Value = 50
Adata = Len(Text4.Text)
For i = 1 To Adata
    NumA(i) = Mid(Text4.Text, i, 1)
    If NumA(i) = 0 Then Form1.MSComm1.Output = Chr(48) '0
    If NumA(i) = 1 Then Form1.MSComm1.Output = Chr(49) '1
    If NumA(i) = 2 Then Form1.MSComm1.Output = Chr(50) '2
    If NumA(i) = 3 Then Form1.MSComm1.Output = Chr(51) '3
    If NumA(i) = 4 Then Form1.MSComm1.Output = Chr(52) '4
    If NumA(i) = 5 Then Form1.MSComm1.Output = Chr(53) '5
    If NumA(i) = 6 Then Form1.MSComm1.Output = Chr(54) '6
    If NumA(i) = 7 Then Form1.MSComm1.Output = Chr(55) '7
    If NumA(i) = 8 Then Form1.MSComm1.Output = Chr(56) '8
    If NumA(i) = 9 Then Form1.MSComm1.Output = Chr(57) '9
    Call delay1
Next i
ProgressBar3.Value = 60
Form1.MSComm1.Output = Chr(69) 'E
Call delay1
ProgressBar3.Value = 80
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar3.Value = 90
Form1.MSComm1.Output = Chr(109) 'm
Call delay1
ProgressBar3.Value = 100
Command5.Enabled = True
Command6.Enabled = True
HiVol = Text4.Text
GoTo next2
next1: Response = MsgBox("Error in put data", vbExclamation + vbOKOnly,
"Error!")
next2:
End Sub
Private Sub Command7_Click()
Unload Me
End Sub
Private Sub Command8_Click()
Command7.Enabled = False
Command8.Enabled = False
Form1.MSComm1.Output = Chr(77) 'M
Call delay1
ProgressBar4.Value = 30
    If Option5.Value = True Then Form1.MSComm1.Output = Chr(49) '1
    If Option6.Value = True Then Form1.MSComm1.Output = Chr(50) '2
    If Option7.Value = True Then Form1.MSComm1.Output = Chr(51) '3
    If Option8.Value = True Then Form1.MSComm1.Output = Chr(52) '4
    If Option9.Value = True Then Form1.MSComm1.Output = Chr(53) '5
    Call delay1
ProgressBar4.Value = 50
Form1.MSComm1.Output = Chr(49) '1
Call delay1
ProgressBar4.Value = 80
Form1.MSComm1.Output = Chr(69) 'E
Call delay1
ProgressBar4.Value = 100
Command7.Enabled = True
Command8.Enabled = True
End Sub
Private Sub Option1_Click()
Pos = 1
Neg = 0
End Sub

```

```

Private Sub Option2_Click()
Pos = 0
Neg = 1
End Sub
Private Sub Option3_Click()
Fast = 1
Slow = 0
End Sub
Private Sub Option4_Click()
Slow = 1
Fast = 0
End Sub
Private Sub Option5_Click()
Memory = 1
Mem = 4096
addMem = 512
End Sub
Private Sub Option6_Click()
Memory = 2
Mem = 2048
addMem = 256
End Sub
Private Sub Option7_Click()
Memory = 3
Mem = 1024
addMem = 128
End Sub
Private Sub Option8_Click()
Memory = 4
Mem = 512
addMem = 64
End Sub
Private Sub Option9_Click()
Memory = 5
Mem = 256
addMem = 32
End Sub
//-----form 5-----//
Option Explicit
Private sCh As Single
Private sE As Single
Private sChE As Single
Private sChCh As Single
Private Energy(5000) As Single
Private ECh(5000) As Single
Private nData As Integer
Private Sub Command1_Click()
Energy(nData) = Text2.Text
ECh(nData) = Text3.Text
Table1.Cells(nData, 1) = Energy(nData)
Table1.Cells(nData, 2) = ECh(nData)
Text2.Text = ""
Text3.Text = ""
nData = nData + 1
End Sub
Private Sub Command2_Click()
Dim i As Integer
For i = 1 To nData
Table1.Cells(i, 1) = ""
Table1.Cells(i, 2) = ""
Next i
nData = 0
End Sub
Private Sub Command3_Click()
Dim i As Integer
sCh = 0
sE = 0
sChE = 0
sChCh = 0
For i = 1 To nData
sCh = sCh + ECh(i)
sE = sE + Energy(i)
sChE = sChE + (ECh(i) * Energy(i))
sChCh = sChCh + (ECh(i) * ECh(i))
Next i
Aa = ((sE * sChCh) - (sChE * sCh)) / ((nData * sChCh) - (sCh * sCh))
Bb = ((nData * sChE) - (sCh * sE)) / ((nData * sChCh) - (sCh * sCh))
Unload Me
End Sub
Private Sub Command4_Click()
Unload Me
End Sub
Private Sub Form_Load()
nData = 1
End Sub
//-----form 6-----//
Private Sub Command1_Click()
On Error GoTo down
Ca(NumRoi) = Val(Text1.Text)
Cb(NumRoi) = Val(Text2.Text)
If Ca(NumRoi) >= Cb(NumRoi) Then GoTo down
If Ca(NumRoi) < Cb(NumRoi) Then NumRoi = NumRoi + 1
Unload Me
GoTo down2
down: MsgBox "Error input data"
down2:
End Sub
Private Sub Command2_Click()
Unload Me
End Sub
Private Sub Form_Load()
Command1.Enabled = False
End Sub
Private Sub Text2_Change()
Command1.Enabled = True
End Sub

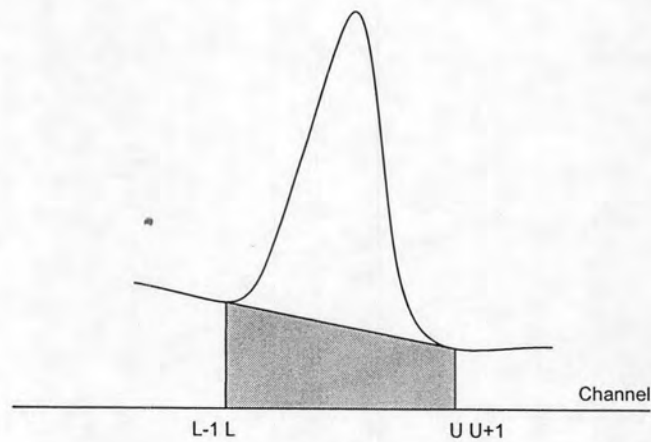
```

ภาคผนวก ข

วิธีการคำนวณทางคณิตศาสตร์เพื่อหาค่าพารามิเตอร์ในการวิเคราะห์สเปกตรัม

1. Covell's Method

เป็นวิธีการคำนวณหาพื้นที่สุทธิใต้พีคที่หักลบแบคกราวนด์เรียบร้อยแล้ว โดยหลักการจะ
เริ่มจากหาตำแหน่งช่องสัญญาณที่มีค่าจำนวนนับสูงสุด เป็นจุดกึ่งกลางของสเปกตรัมจากนั้น
กำหนดขอบเขตด้านซ้ายและด้านขวาของพีค ดังรูปที่ 1



รูปที่ 1 แสดงการคำนวณพื้นที่สุทธิใต้พีค โดยใช้การคำนวณแบบ Covell's Method

เมื่อหาขอบเขตได้แล้วนำค่านับวัดในแต่ละช่องสัญญาณจากขอบเขตซ้ายไปจนถึงขอบเขต
ขวามารวมกันจะได้จำนวนนับรวมบนพีค ดังสมการที่ 1

$$G = \sum_{i=1}^U C_i \quad (1)$$

ถ้าต้องการเฉพาะค่าพื้นที่สุทธิใต้พีคต้องหักลบแบคกราวนด์ออกไปดังสมการที่ 2

$$A = G - B \quad (2)$$

การคำนวณหาพื้นที่แบบกราวนด์ใต้พีค หาได้จากสมการที่ 3

$$B = \frac{n(C_L + C_U)}{2} \quad (3)$$

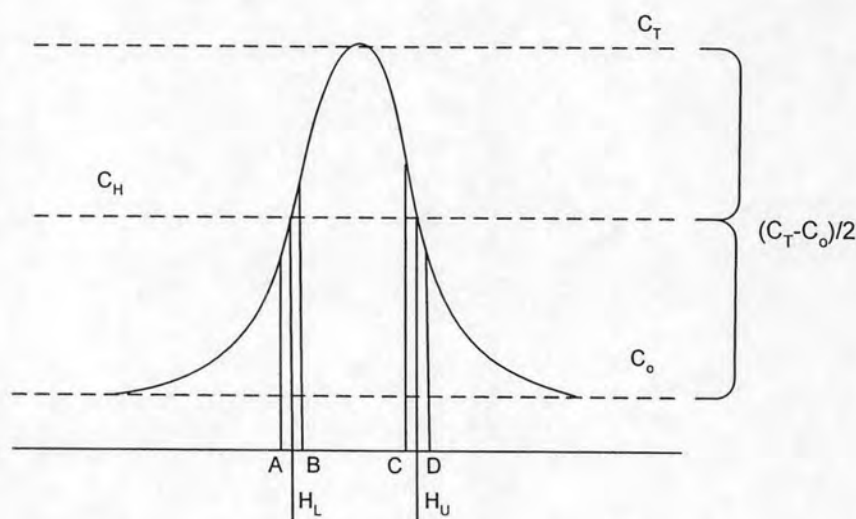
เมื่อ n เท่ากับ จำนวนช่องสัญญาณระหว่างพื้นที่ใต้พีค

C_L เท่ากับ ค่าจำนวนนับที่ช่องสัญญาณด้านซ้าย

C_U เท่ากับ ค่าจำนวนนับที่ช่องสัญญาณด้านขวา

2. การประมาณค่าความกว้าง ณ ตำแหน่งครึ่งหนึ่งของความสูงของพีค

ใช้วิธีการประมาณค่าแบบปรับเทียบ (Interpolation) มีหลักการดังนี้



รูปที่ 2 วิธีการประมาณค่าความกว้างที่ตำแหน่งครึ่งหนึ่งของความสูงพีค

- 1.) หาค่านับวัดที่ยอดพีค C_T
- 2.) หักลบค่า C_T จากค่าจำนวนนับของแบคกราวนด์เฉลี่ย C_0
- 3.) นำค่าที่หักลบแบคกราวนด์แล้วมาหารสองแล้วบวกเพิ่ม C_0 อีกครั้งจะได้ค่าจำนวนนับโดยประมาณ ณ ตำแหน่งครึ่งหนึ่งของความสูงของพีค (C_H)
- 4.) หาค่าตำแหน่งช่องสัญญาณ ทางด้านซ้ายของยอดพีคสองจุดที่มีค่าจำนวนนับใกล้เคียงกับค่า C_H โดยช่องสัญญาณที่มีจำนวนนับใกล้เคียงกับค่า C_H แต่มีค่าน้อยกว่าให้กำหนดเป็นช่องสัญญาณ A ส่วนช่องสัญญาณที่มีจำนวนนับใกล้เคียงกับค่า C_H แต่มากกว่าให้กำหนดเป็นช่องสัญญาณ B ค่าจำนวนนับ ณ ตำแหน่ง A และ B จะกำหนดให้เท่ากับ C_A และ C_B ตามลำดับ จะได้ตำแหน่ง

ช่องสัญญาณทางด้านซ้ายที่มีความสูงเท่ากับครึ่งหนึ่งของพีคเท่ากับ

$$H_L = \frac{A + (C_H - C_A)}{(C_B - C_A)} \quad (4)$$

5.) ตำแหน่งของช่องสัญญาณทางด้านขวาที่มีความสูงเท่ากับครึ่งหนึ่งของความสูงพีค เท่ากับ

$$H_U = \frac{C + (C_0 - C_H)}{(C_C - C_D)} \quad (5)$$

6.) ค่าความต่างระหว่าง $H_U - H_L$ จะเป็นค่าความกว้างที่ตำแหน่งครึ่งหนึ่งของความสูงพีคในหน่วย Channel

3. อัลกอริทึมในการค้นหาตำแหน่งพีค

ตำแหน่งกึ่งกลางพีคสามารถคำนวณได้จากค่าช่องสัญญาณและค่าจำนวนนับเพื่อประมาณค่าตำแหน่งของพลังงานรังสีแกมมาโดยหาจากสมการดังนี้

$$\text{Centroid} = \frac{\sum_{i=L}^U C_i i}{\sum_{i=L}^U C_i}$$

โดยที่	C_i	คือ	ค่าจำนวนนับ ณ ตำแหน่งช่องสัญญาณ i
	i	คือ	ตำแหน่งช่องสัญญาณใด ๆ
	L	คือ	ค่าตำแหน่งช่องสัญญาณขอบเขตซ้าย
	U	คือ	ค่าตำแหน่งช่องสัญญาณขอบเขตขวา

ตัวอย่างการคำนวณ

การหาจำนวนนับรวมของพีคคำนวณจาก

$$G = \sum_{i=1}^U C_i = 206226$$

$$\text{โดยที่ } 1 = 260$$

$$U = 345$$

การหาพื้นที่สุทธิพีคคำนวณจาก

$$A = G - B = 184743$$

การหาค่า FWHM คำนวณจาก

$$H_L = \frac{A + (C_H - C_A)}{(C_B - C_A)} = 291.0409$$

$$= 291.0409 \times 2.212698 = 643.9856 \text{ KeV}$$

$$H_U = \frac{C + (C_0 - C_H)}{(C_C - C_D)} = 317.935$$

$$= 317.935 \times 2.212698 = 703.494179 \text{ KeV}$$

$$\text{FWHM} = 59.51 \text{ KeV}$$

จุดกึ่งกลางพีคอยู่ที่ตำแหน่ง 306

โดยข้อมูลทั้งหมดที่นำมาคำนวณนำมาจากสเปกตรัมรังสีที่พลังงาน 0.662 MeV จากต้นกำเนิดรังสี Cs-137

ประวัติผู้เขียนวิทยานิพนธ์

นายดิเรกพัฒน์ สว่างโกศล เกิดวันที่ 13 ธันวาคม พ.ศ. 2526 จังหวัดระยอง สำเร็จการศึกษา ระดับปริญญาวิทยาศาสตรบัณฑิต ภาควิชาฟิสิกส์ คณะวิทยาศาสตร์ มหาวิทยาลัยบูรพา ในปีการศึกษา 2549 แล้วเข้าศึกษาต่อในหลักสูตร วิทยาศาสตรมหาบัณฑิต สาขานิวเคลียร์เทคโนโลยี ภาควิชานิวเคลียร์เทคโนโลยี คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ในปีการศึกษา 2549

