A differentiation function

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I. Introduction

The function below is able to differentiate a curve formed by a series of equally spaced points. It is also able to smooth the differentiated curve to get rid of noise. The principle is fairly simple: select a certain number of successive points (defined by the "sizewindow"), fit them with a line, and record the slope "W_coef" in the "diffwave" (the differentiated wave). Then shift the window forward by one point, repeat the process until the number of increments n is equal to the number of point of the curve minus the "sizewindow".

II. A differentiation function

This function is programmed in IGOR Pro language: it looks like C. In order to run this function you have to pre-define an "xwave", "ywave" and a "differentiatewave", or you have to define a new program using this function where a display function is defined. The program use the IGOR Pro fitting program. "W_coef" is a global variable defined by IGOR Pro (however it needs to be declare as a normal variable) corresponding to the slope of a fitting line. See IGOR Pro user guides for more detail concerning the commands. Italics text are comments of the program.

```
Function DiffData(xwave, ywave, sizewindow, differentiatewave)

Variable declaration
Wave xwave, ywave, W_coef
String differentiatewave
Variable sizewindow, i, n

Initialization
Duplicate/o ywave $differentiatewave
Wave diffwave=$differentiatewave

diffwave=NaN

n=numpnts(ywave)-sizewindow

Loop
Do
CurveFit line ywave[i,i+sizewindow] /X=xwave /D
diffwave[i+sizewindow/2] =W_coef[1]
i = i + 1
While(i < n)

End
```

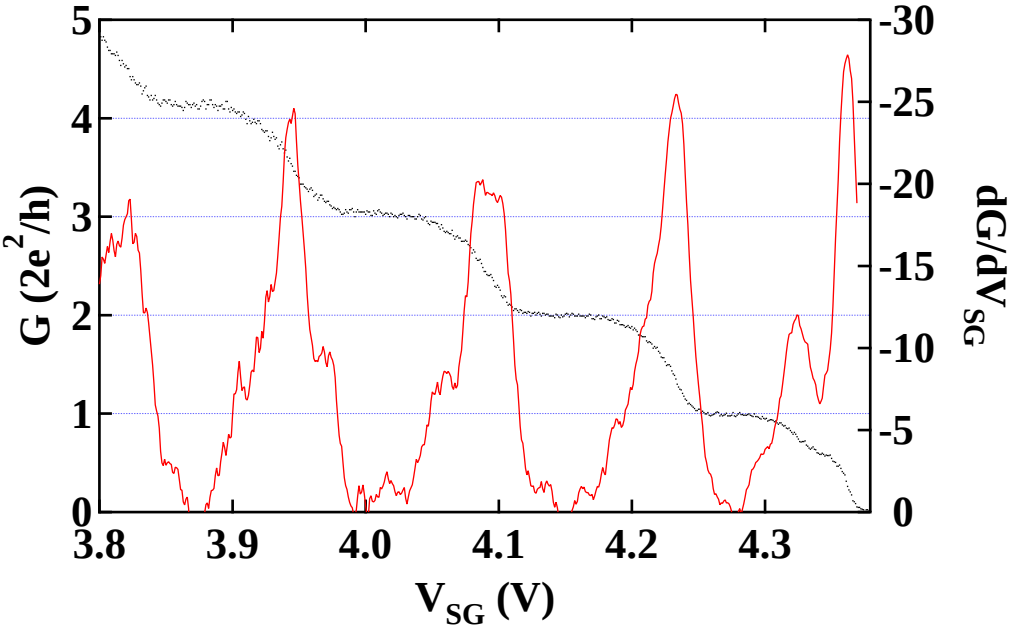

Figure 1: Example of a differentiated curve: black dots are the points which define the curve to differentiate and the red curve corresponds to the differentiate curve for a "sizewindow" of 20.

III. Example of program

This program uses the differentiate function to differentiate successive columns from a matrix of [50 x 100]. As previously, you have to pre-define an "initialmatrix", an "xwave", a "differentiatewave" and a "finalmatrix" or you have to define a new program using this function where a display function is defined.

```
Function mapdiff(initialmatrix,xwave,sizewindow,differentiatewave,finalematrix)

Variable declaration
Wave xwave, column
String initialmatrix, differentiatewave, finalematrix
Variable sizewindow, j, s

Initialization
Duplicate/o $initialmatrix $finalematrix
Wave Matrix_init = $initialmatrix
Wave Matrix_diff = $finalematrix

make/O/N=50 column

s=100

Loop
Do
column = Matrix_init[p][j]
DiffMatrix(xwave, column, sizewindow, differentiatewave)
Wave NewColumn = $differentiatewave
Matrix_diff[ ][j]= NewColumn[p]
j = j + 1
While(j < s)

End
```