UAq EMC Laboratory

"Feature Selective Validation"

A new approach for new Engineers

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European IBIS Summit

Naples, May 11, 2011

What is FSV?

The Feature Selective Validation technique has been proposed by

Prof. Alistair Duffy

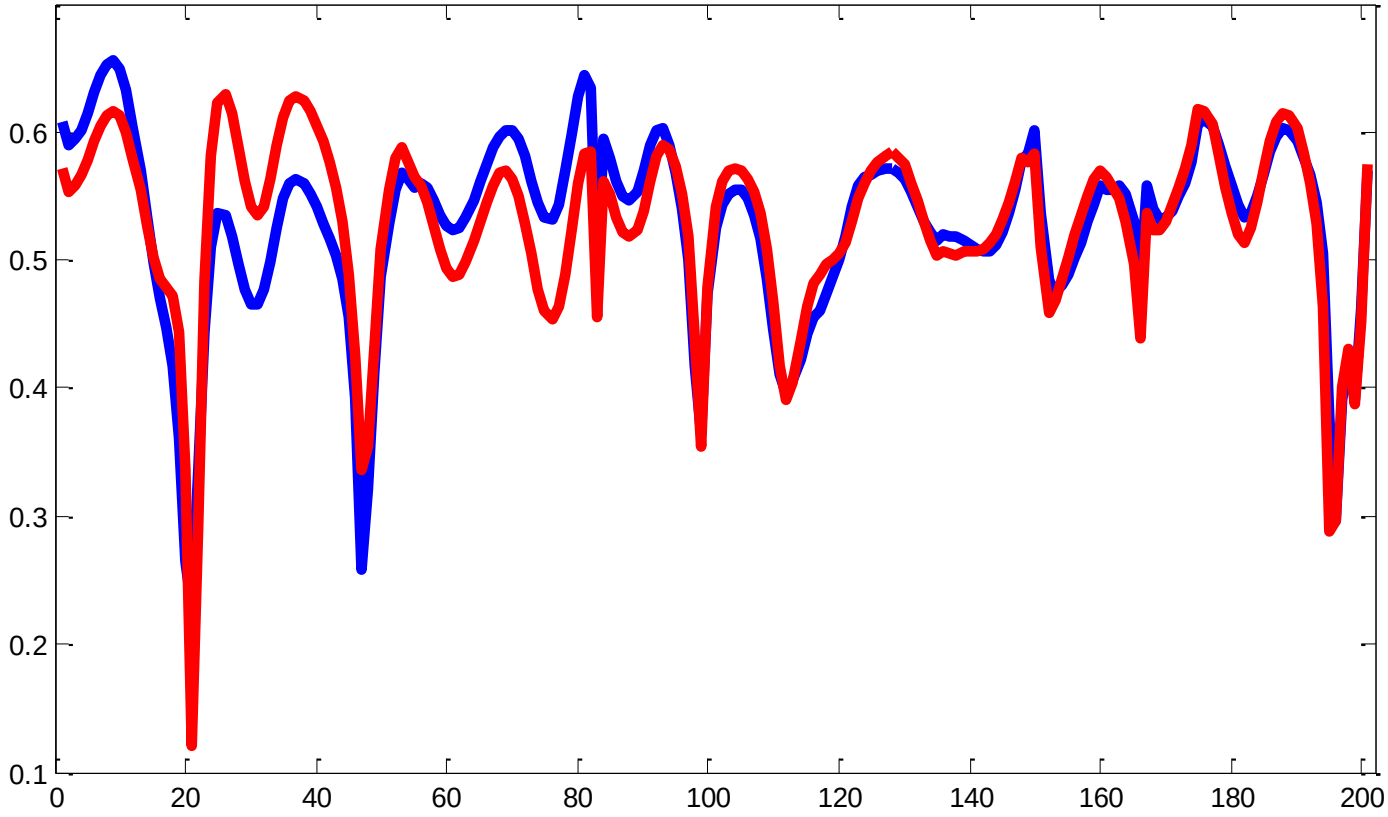
De Montfort University, Physical Layer Laboratory, Leicester, UK

What is FSV?

- The *UAq EMC Laboratory*, in cooperation with *DMU Physical Layer Laboratory* , has developed an automatic tool to compare datasets
- The FSV tool can compare 1D and 2D datasets
- FSV uses the same approach for all data→ this makes standard each comparison

Why Do We Need FSV?

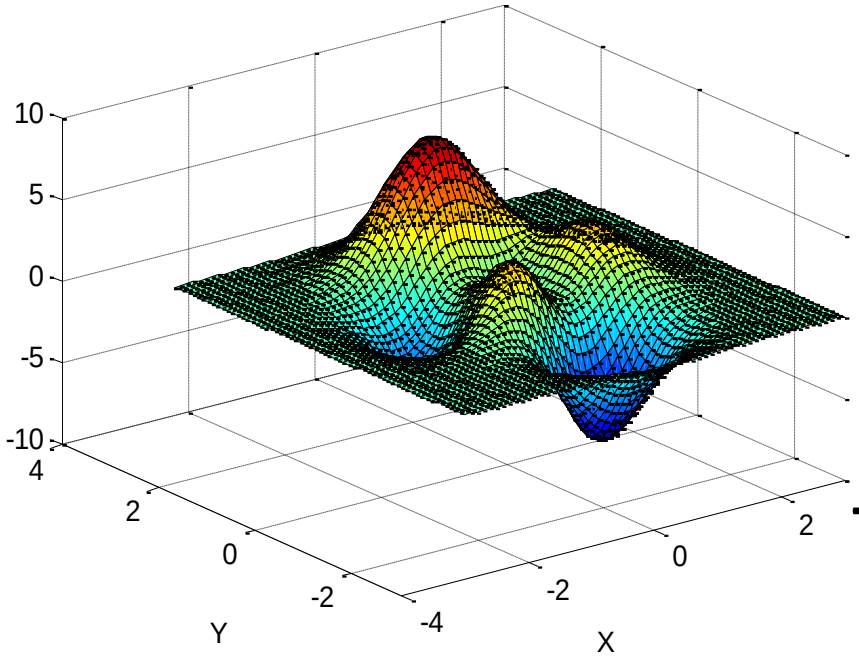
What do you think about these two files?

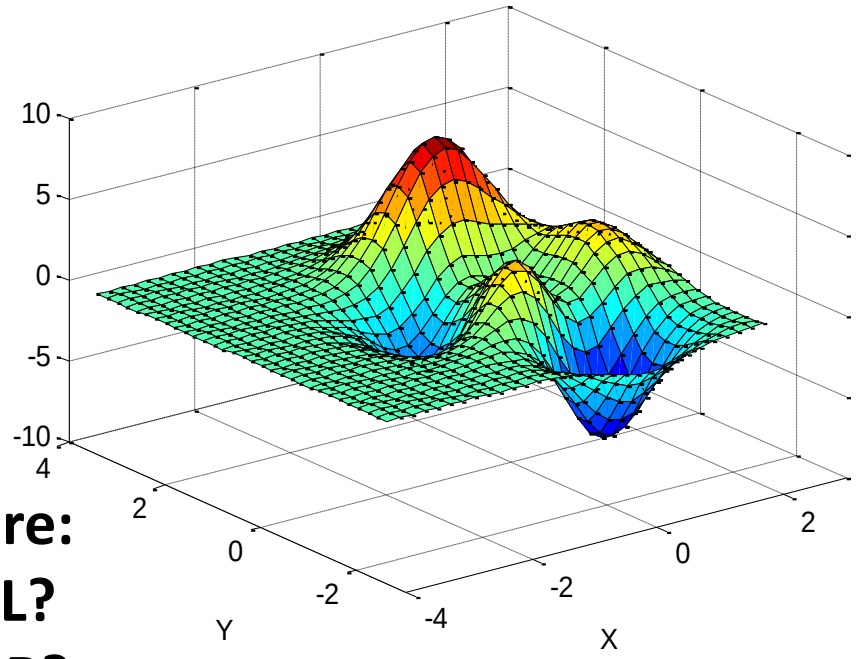


They are:
EQUAL?
SIMILAR?
DIFFERENT?
VERY DIFFERENT?
VERY SIMILAR?

Why Do We Need FSV?

And these ?





They are:

EQUAL?

SIMILAR?

DIFFERENT?

VERY DIFFERENT?

VERY SIMILAR?

Old Approaches to Compare

Comparison

CAL?

(a-b

b|?

Now can YOU classify these two files?

EQUAL,

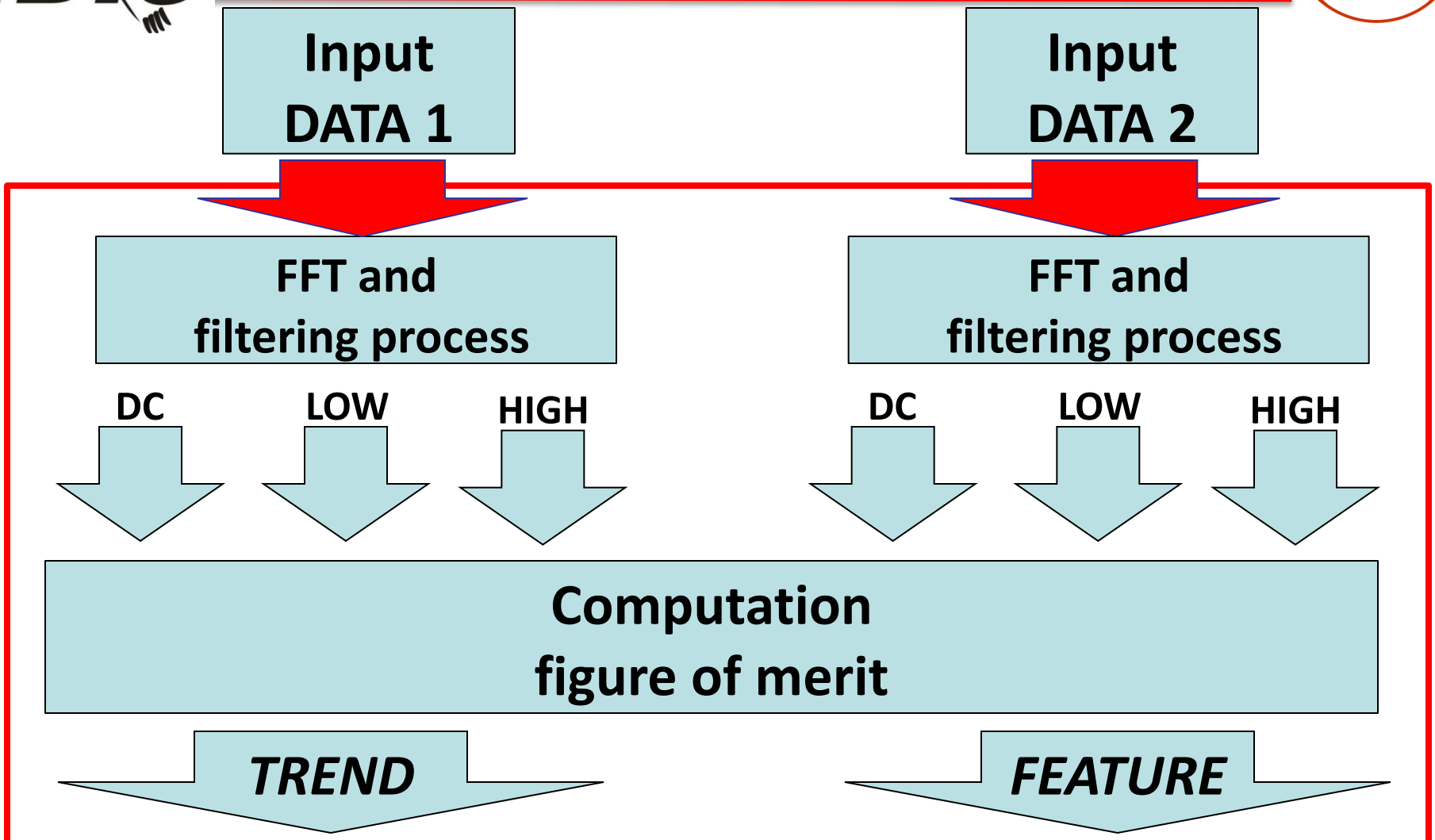
SIMILAR,

DIFFERENT

VERY DIFFERENT

And YOUR NEIGHBOURS?

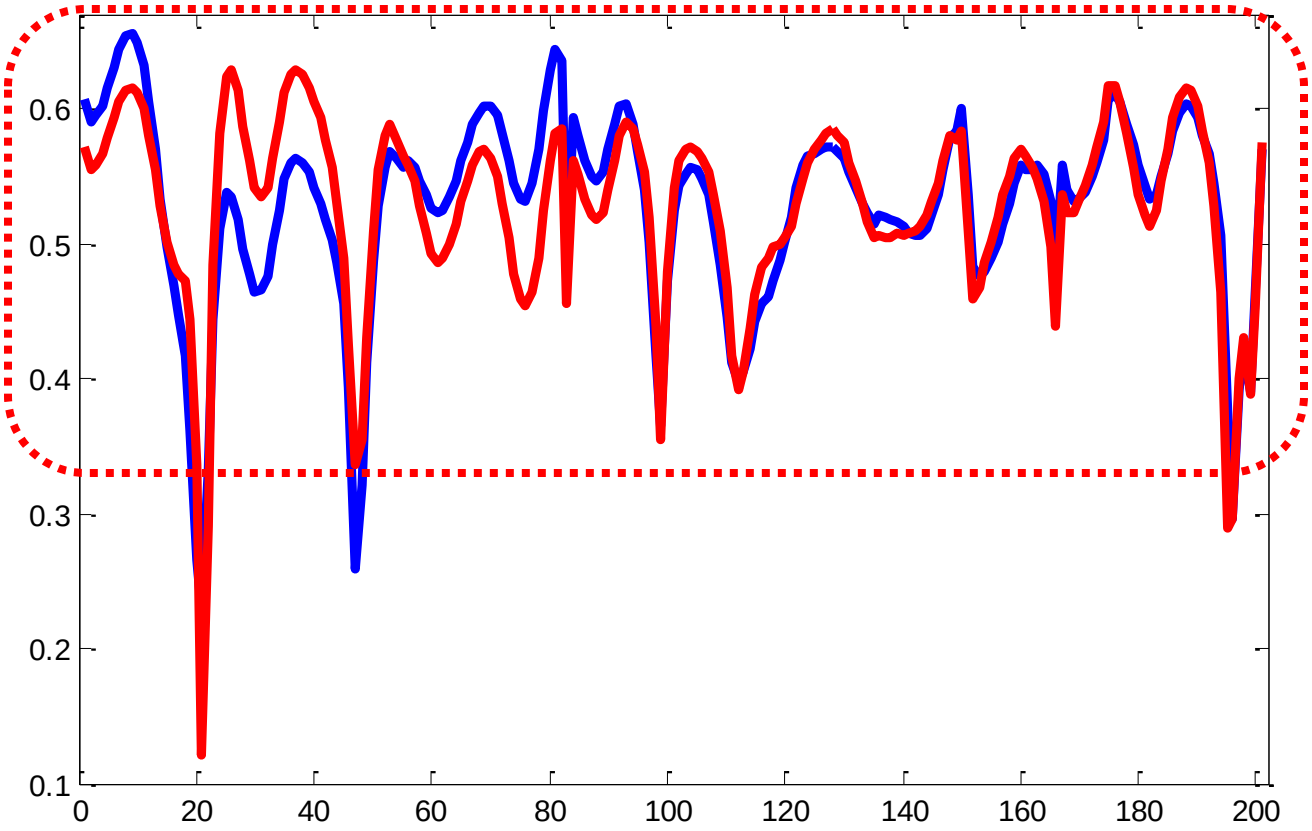
FSV Method


Input DATA 1
Input DATA 2
FFT and filtering process
FFT and filtering process
DC
LOW
HIGH
DC
LOW
HIGH
Computation figure of merit
TREND
FEATURE

FSV: Trend

Amplitude Difference Measure (ADM)

TREND



ADM Computation

Point-by-Point

$$ADM(n) = \left|\frac{\alpha}{\beta}\right| + \left|\frac{\chi}{\delta}\right| \exp\left\{\left|\frac{\chi}{\delta}\right|\right\}$$

$$ADM = \frac{\sum_{n=1}^{N} ADM(n)}{N}$$

From the 'trend' data

From the 'offset' data

Calculate:

$$\alpha = \left(\left|Lo_1(n)\right| - \left|Lo_2(n)\right|\right)$$

Point-by-point

$$\chi = \left(\left|DC_1(n)\right| - \left|DC_2(n)\right|\right)$$

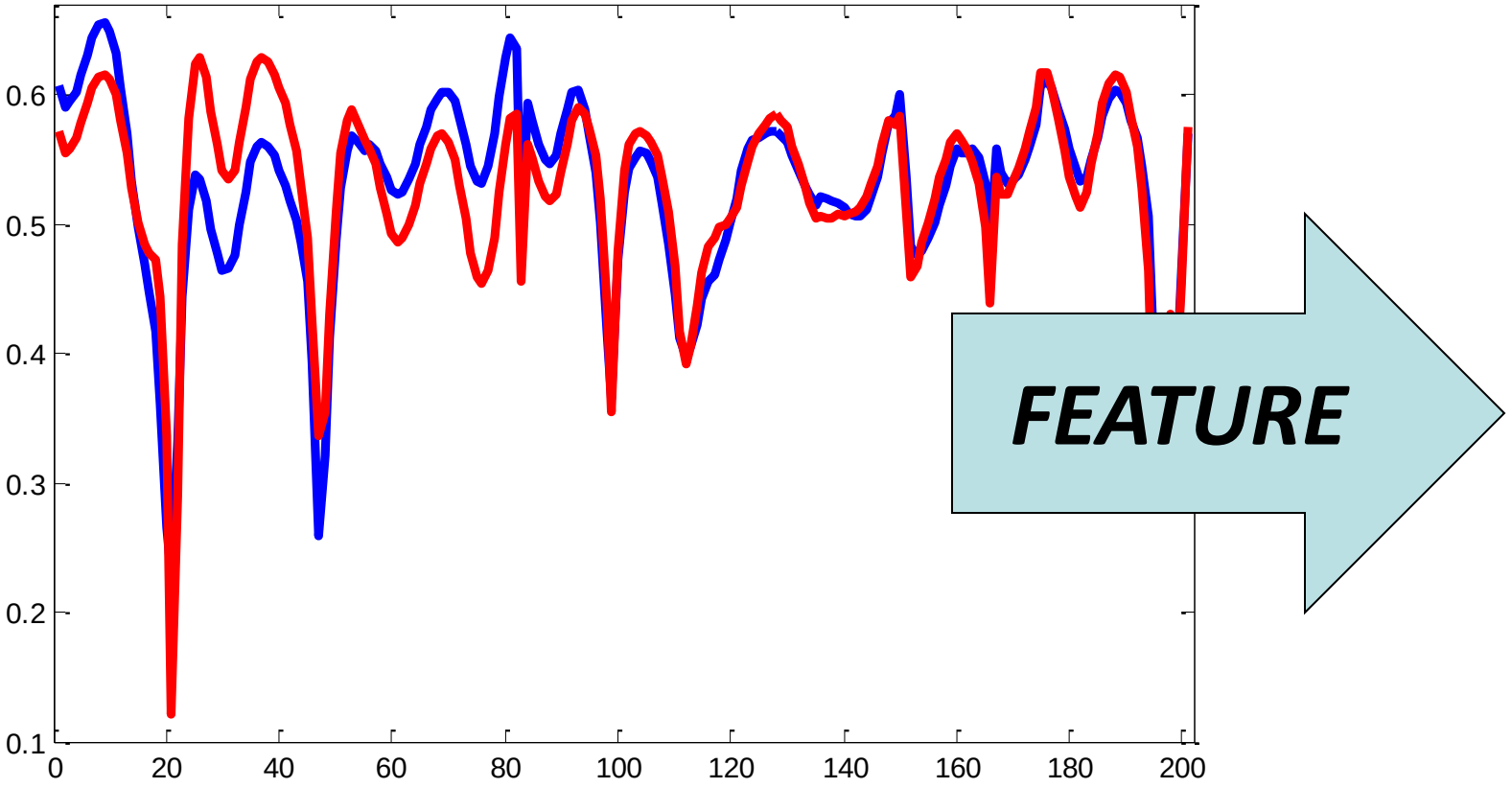
$$\beta = \frac{1}{N}\sum_{i=1}^{N}\left(\left(\left|Lo_1(i)\right| + \left|Lo_2(i)\right|\right)\right)$$

Once only

$$\delta = \frac{1}{N}\sum_{i=1}^{N}\left(\left(\left|DC_1(i)\right| + \left|DC_2(i)\right|\right)\right)$$

n is the nth data point

FSV: Feature



FDM Computation

Feature Different Measure (FDM)

$$FDM(f) = 2\left(\left|FDM_1(f) + FDM_2(f) + FDM_3(f)\right|\right)$$

$$FDM_1(f) = \frac{\left|Lo_1'(f)\right| - \left|Lo_2'(f)\right|}{\frac{2}{N}\sum_{i=1}^{N}\left(\left(\left|Lo_1'(i)\right| + \left|Lo_2'(i)\right|\right)\right)}$$

$$FDM_2(f) = \frac{\left|Hi_1'(f)\right| - \left|Hi_2'(f)\right|}{\frac{6}{N}\sum_{i=1}^{N}\left(\left(\left|Hi_1'(i)\right| + \left|Hi_2'(i)\right|\right)\right)}$$

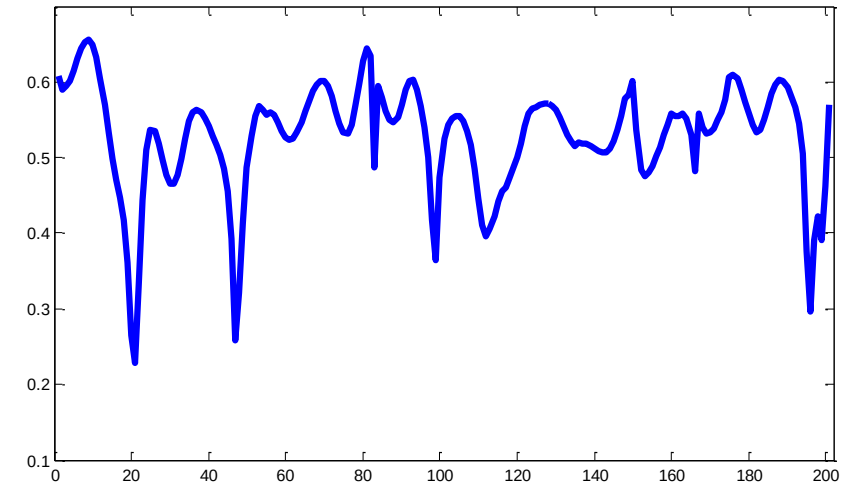
$$FDM_3(f) = \frac{\left|Hi_1''(f)\right| - \left|Hi_2''(f)\right|}{\frac{7.2}{N}\sum_{i=1}^{N}\left(\left(\left|Hi_1''(i)\right| + \left|Hi_2''(i)\right|\right)\right)}$$

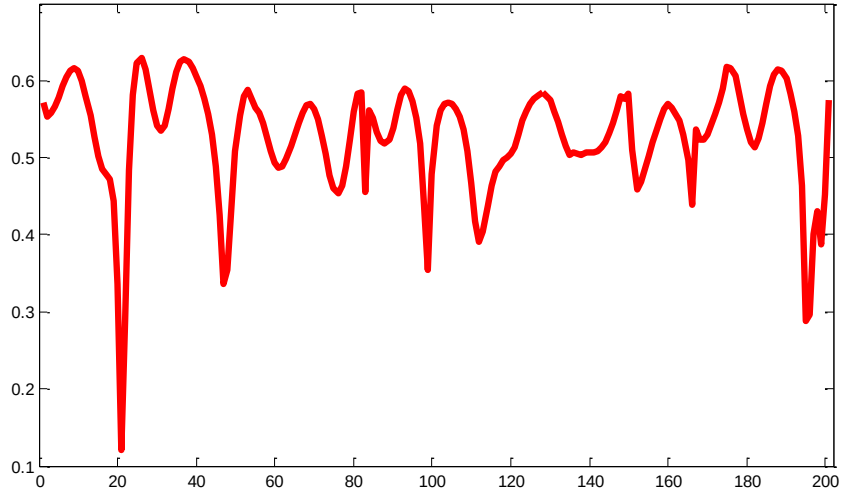
GDM Computation

Global Different Measure (GDM)

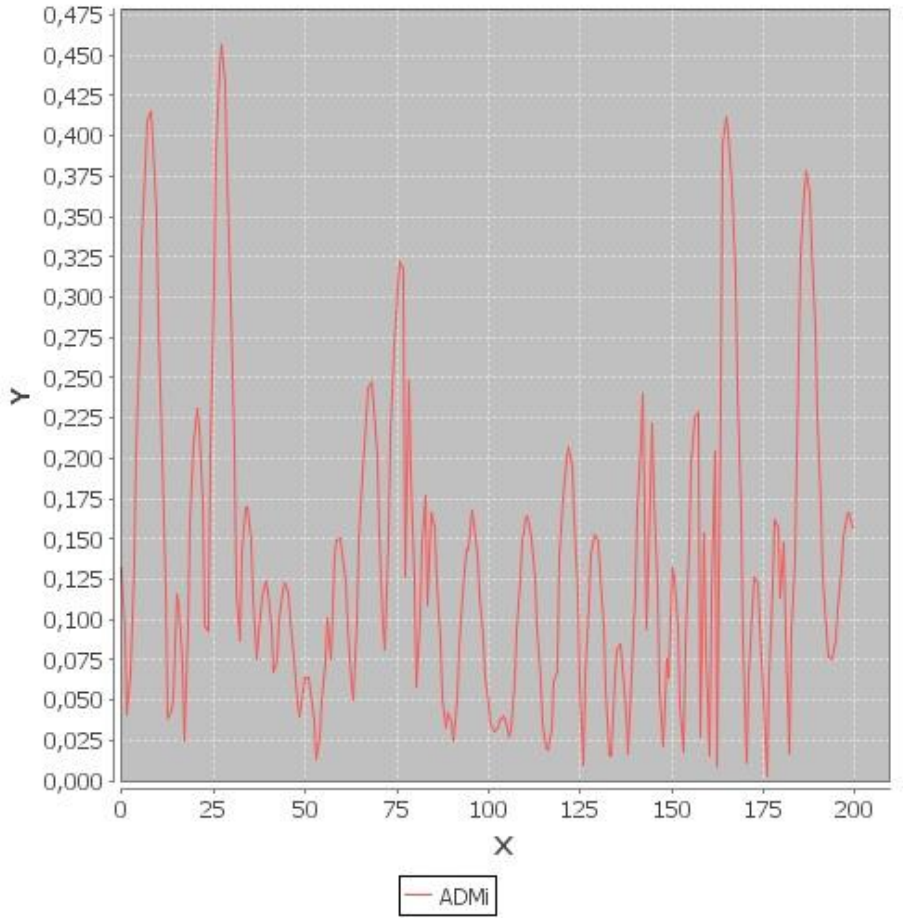
$$GDM(f) = \sqrt{ADM(f)^2 + FDM(f)^2}$$

Interpretation Scale for FSV





ADMi

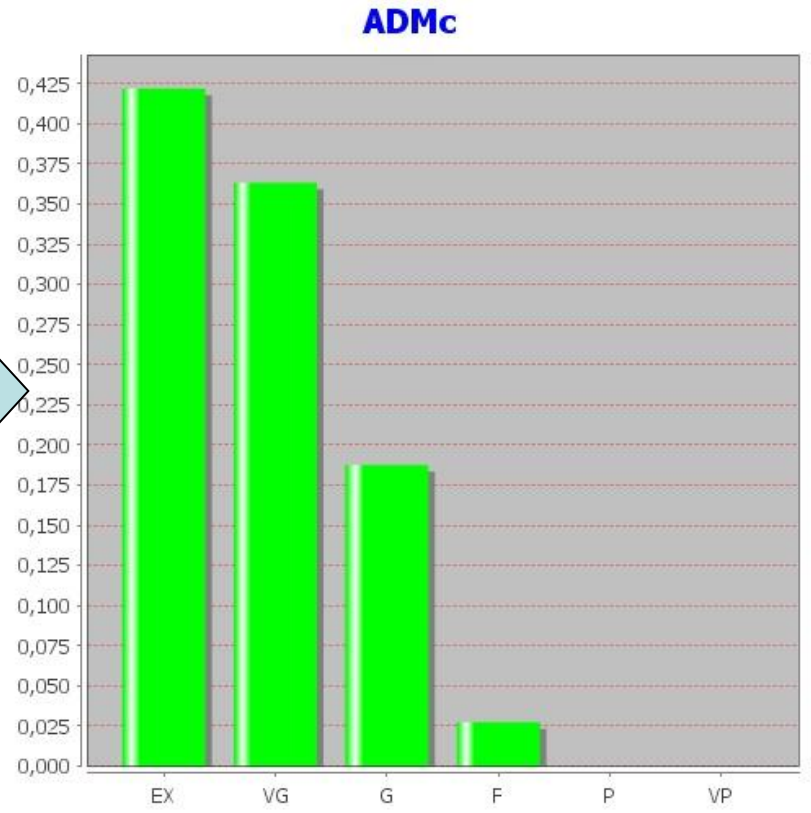


From ADMi to ADMc: Histogram

How many points of the ADMi fall into each category?

Same algorithm applys for FDM and GDM

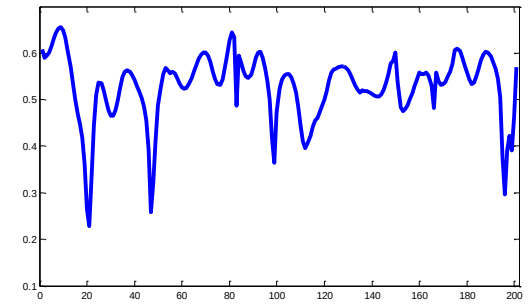
FSV value (quantitative)	FSV interpretation (qualitative)
Less than 0.1	Excellent
Between 0.1 and 0.2	Very good
Between 0.2 and 0.4	Good
Between 0.4 and 0.8	Fair
Between 0.8 and 1.6	Poor
Greater than 1.6	Very poor

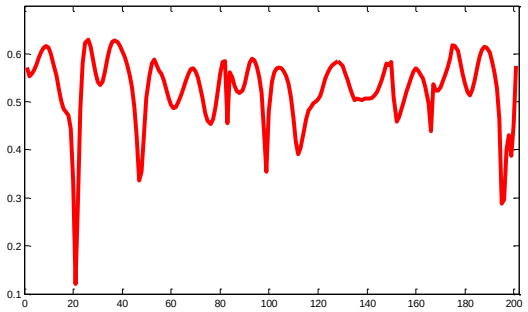


Grade & Spread Chart

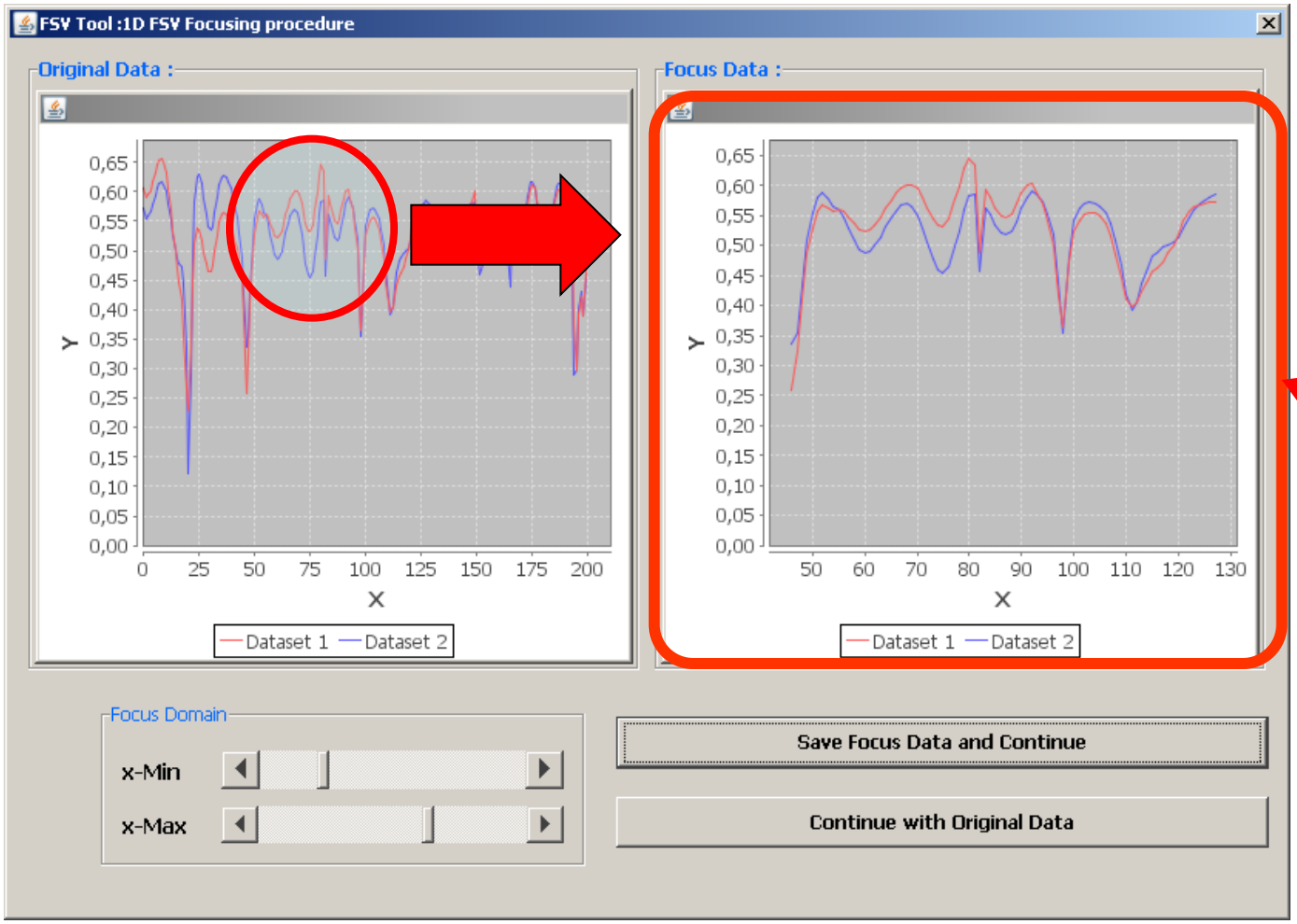
- Grade: number of categories starting from ‘Excellent’ to contain 85% of the total confidence data.
- Spread: number of categories around the highest value category to contain 85% of the total confidence data.
  - Similar use to variance in statistics
- Gives a measure of reliability of the FDM and ADM in calculating the GDM and can be used to weight the GDM calculation

FSV Tool: 1D Analysis



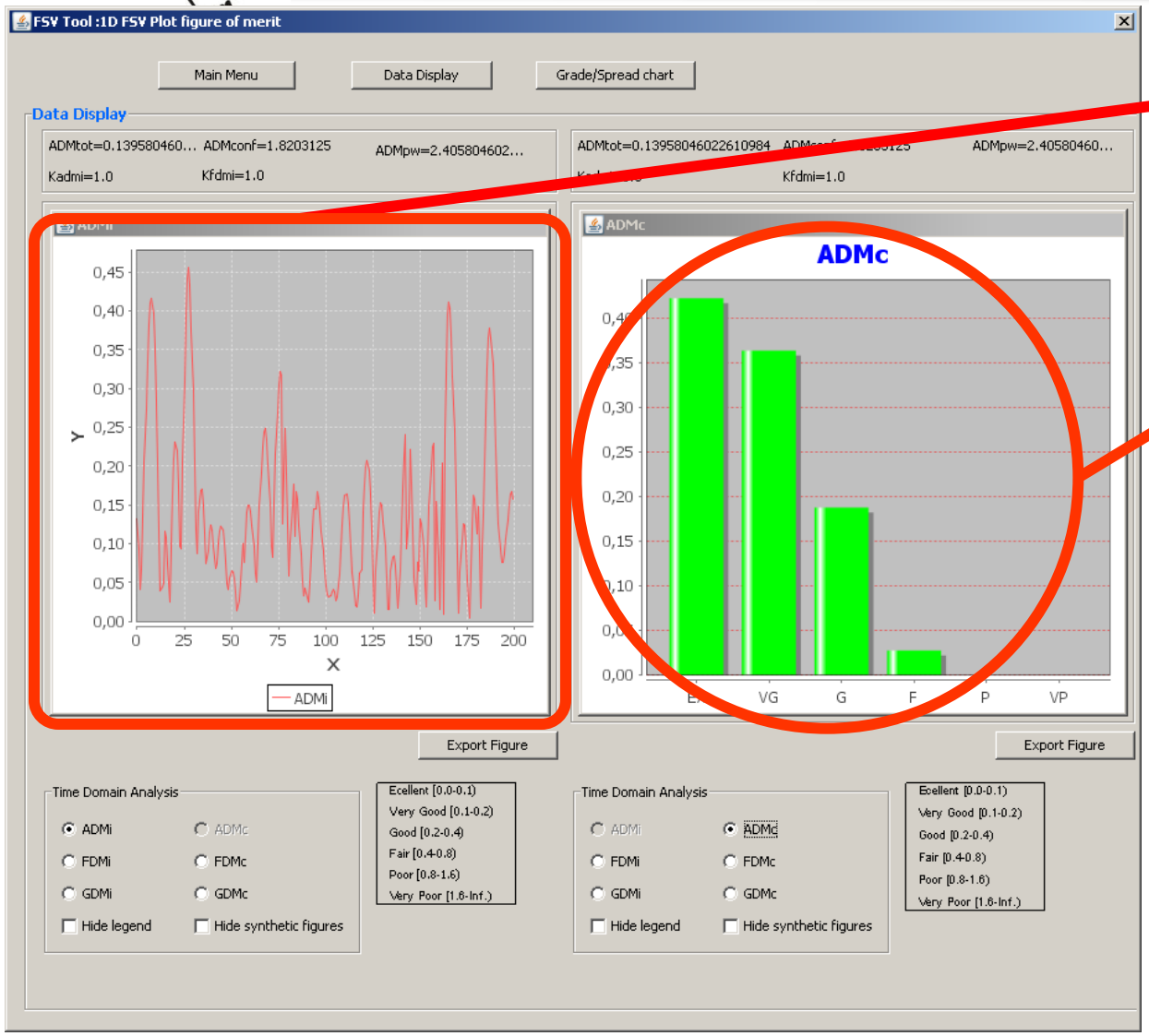


View Input & Focus Options



Focusing

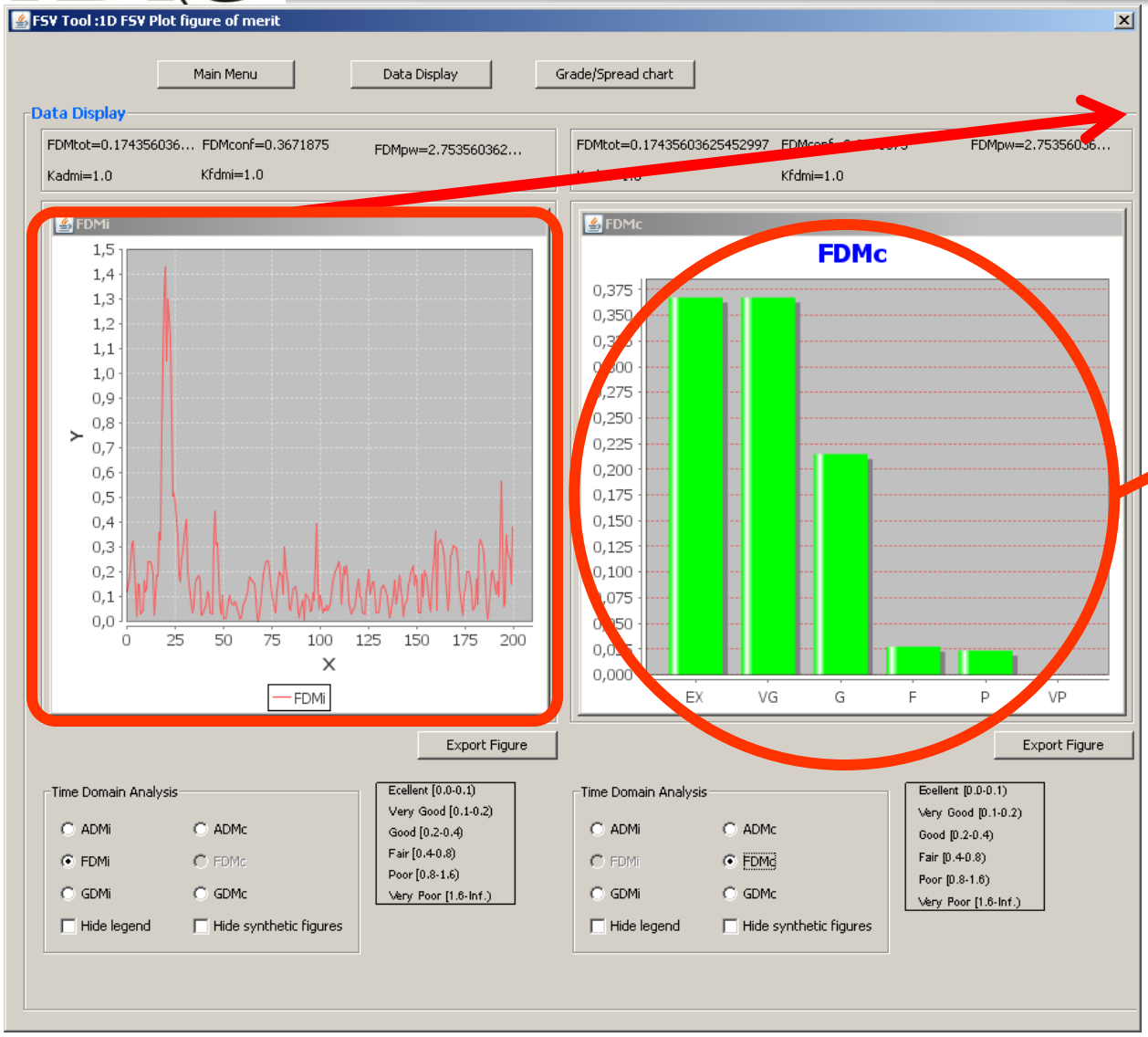
Result Window: ADM



ADMi Plot

ADMc Plot

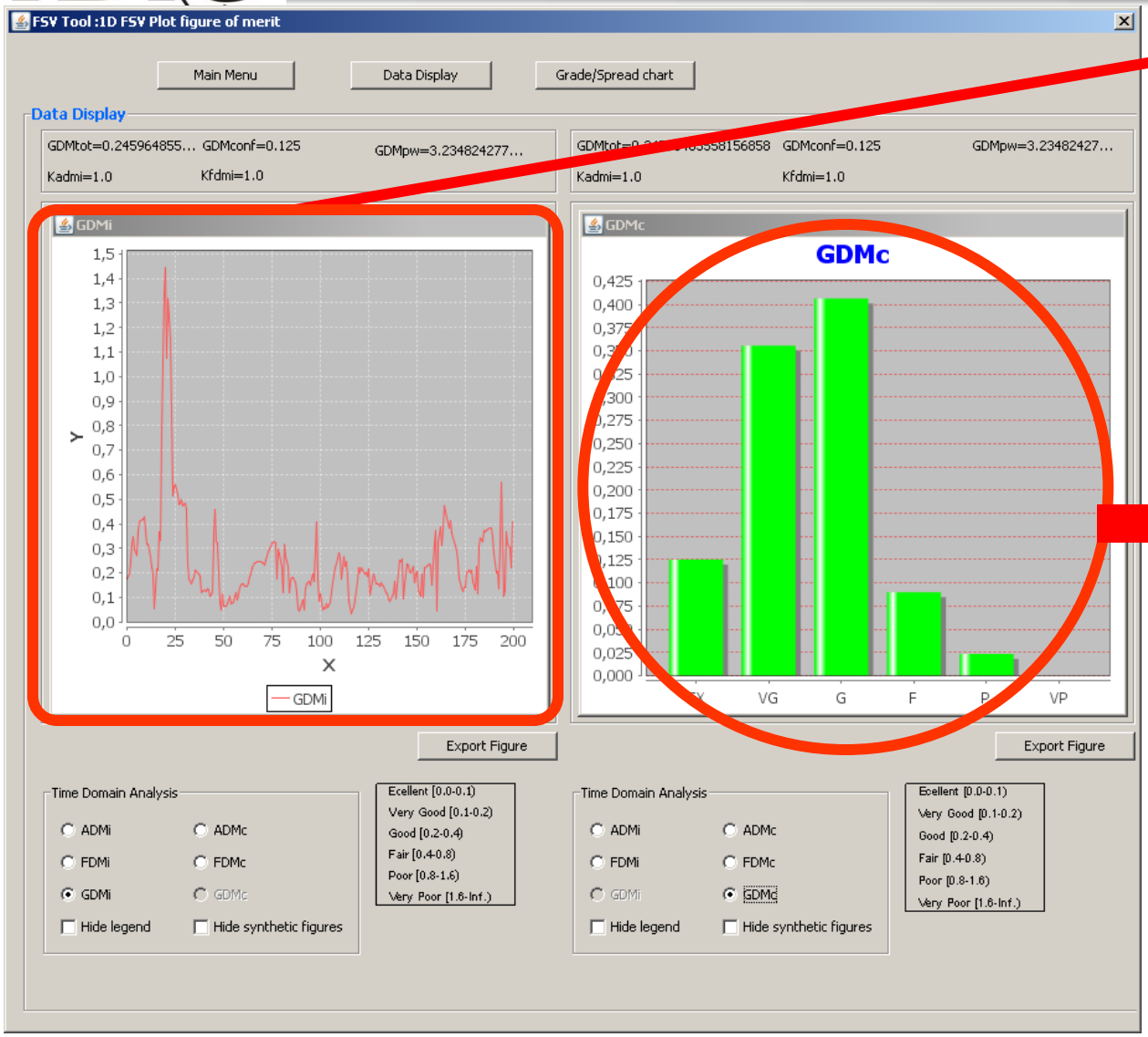
Result Window: FDM



FDMi Plot
(Derivatives applied)

FDMc Plot

Result Window: GDM



GDMi Plot

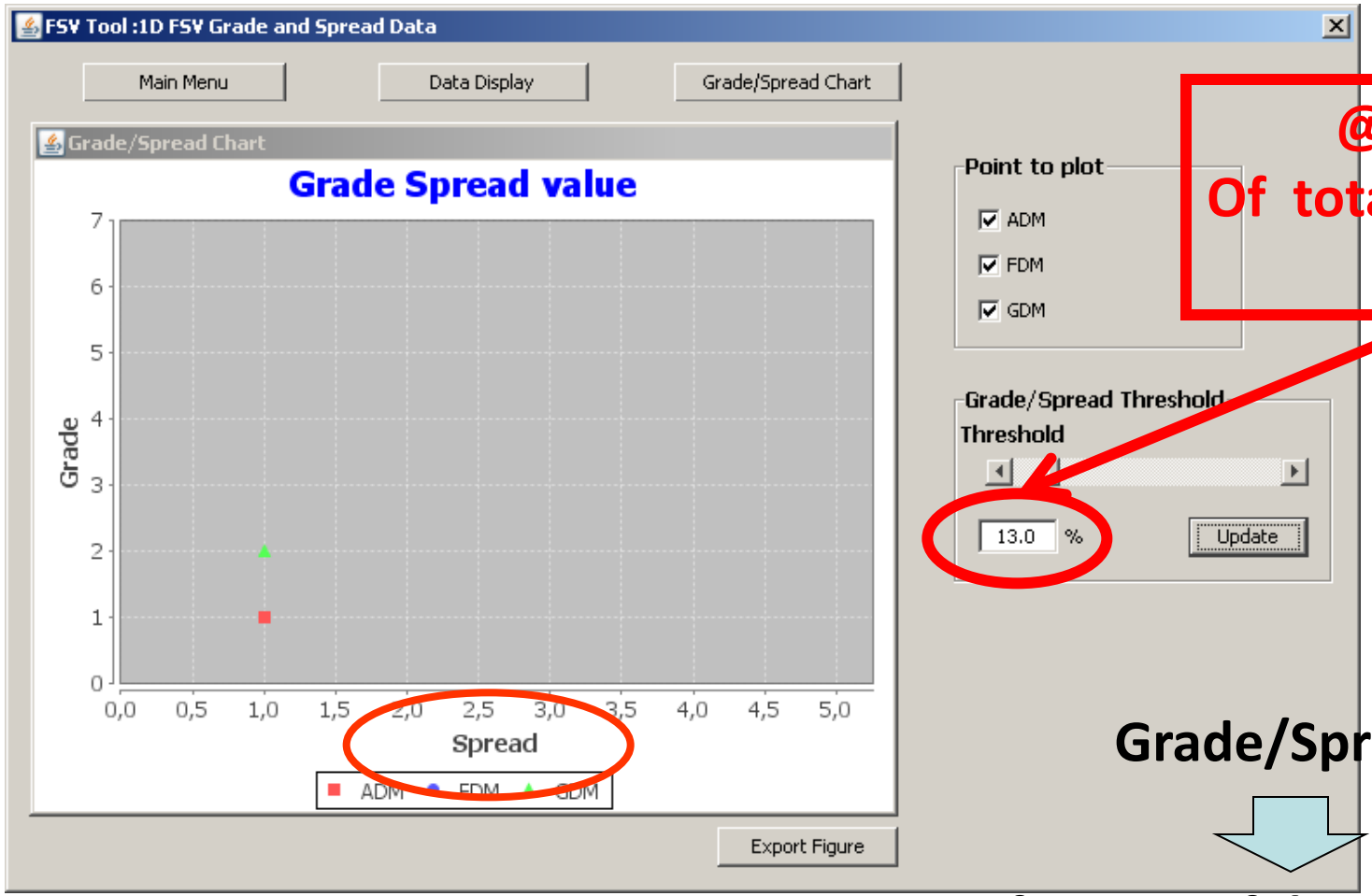
$$GDM(f) = \sqrt{ADM(f)^2 + FDM(f)^2}$$

GDMc Plot

This two files:

- ***EX* for ≥ 12%**
- ***VG* for ≥ 35%**
- ***G* for ≥ 40%**
- ***F* for > 7.5%**
- ***P* for ≥ 2.5%**
- ***VP* for 0%**

Grade Spread View

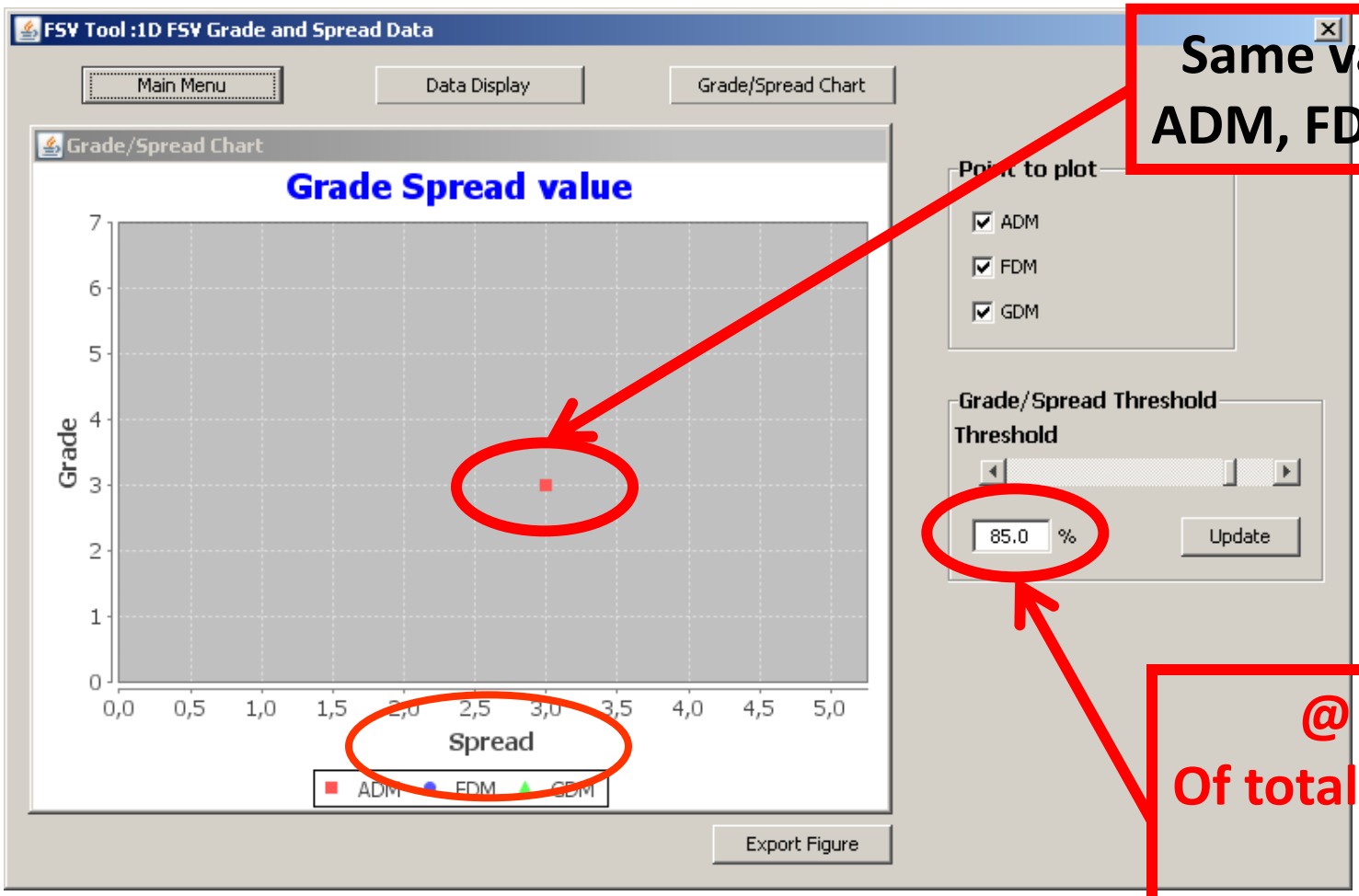


@ 13.0%
Of total confidence data

Grade/Spread

quantification of data comparisons

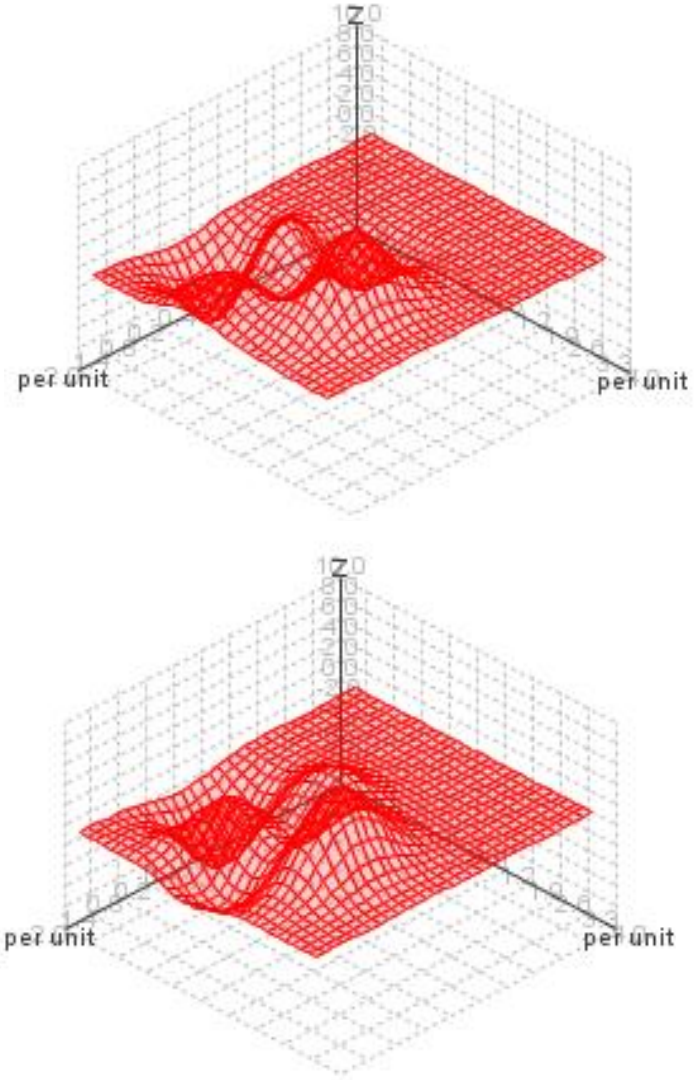
Varying the Threshold



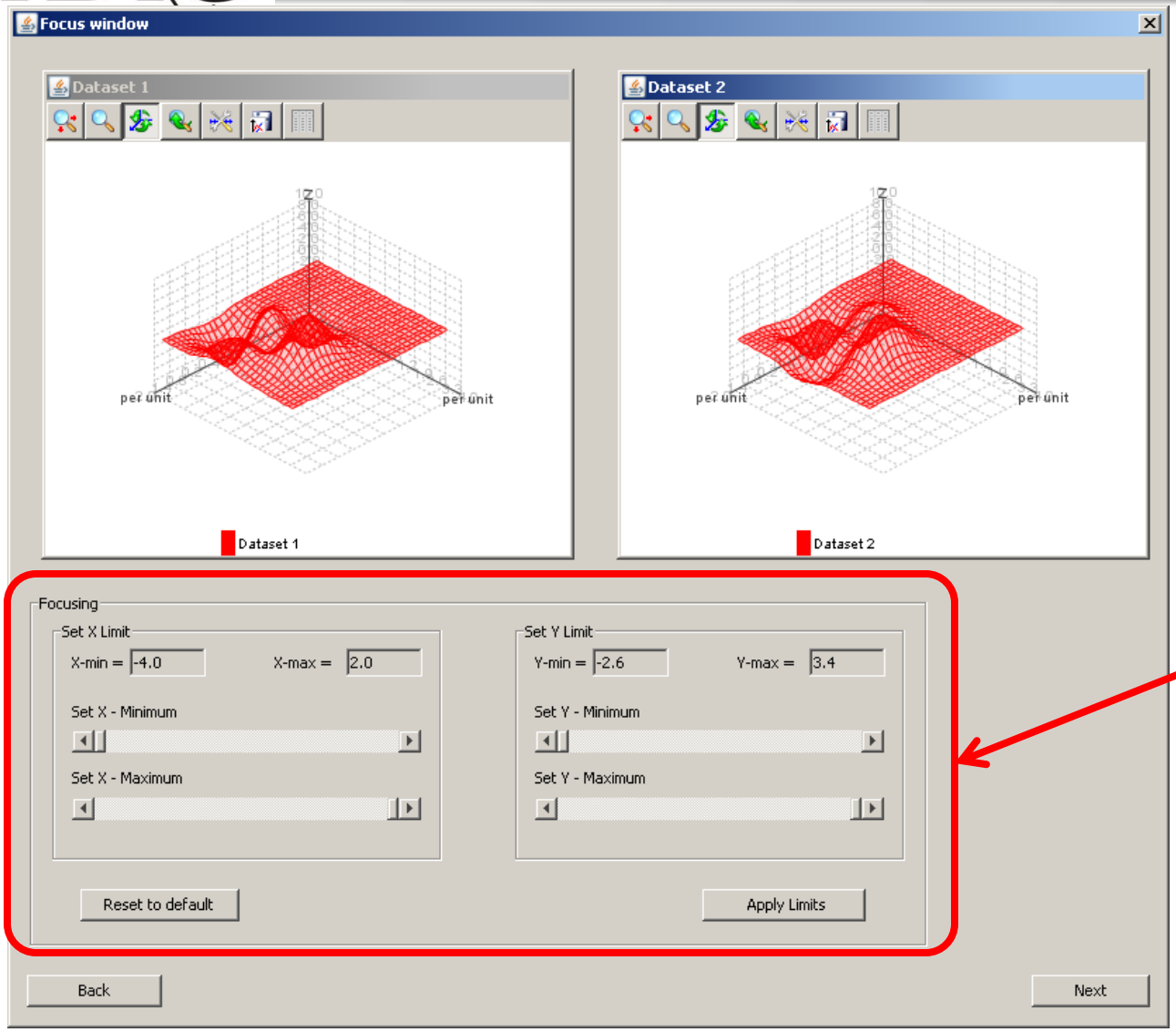
Same value for ADM, FDM, GDM

@ 85.0% Of total confidence data (default value)

FSV Tool: 2D Analysis

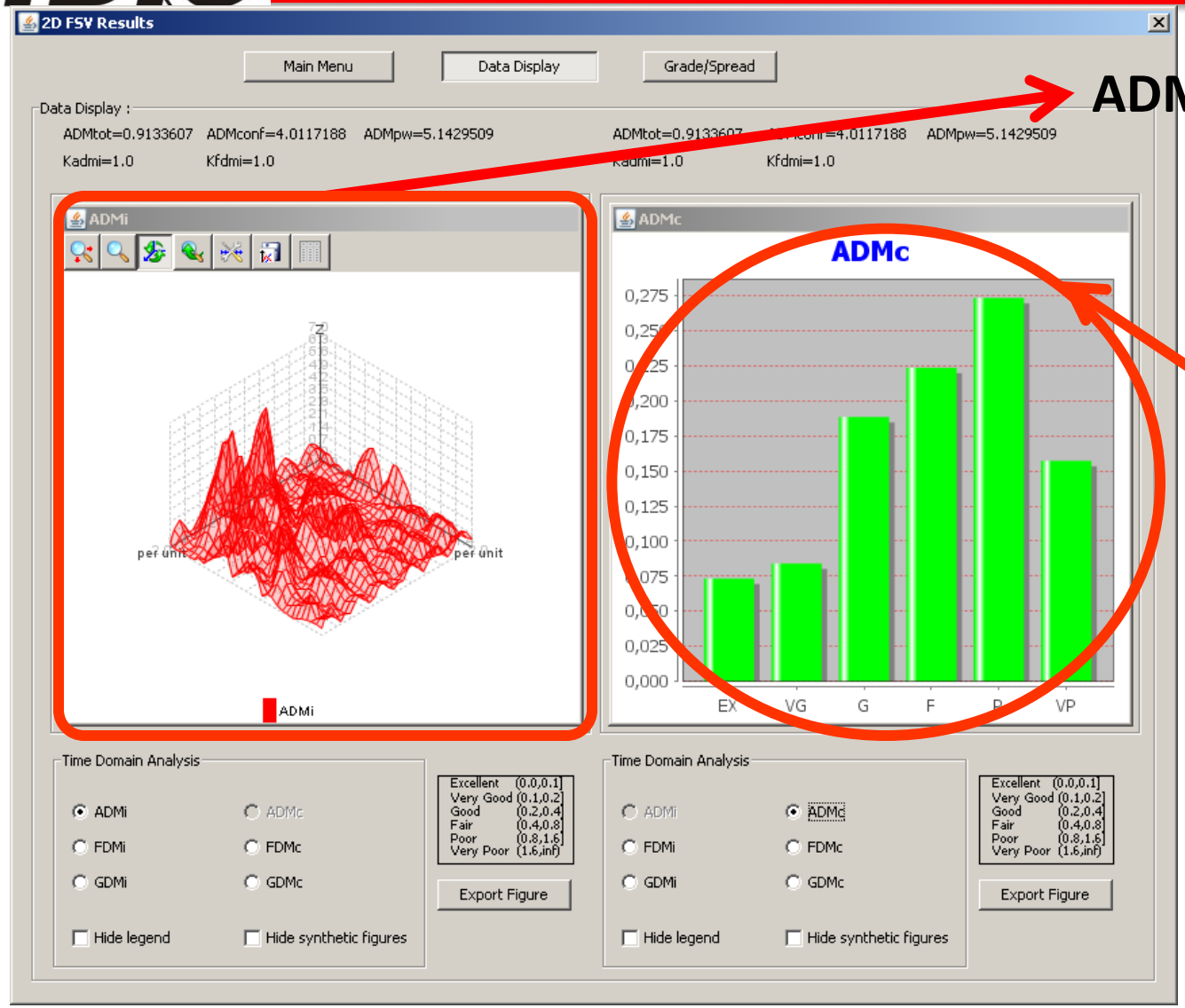


Focusing Window



Focusing Section

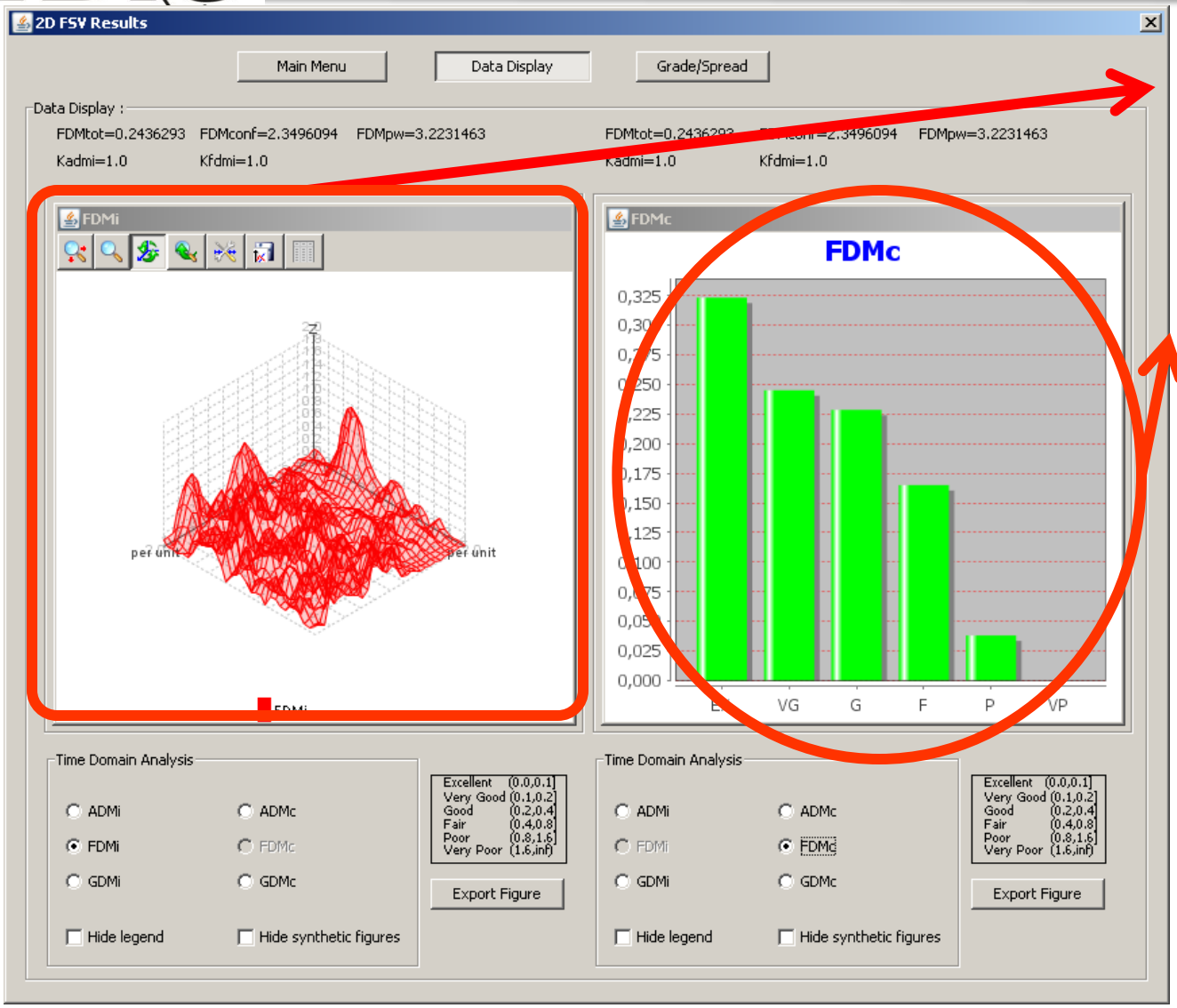
Trend: ADM



ADMi Plot

ADMc Plot

Feature: FDM

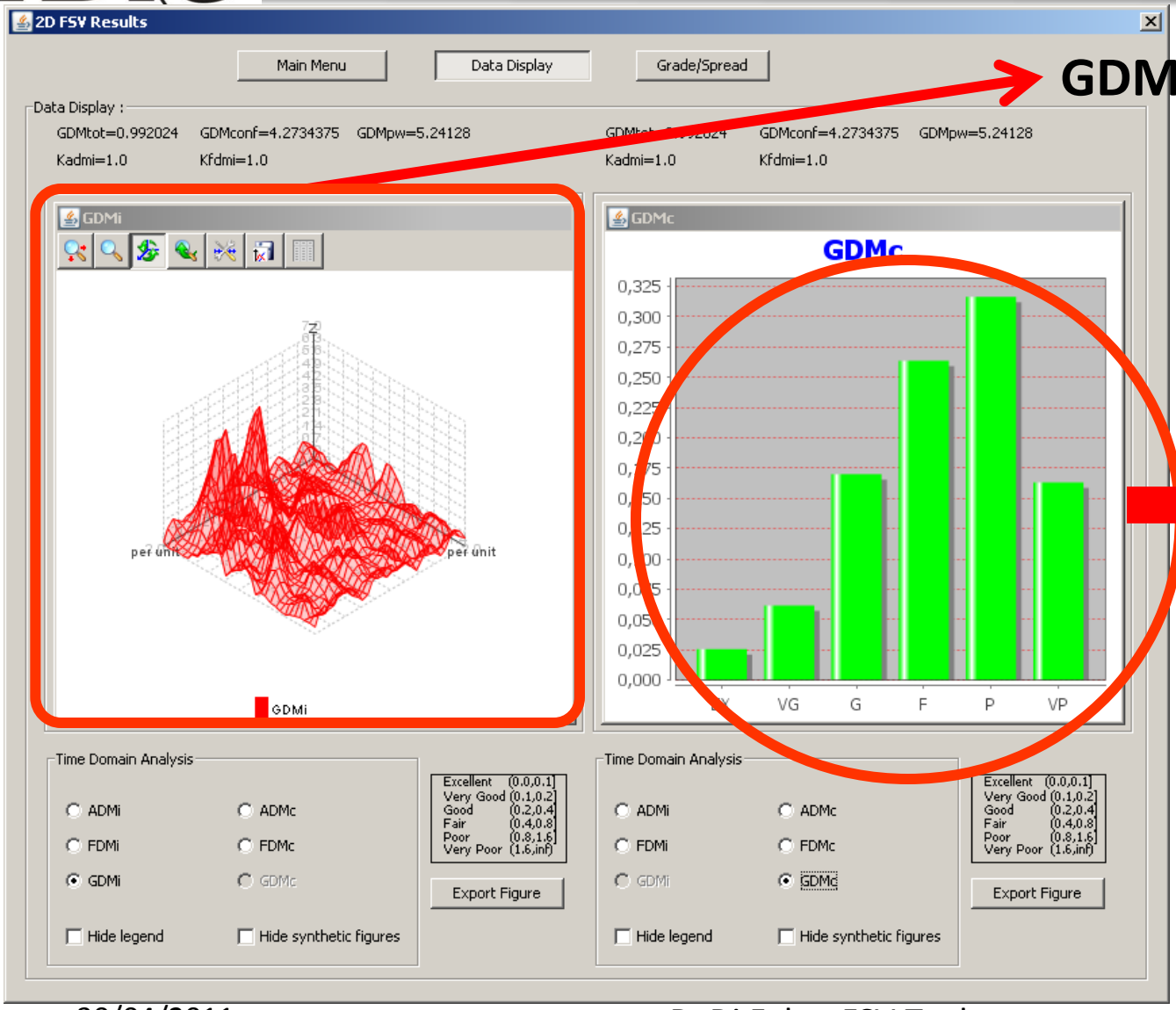


FDMi Plot

(Derivatives applied)

FDMc Plot

Global Value: GDM



GDMi Plot

GDMc Plot

This two files:

- ***EX* for ≥ 2.5%**
- ***VG* for ≥ 5.0%**
- ***G* for ≥ 18.0%**
- ***F* for > 25%**
- ***P* for ≥ 30%**
- ***VP* for 15%**

Summary

- Quantification of data comparisons
  - ADMi/c Amplitude difference
  - FDMi/c Feature difference
  - GDMi/c Global difference
  - Grade & Spread visual data
- Portability (Java version)
- Free (at present) upon request

Next Steps

- Vector FSV-1D: Analyze and compare more 1D data sets together.
- Vector FSV-2D: Analyze and compare more 2D data sets together.

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