

# 第23章

## MSC.FATIGUE 实用工具



# 实用工具总览

- **MSC.Fatigue** 有许多实用工具来方便用户
- **6 主要的实用工具目录:**
  - ◆ **Fatigue** 前处理实用工具
  - ◆ 材料管理实用工具
  - ◆ 高级载荷工具
  - ◆ 图形显示工具
  - ◆ 文件转换工具
- 这里对最通用的工具给出简单说明,更详细的内容,请参阅下面手册:
  - ◆ ***Quick Start Guide, MSC.Fatigue 2005***
  - ◆ ***User's Guide Volume 2, MSC.Fatigue 2005***

# 实用工具总揽 (Contd.)

## ■ 实用工具命名

- ◆ 来自nsoft的程序在MSC.Fatigue中命名都在前面加m
- ◆ 如 ‘QLD’ (Quick Look Display) 变成 ‘mQLD’ 等.
- ◆ 这样可以避免在同一个机器上安装了MSC.Fatigue和nsoft而发生冲突.
- ◆ 在快速开始手册中也反应这个变化,但是MSC.Fatigue的下拉菜单没有反应这个变化.

# 访问 MSC.Fatigue 实用工具

- 图形访问：这个实用工具可以从下面访问

(MSC.Fatigue for MSC.Patran) **Tools -> MSC.Fatigue** pull down menu

(MSC.Fatigue Standalone) **Tools -> Fatigue Utilities** pull down menu

- 系统提示符访问：

在系统提示符下输入。例如，调用  
mqld (Quick Look Display), 输入：  
***mqld***

# 载荷实用工具

- **MSC.Fatigue**的主要载荷模块是时间历程管理器 (**ptime**). 它包括下面的数据处理功能：
  - ◆ ASCII File Input
  - ◆ Waveform creation
  - ◆ Block Cycle Definition
  - ◆ Rainflow Cycle Counting
  - ◆ Polynomial Data Transformation
  - ◆ Data Display Tools

# 时间历程处理工具

- Arithmetic Manipulation (ART)
- Spreadsheet Multichannel Editor (COE)
- Edit, Extract & Join Data (LEN)
- Combine Multiple Channels (MFM)
- User defined formulae (FRM)
- Multiple File Peak Valley Extraction (PVXMUL)
- Simultaneous Value Analysis on Multiple Channels (SIMMAX)
- Graphical Data Editor (GED)

# 数学运算 - “ART”

The image displays two overlapping dialog boxes from the ART software. The background dialog is titled "ART - Multiplication by a Constant" and contains the following fields and controls:

- Input Filename: G04.DAC
- Output Filename: G04.DAC
- Multiply By: 9.807
- From: START To: END
- Axis To Use:  Both,  X only,  Y only
- Y Label + Units: rear g2, g
- X Label + Units: (empty)
- Z Label + Units: (empty)
- Buttons: OK, Cancel, Help

The foreground dialog is titled "ART - Option Selection" and contains a list of mathematical operations with radio buttons:

- Multiply by a constant
- Divide by a constant
- Add a constant
- Subtract a constant
- Normalise to a new mean
- Raise to a power
- Trigonometric functions
- Absolute value of data
- Y = mX+c
- Logarithmic functions
- e<sup>X</sup>

Below the list are buttons for OK, Cancel, and Help. To the right of the "Option Selection" dialog, a vertical menu is open, listing the following options:

- Sine
- Cosine
- Tangent
- 1 Log base e
- 2 Log base 10
- 3 Antilog base e
- 4 Antilog base 10



# 表格的多通道编辑 - “COE”

The screenshot displays the COE software interface. The main window shows a data table with columns B, F, C, D, and E. The table contains numerical data, with the value 6.539 highlighted in the C column. Three dialog boxes are open over the table:

- COE - Mode of Operation:** A dialog box with radio buttons for **Browse**, **Edit**, **Create**, and **eXit**. It includes **OK**, **Cancel**, and **?** buttons.
- COE Select Option:** A dialog box with a list of options: **Gap**, **Delete**, **Copy**, **paSte**, **cYcle**, **Insert**, **Append**, **Join**, **Export**, **Plot**, **Rescale and offset**, **view file Headers**, **View extra details**, **Format columns**, **eXit**, and **Quit**. It includes **Cancel** and **?** buttons.
- COE Select Preference:** A dialog box with radio buttons for **Point pick method**, **X-value format**, **Data format**, **Scale x-values**, and **Export options**. It includes **Cancel** and **?** buttons.

At the bottom of the main window, there is a status bar showing **(UE) S61A.DAC** and the value **6.539**.

B	F	C	D	E
		S61A	S61B	S61C
		(UE)	(UE)	(UE)
	.000	6.539	8.260	5.162
	.002	3.786	8.948	4.130
	.005	2.409	9.895	1.721
	.007	5.507		
	.010	3.786	11	
	.012	5.507	11	
	.015	4.474		
	.017	5.851	11	
	.020	3.786		
	.022	2.409	11	
	.024	6.539	11	
	.027	6.539	11	
	.029	4.130	11	
	.032	4.130		
	.034	6.195		
	.037	4.130		
	.039	5.507		

# 编辑, 提取 & 组合 - “LEN”

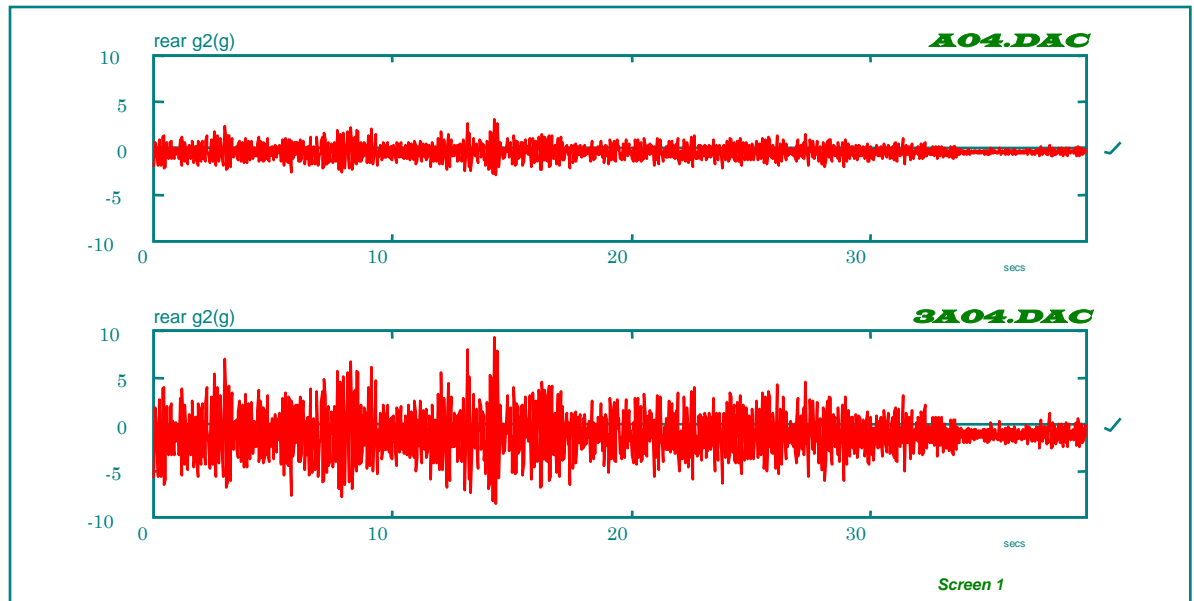
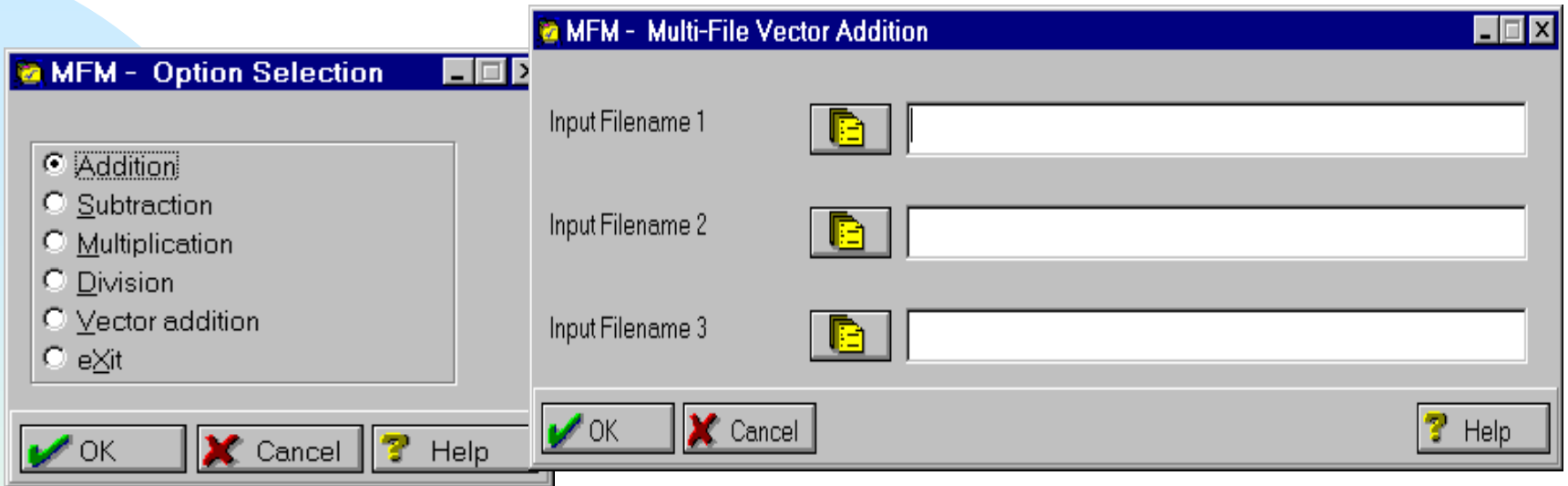
The image displays the LEN software interface, specifically the 'LEN - File Concatenation' dialog box and two waveform plots. The dialog box is open, showing the following settings:

- Input Filenames: [Empty field]
- Number of files selected: 3
- Output Filename: 3a04
- Channel Title: rear g2
- Joining Function: Half Sine
- Join Window: 1
- Taper Function: None
- Taper Window: [Empty field]
- Cycle Functions: Yes

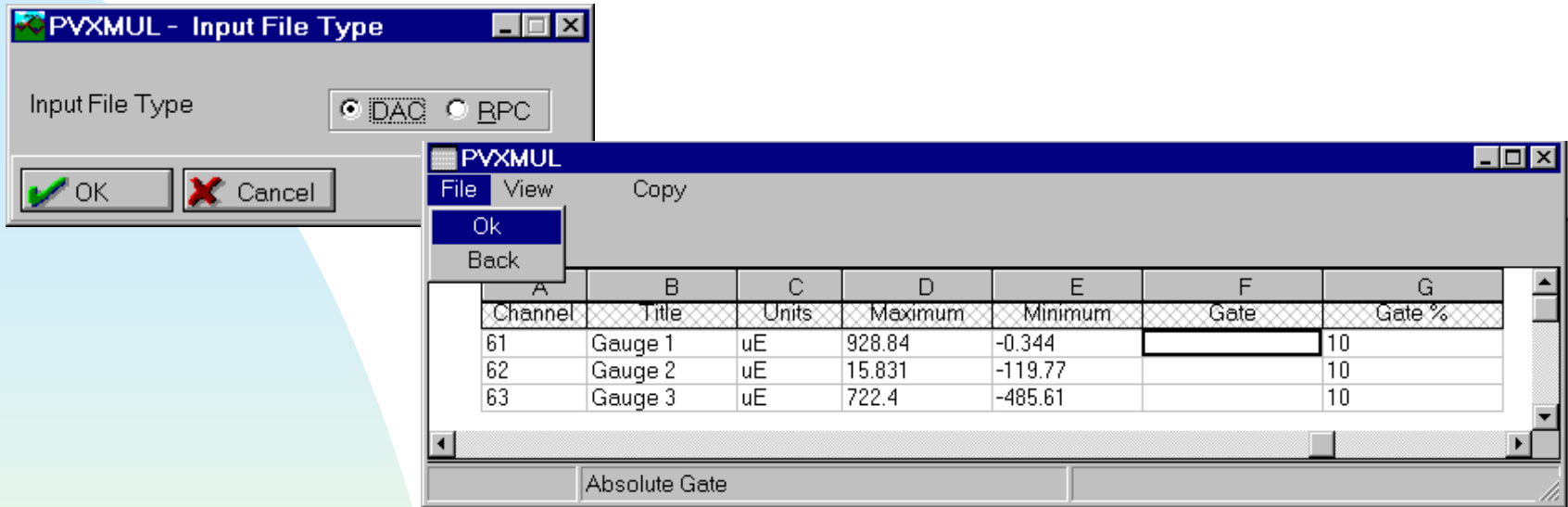
The dialog box also features 'OK', 'Cancel', and 'Help' buttons. A 'Cycle Functions' dropdown menu is open, showing 'Yes', 'Yes', and 'No' options. The 'OK' button is highlighted with a green checkmark.

Below the dialog box, two waveform plots are shown. The top plot is titled 'rear g2(g)' and shows a red waveform with a peak amplitude of 10 and a duration of approximately 40 seconds. The bottom plot is also titled 'rear g2(g)' and shows a red waveform with a peak amplitude of 10 and a duration of approximately 120 seconds. The bottom plot is labeled '3A04.DAC' and 'Screen 1'.

# 联合多通道 - “MFM”



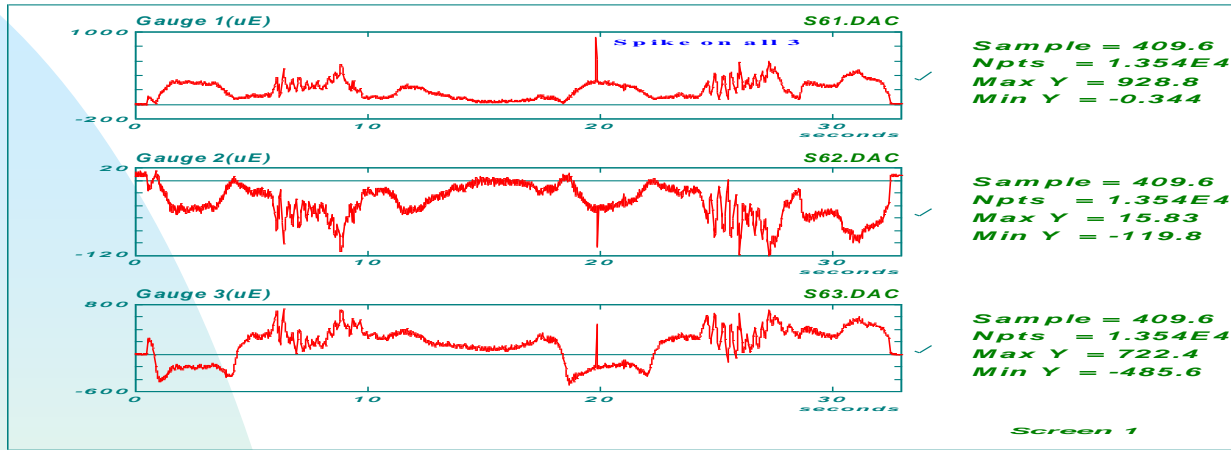
# 多文件峰谷提取 “PVXMUL”



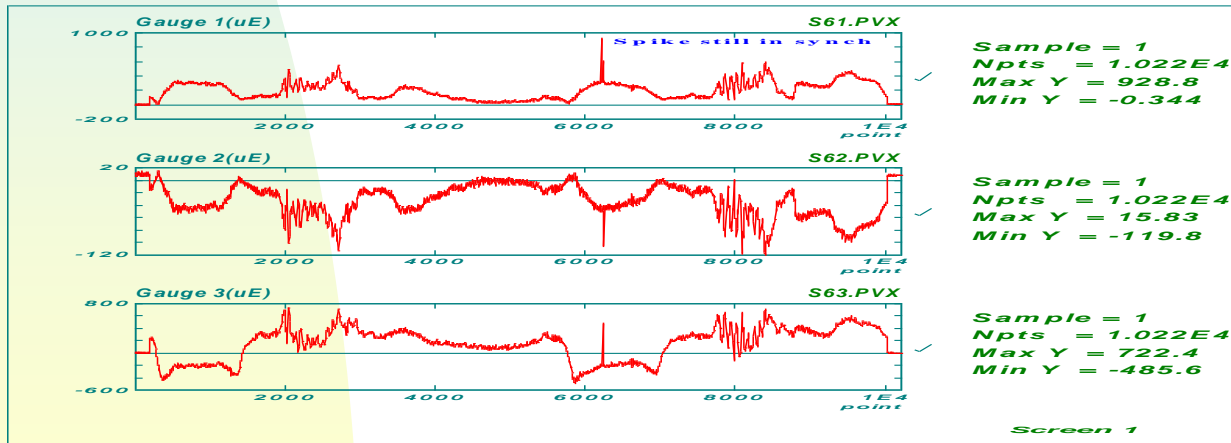
短的时间历程载荷仅仅保留最大和最小点(拐点),通过设置绝对或者百分比的门值来忽略小循环.

通过考虑所有通道的同时性来保证相位.如果在任何输入通道发现拐点,响应点会被写入输出的.pvx 文件.

# 多通道文件峰谷提取 “PVXMUL”



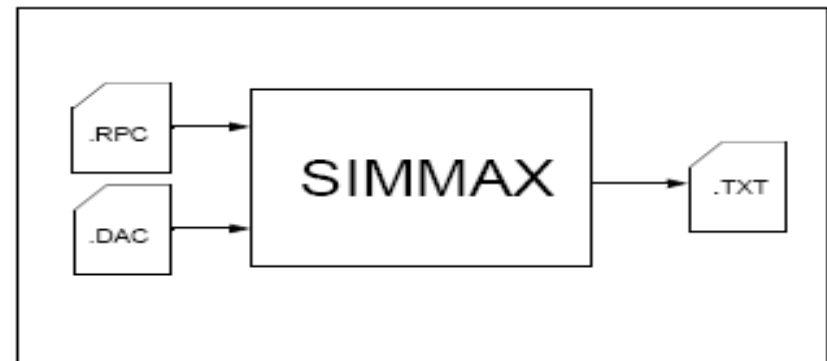
输入 .DAC 文件



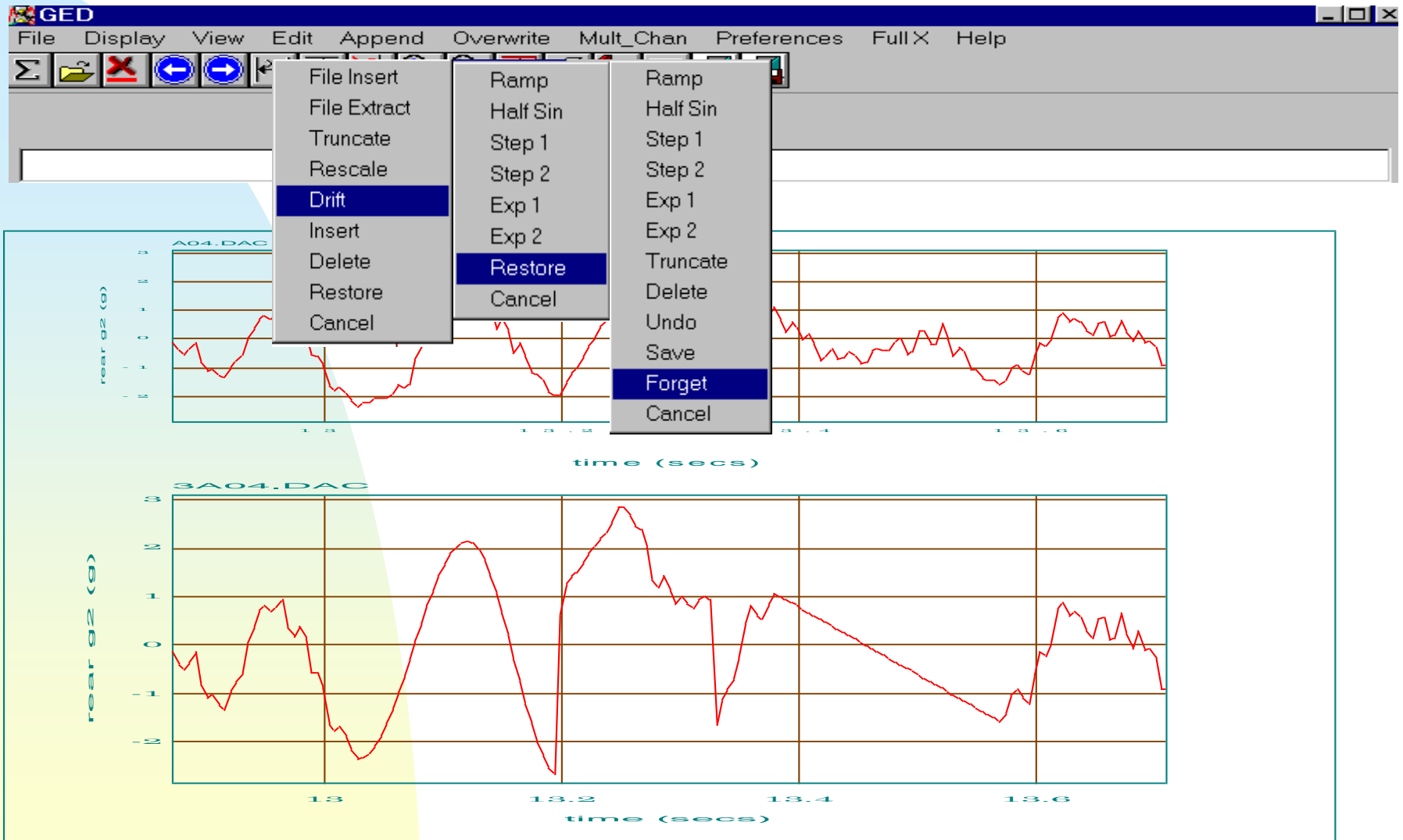
输出 .PVX 文件 – 减少了点数

# 多通道同时性评估分析 (SIMMAX)

- 执行多通道同时性评估分析,来自单个RPC,或者多DAC文件.
- 高峰,通过扫描一个单(控制)通道,或者输入的每个通道,低谷或者最大的绝对值是第一个获得的.所有其它通道的在期望事件位置(时间)的同时性评估都存储到输出文件中.



# 数据的图形编辑 - “GED”



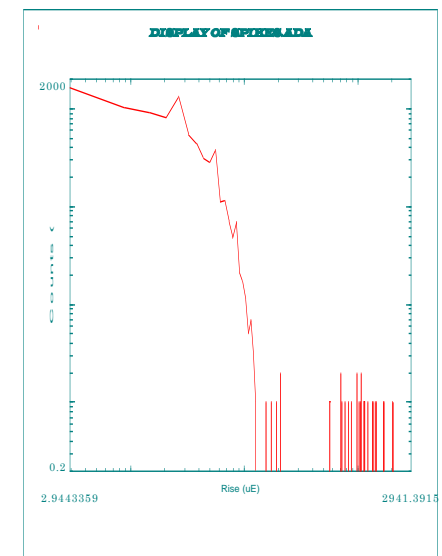
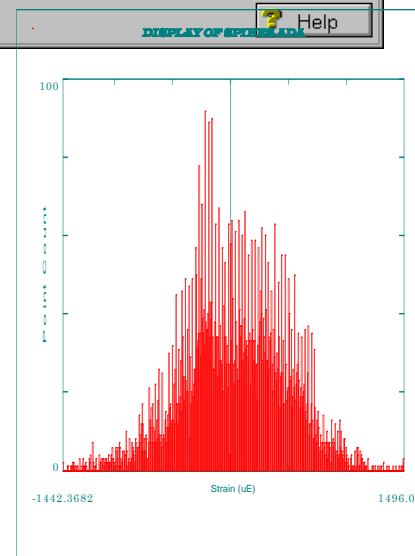
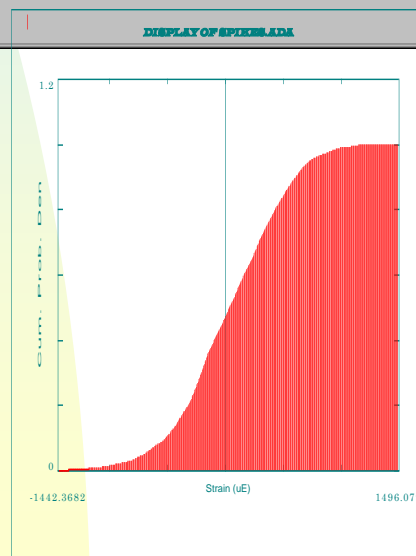
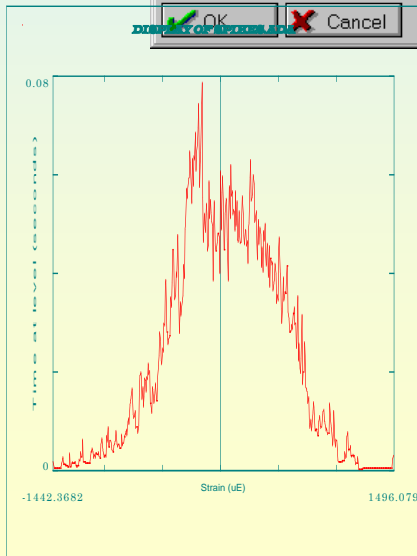
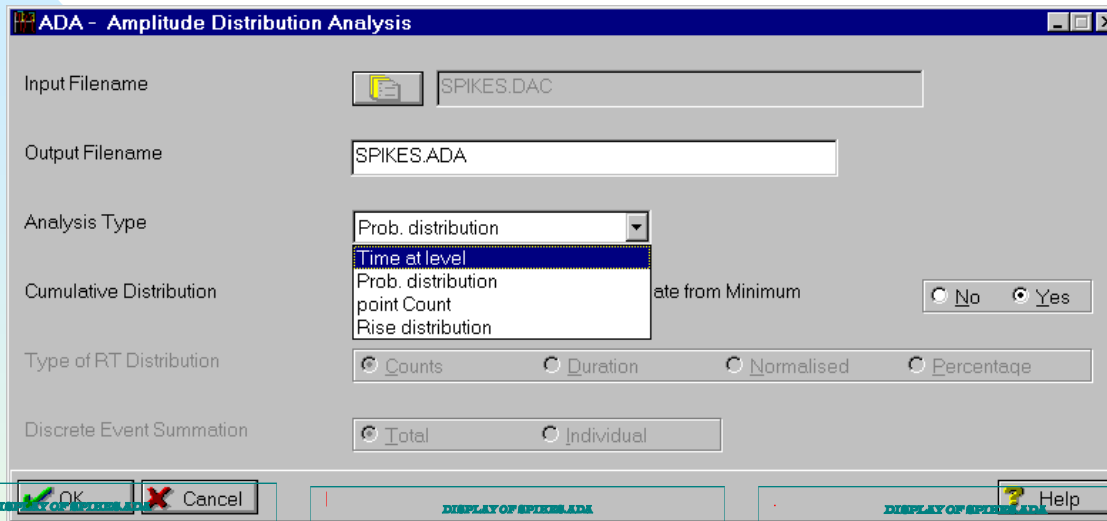
# 时间历程的分析和统计

- 振幅分布分析 (ADA)
- 运行统计分析Running Statistics (RSTATS)



# 振幅分布分析 - “ADA”

某一幅值在时域的概率



# 运行统计分析-“RSTATS”

- 计算用户自定义的数据窗口

The image displays the RSTATS software interface, which is used for running statistics calculation on simulation data. It consists of several windows and a main plot area.

**RSTATS - Running Stats Calculation**

Options:  aCcept,  Iaq/untaq,  taq All,  Untaq all,  eXit

Statistics to calculate:

- \* 1 RMS
- \* 2 Standard Deviation
- \* 3 Mean
- \* 4 Maximum Value
- \* 5 Minimum Value
- \* 6 Absolute Maximum Value (including sign)
- \* 7 Area Under Data

**RSTATS - Running Statistics Setup**

Input Filename: SPIKES.DAC

Output Filename(s): SPIKES

Window Type:  Time,  Pts.

Window Size: 10

Overlap Type:  Time,  Pts.

Overlap: 0

Gating Option: No gate applied

Buttons:  OK,  Cancel

Legend: 1 - Equal to a value, 2 - Not equal to a value.

**Main Plot Area (Screen 1)**

The main plot area displays eight time-series plots for the input file SPIKES.DAC. The x-axis for all plots is labeled 'seconds' and ranges from 0 to 10. The y-axis for the first seven plots ranges from -1500 to 1500. The eighth plot, 'Running Area(uE)', has a y-axis ranging from -52.8 to 59.91. Each plot shows a red line representing the data and a green line representing the running statistic. Checkmarks are visible to the right of each plot, indicating that the calculation was successful.

- Strain(uE)
- Running Max(uE)
- Running Min(uE)
- Running Mean(uE)
- Running Abs Max(uE)
- Running RMS(uE)
- Running SD(uE)
- Running Area(uE)

Screen 1

# 过滤

- Butterworth Filtering (BFL)
- Fast Fourier Filtering (FFF)

# 数据过滤 - “FFF” & “BFL”

## 频域

- Fast Fourier Filter (FFF)
  - ◆ Low Pass
  - ◆ High Pass
  - ◆ Band Pass
  - ◆ Band Reject
- 用 FFT 和 逆-FFT 移除一些频率

## 时域

- Butterworth Filter (BFL)
  - ◆ Low Pass
  - ◆ High Pass
  - ◆ Band Pass
  - ◆ Band Reject
- 模拟硬件过滤
- 向前和向前-向后方法
- 可以达到八次切除 Up to 8th order cut off

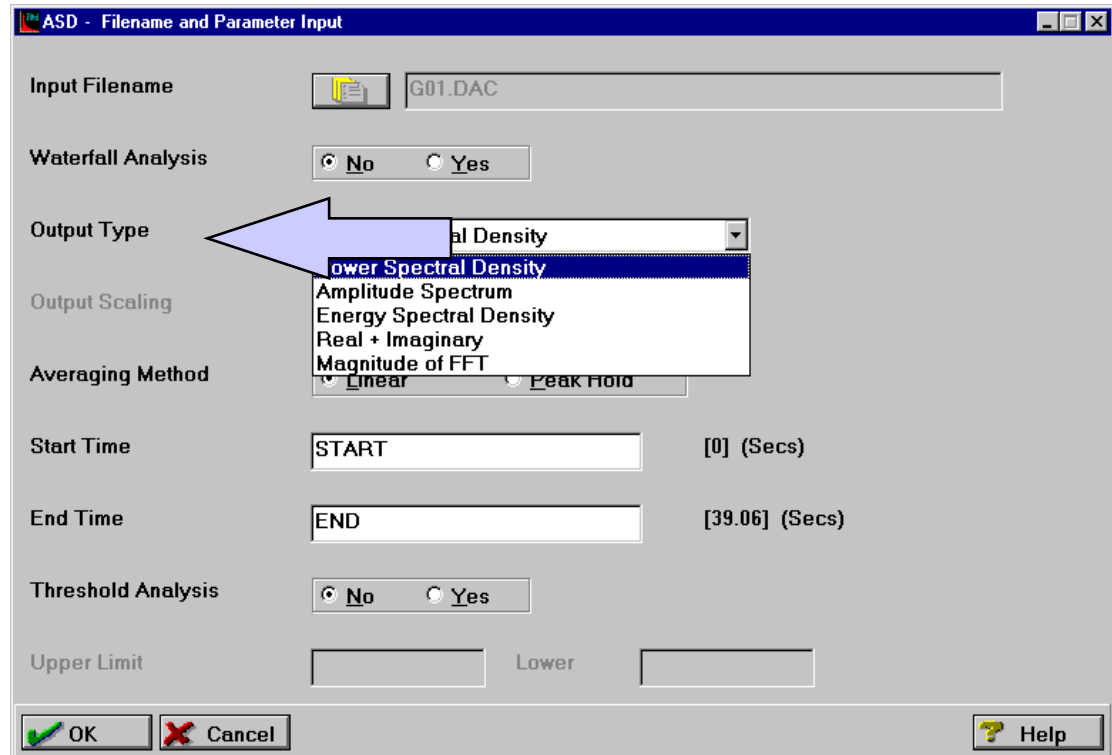
# 频率分析

- 自谱密度Auto Spectral Density (ASD)
- 频率响应分析Frequency Response Analysis (FRA)

# 自谱分析 - “ASD”

- Calculating frequency content of data using FFT

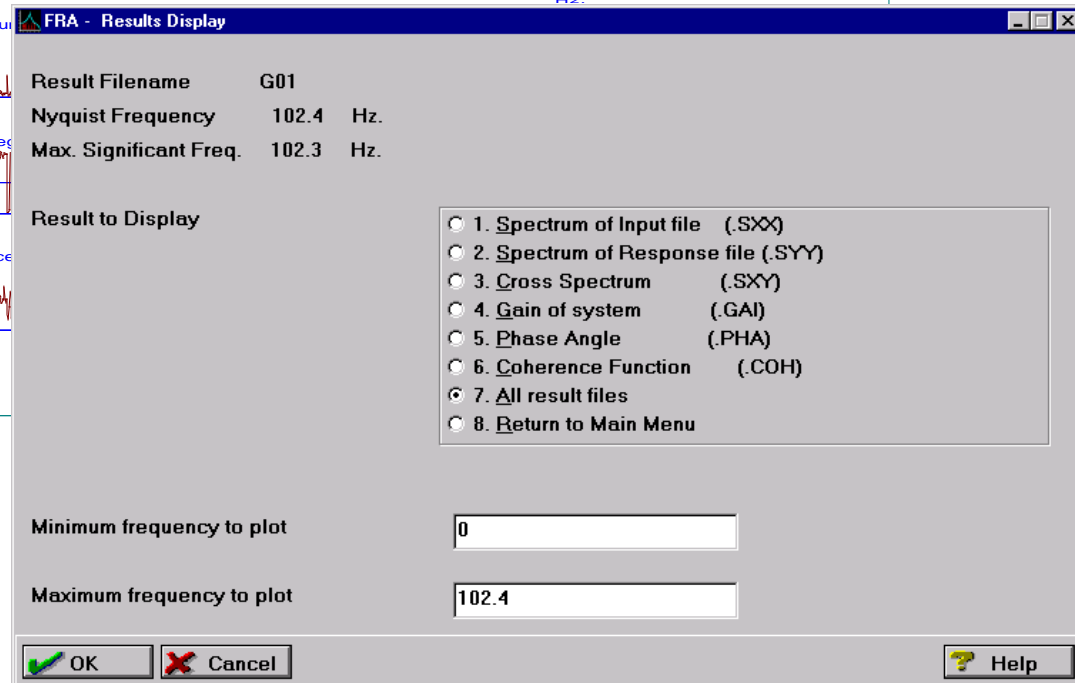
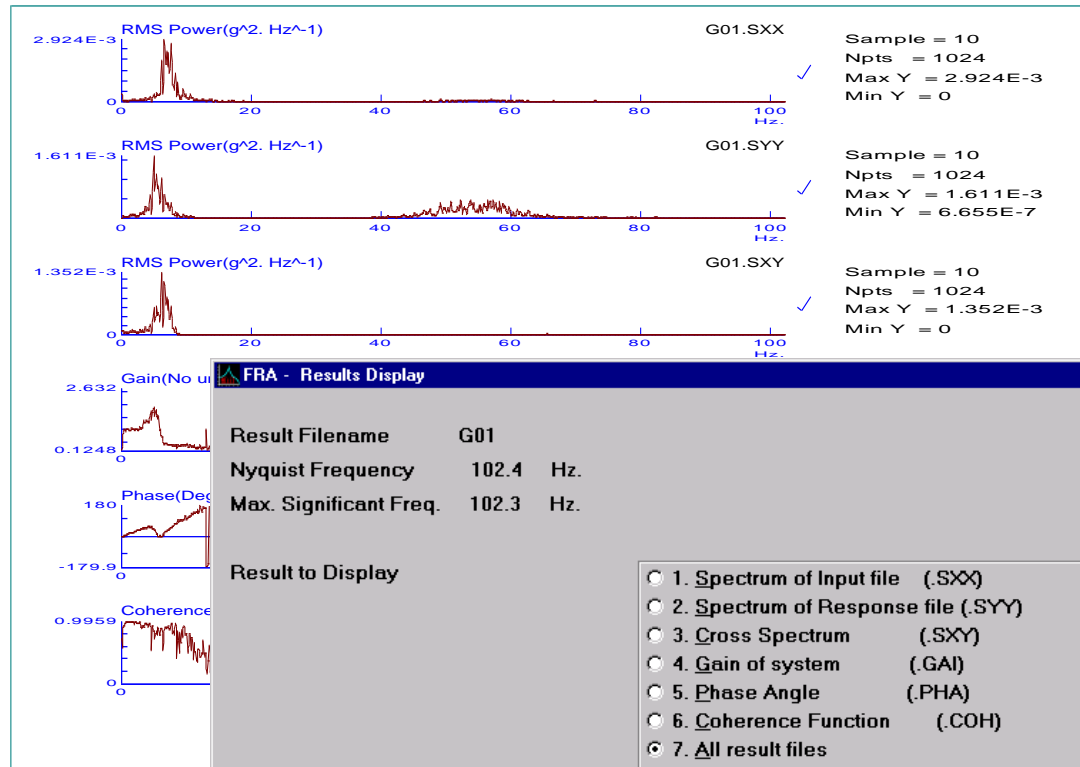
- *PSD*
  - ◆ Area under PSD = Mean square amplitude
- *ASD*
  - ◆ Area under ASD = amplitude
- *ESD*
  - ◆  $ESD = PSD \times Time$
- *Real & Imaginary*
- *Magnitude & Phase of FFT*



# 频率响应分析 - “FRA”

单输入单输出系统的传递函数

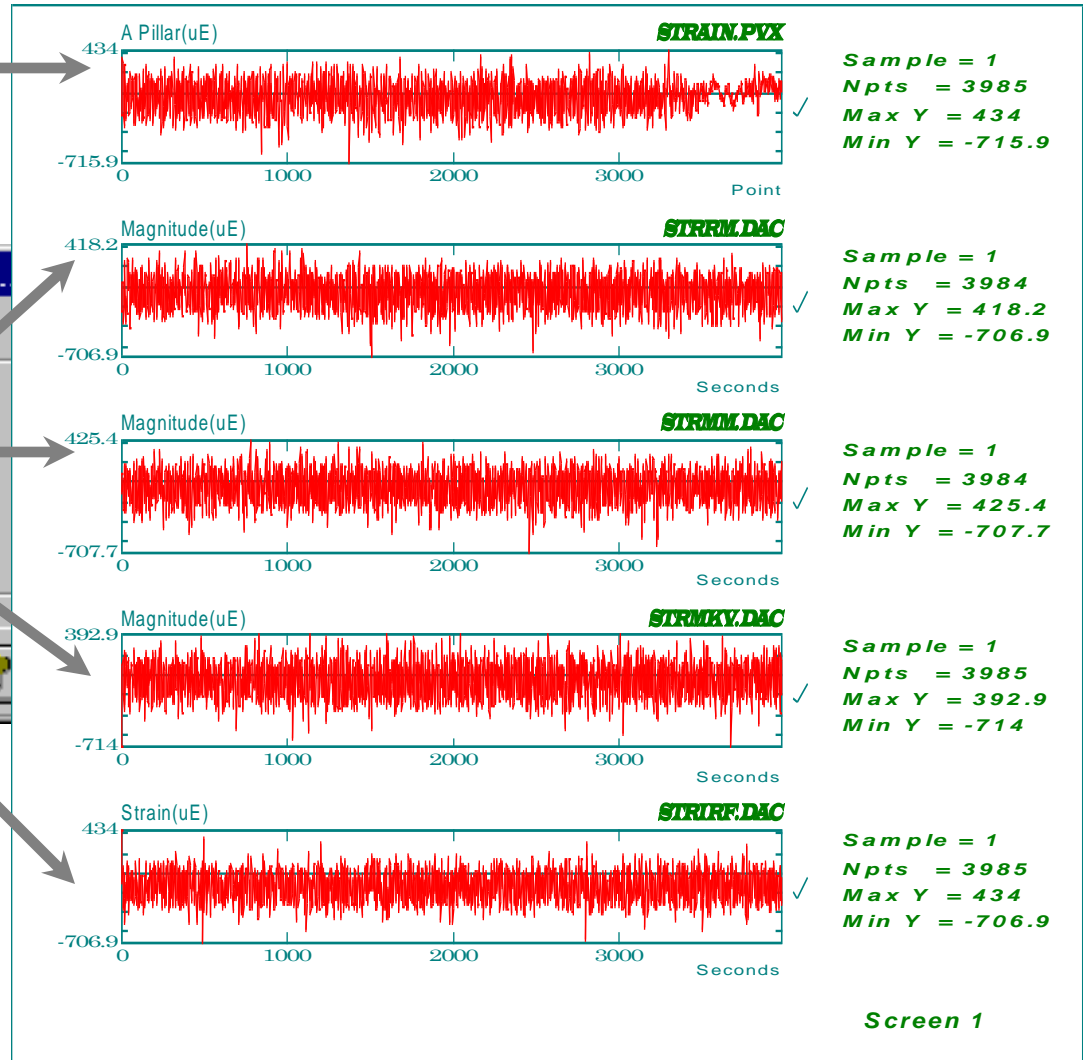
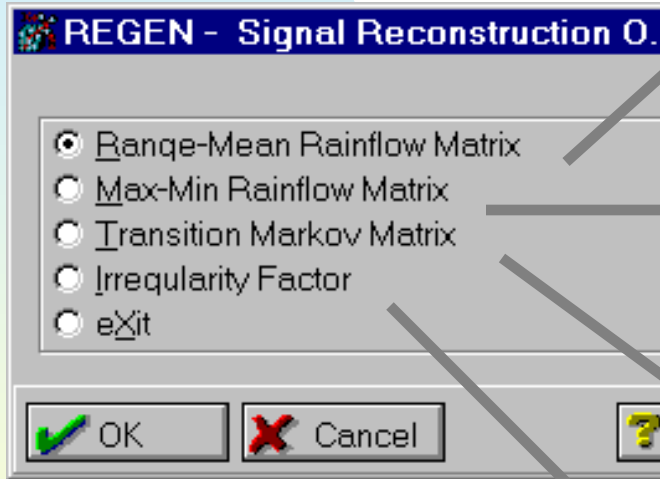
- PSD的输入输出
- 输入输出的互功率谱
- 得到,相位&一致性关系



# 峰谷再生 - “REGEN”

- 从循环矩阵得到时间历程

用于对比的原始峰谷





# 疲劳分析工具 (local or test based)

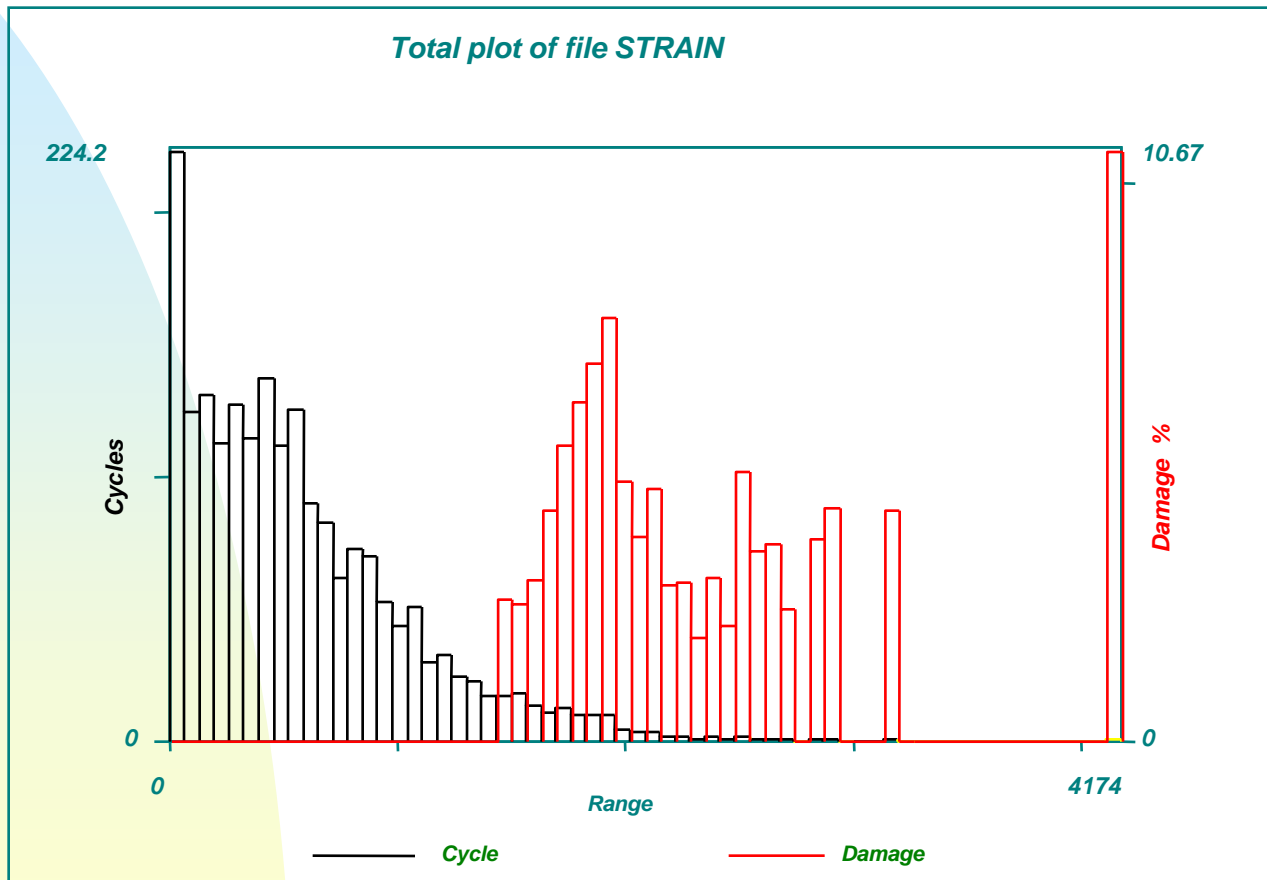
- Stress-Life Analysis (SLF)
- Strain-Life Crack Initiation (CLF)
- Multiaxial Strain-Life (MLF)
- Frequency Domain Fatigue (FLF)
- Crack Growth LEFM (FCG)

# 其它疲劳分析相关工具

- Cycles Damage Analysis (CDA)
- Time Correlated Damage (TCD)
- Stress Concentration Library (KTAN)
- Cycles / Matrix Listing (CYL)
- Rosette Analysis (SSA)

# 循环和损伤分析 - “CDA”

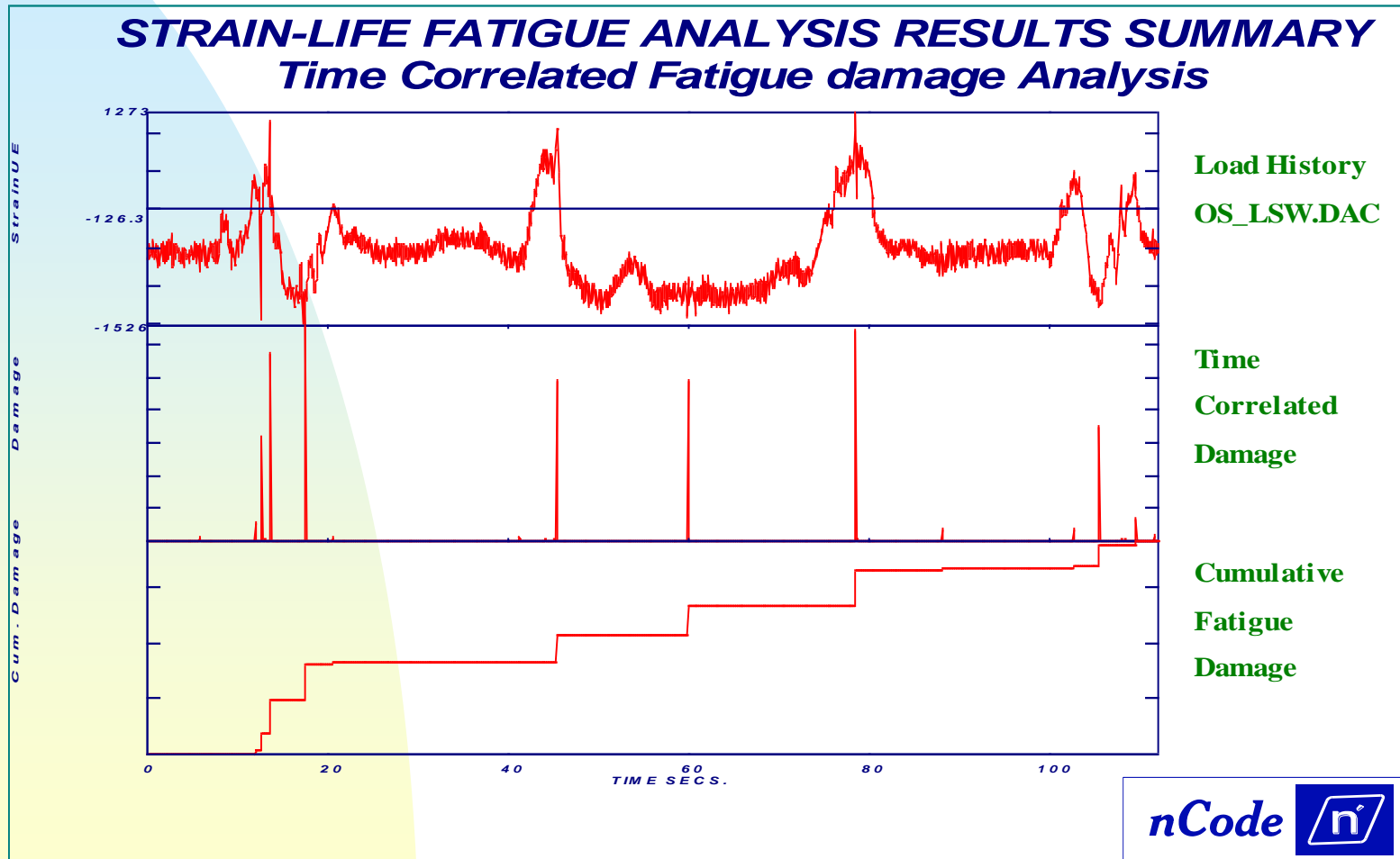
- comparing 2D plots of 3D histogram data



Compares number of cycles with the damage contribution of that stress or strain range

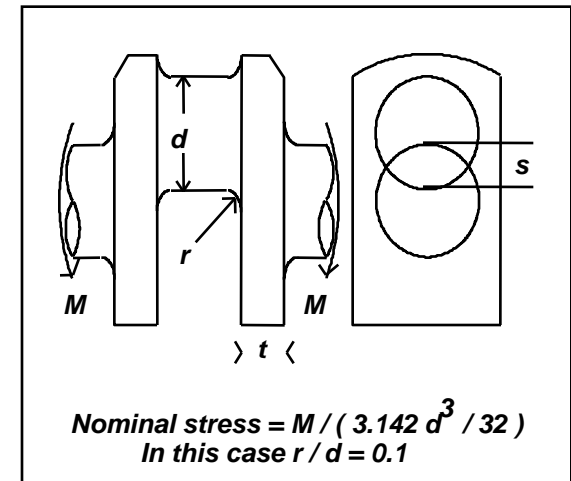
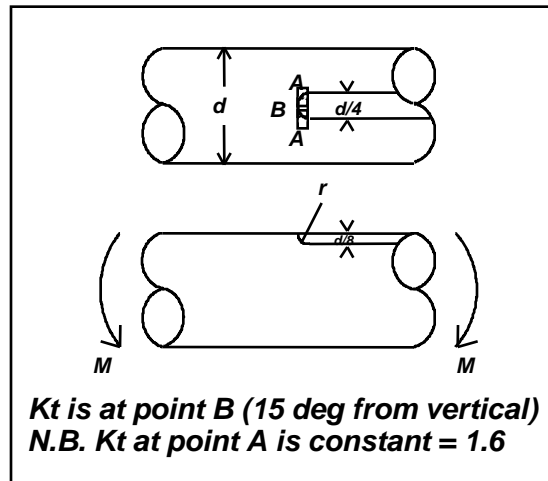
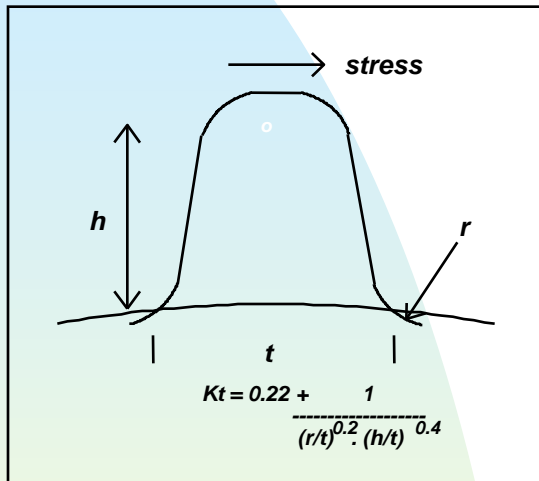
# 时间相关的损伤-“TCD”

- 缺点损伤数据的损伤部分



# 应力集中库 “KTAN”

- 计算标准形状的  $K_t$

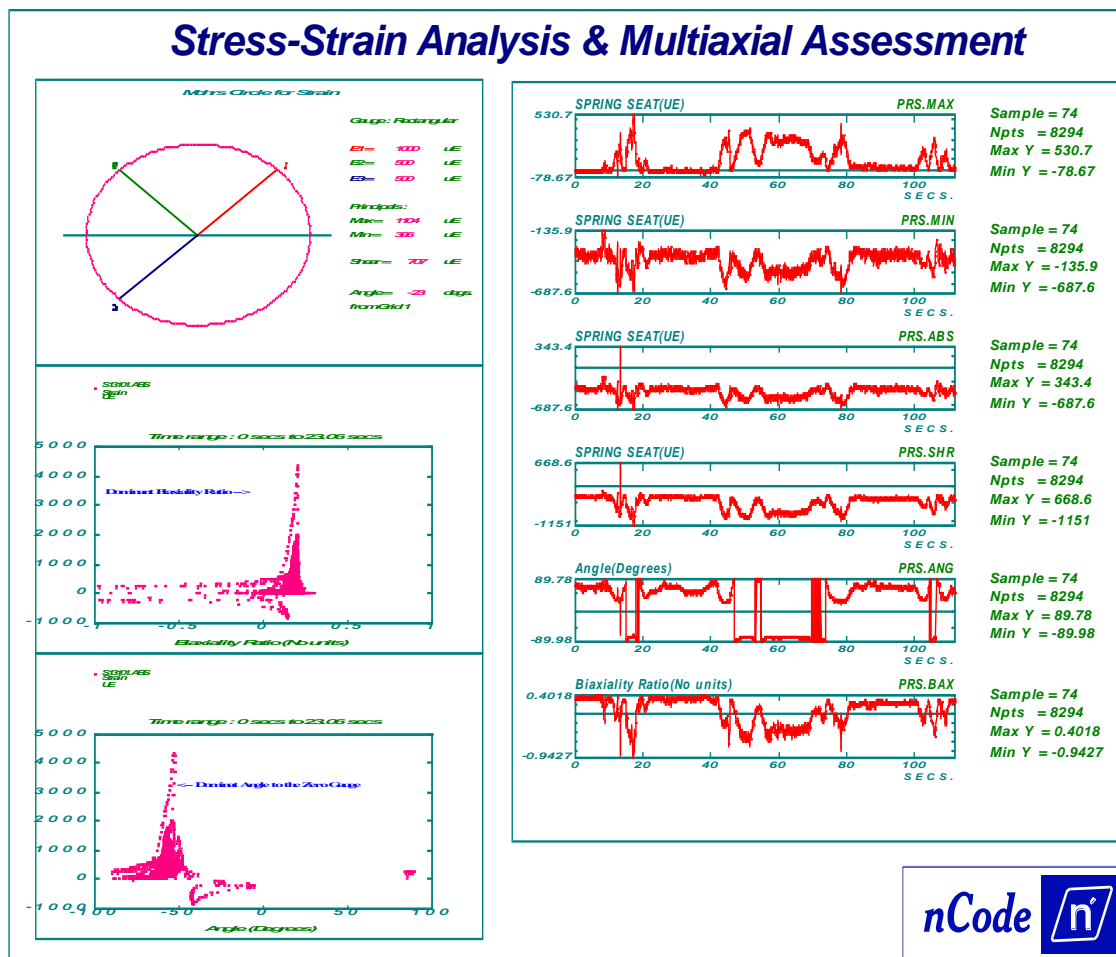


从几何图形库选择和应力集中

# 应变花分析 - “SSA”

- 分析应变花数据的应力状态

- Mohr圆
- 从应变花计算应力分量
- 双轴比对主轴图
- 角度对主轴图
- 弹-塑性转换



# 数据转换和其它工具

## ■ 数据转换

- ◆ 二进制到ASCII (DTA)
- ◆ MTS RPCTM File translators (DACREM/REMDAC)
- ◆ 循环矩阵到时间历程 Cycles Matrix to Time History (REGEN)

## ■ 其它功能

- ◆ Convert data across platforms (CONFIL)
- ◆ View / Edit Data Header (FILMNP)
- ◆ Plotting setup on UNIX (PLTSYS)
- ◆ Viewing Plots on UNIX (QPLOT)
- ◆ Windows Plot Manager on NT (WNPLOT)

# 练习

- 快速开始手册第17章练习,疲劳实用工具