

# Database Integration of Vibration and Ultrasound

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Adash 3TP Limited, Manchester





# Adash Background

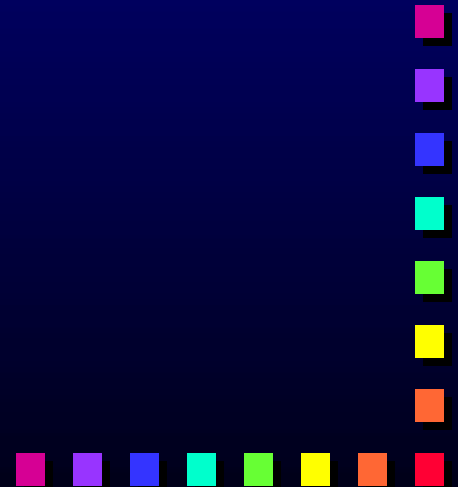
- Manufacture data collectors and on-line monitors
- Write software, DDS2000, for use with that equipment
- Understand the “fear of computers”





# Adash Background

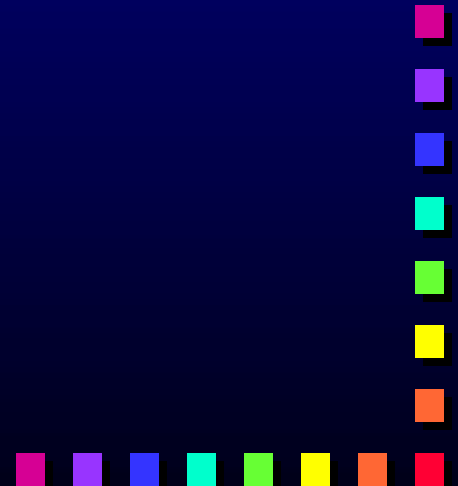
- Founded in 1990
- Factory and technical centre in Ostrava in Czech Republic
- EU/English-speaking office in Manchester





# Adash Background

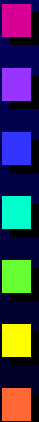
- TJM background
  - Degree in Acoustics
  - Chartered Engineer (Eur Ing)
  - 23 years in application of noise and vibration technology
  - MD of own business since 1993





# Adash Products

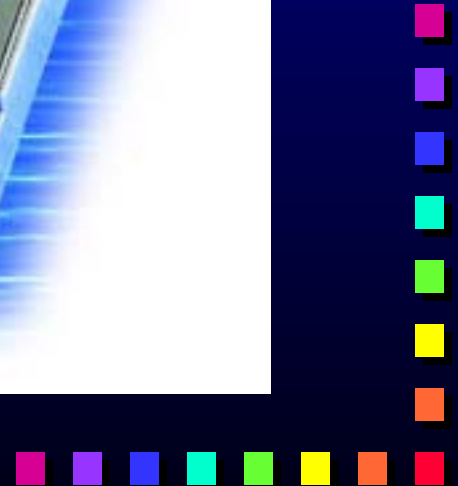
Portable  
Data  
Collectors





# Adash Products

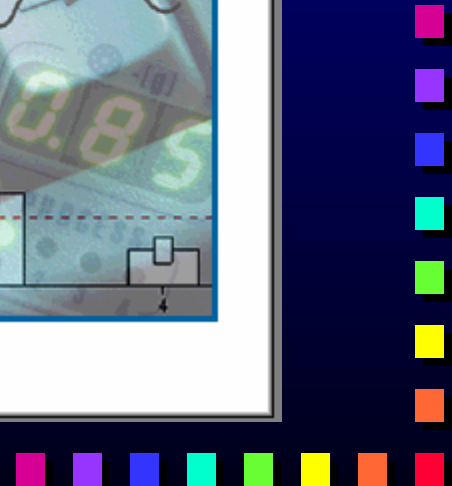
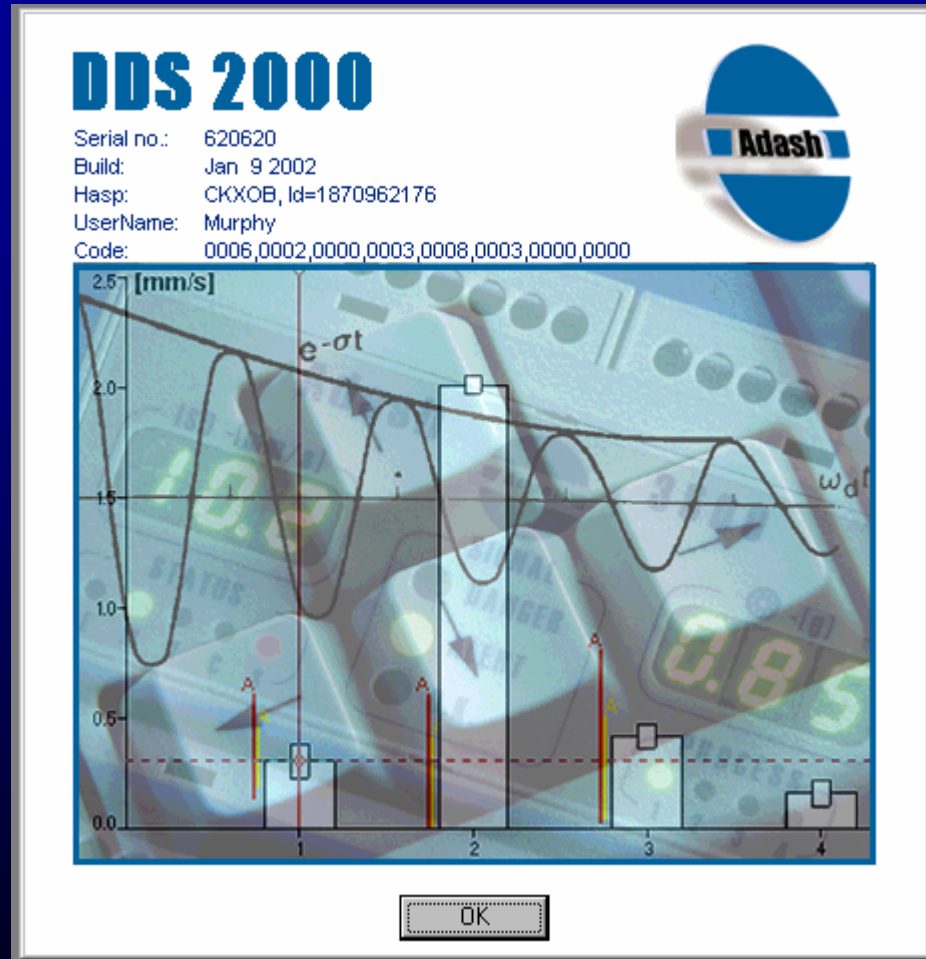
On-line  
Continuous  
Monitors





# Adash Products

## DDS2000 Software





# Practical limitations

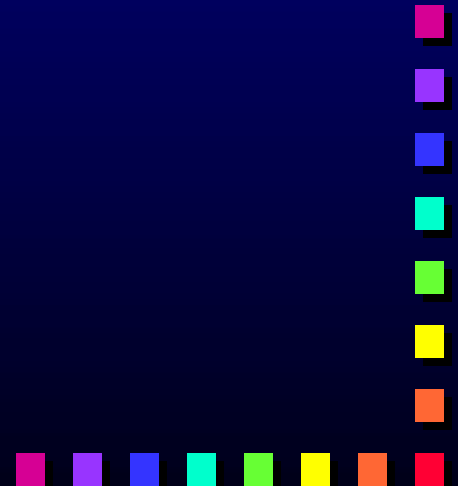
- Applications without diagnosis:
  - Conveyors
  - Ovens
  - Dryers
  - Washers





# Using Ultrasound

- Quick – much quicker than vibration
- Lower volume of data – just a trend
- Great for lubrication condition
- Great for impulsive phenomena



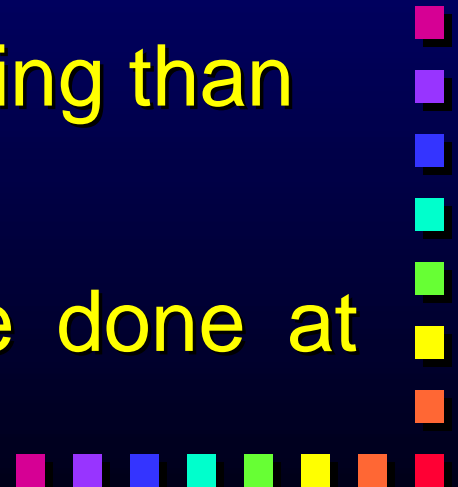


# What business are we in?

## Condition monitoring

A cynical definition of planned maintenance:

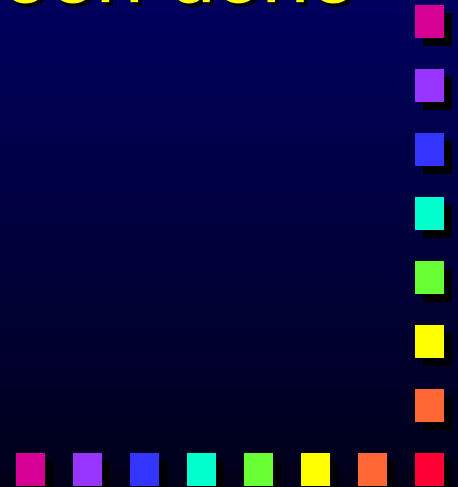
There is nothing more depressing than being highly efficient at doing something which need not be done at all.





# Why do we need software?

- For trending
- For comparison with alarms
- For reporting/ communicating
- For checking that the job has been done





# Profile of software users

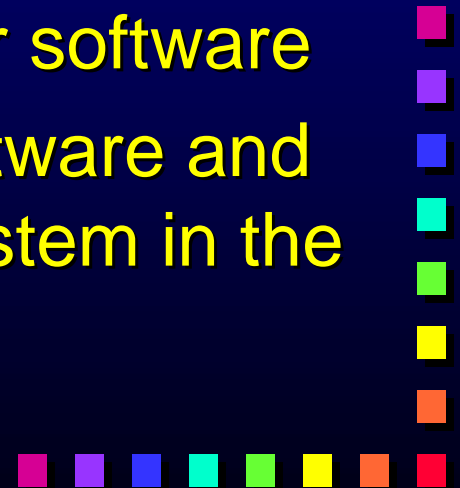
- Class A user
  - Not computer literate
  - Sees software and PCs as a necessary evil
  - The IT department gives them the oldest, dirtiest, slowest PC they have
  - No network
  - Nobody else to report to
  - Why should I pay for software?





# Profile of software users

- Class B user
  - Uses computers
  - Wants to trend information
  - Needs to report to other people
  - Looking for integration with other software
  - Sees the value in having the software and will want to extend the use of system in the future
  - Limited software budget





# Profile of software users

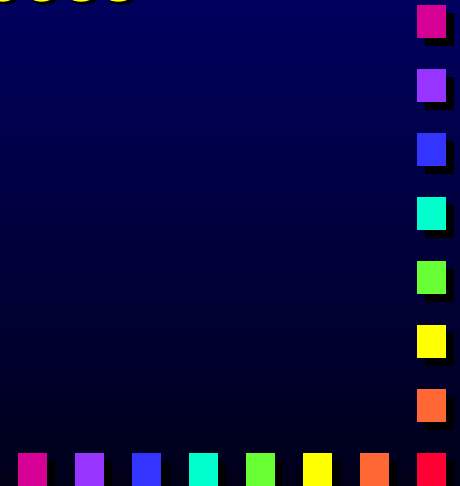
- Class C user
  - Power users computers
  - Network operation is key
  - Multiple users of the equipment and information
  - Possibly also multiple sites
  - May be looking to combine US with vibration, thermography, oil analysis, etc.
  - Software budget is accessible





# Extending the life of software

- The investment in putting information into a database is enormous.
- Predictive maintenance and CMMS databases are frequently a company's most expensive behind their process control systems.





# Extending the life of software

- Operating systems change
- Users change
- Software must be able to grow to meet the changing needs of the customer WITHOUT having to be totally stripped out and replaced.

DDS2000

works with all current operating systems

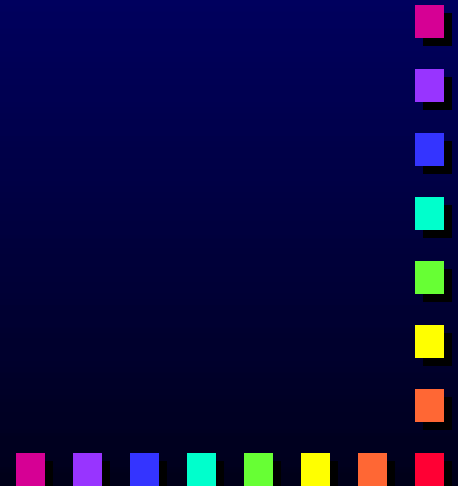




# Working with trees

- A database can just be a single vertical column of information, or,
- A database can use a tree structure

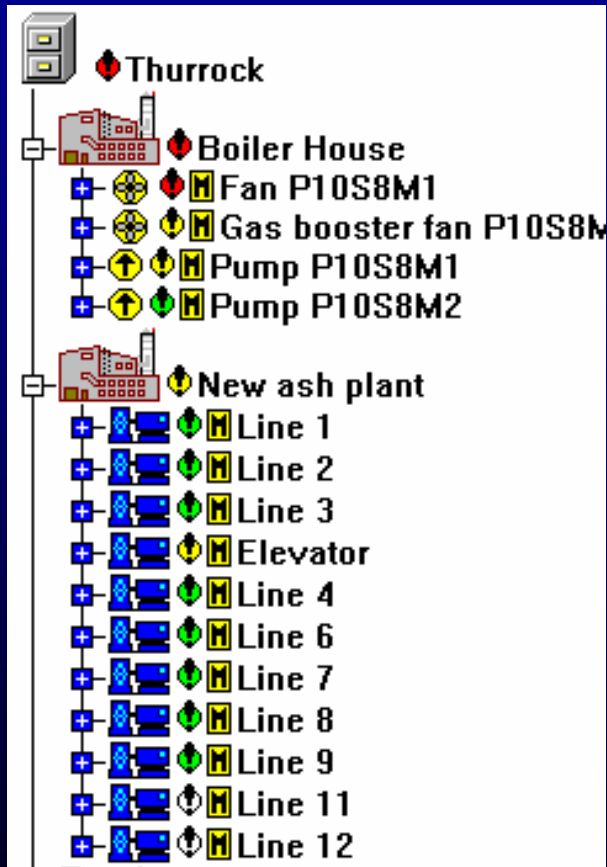
DDS2000  
uses a tree structure



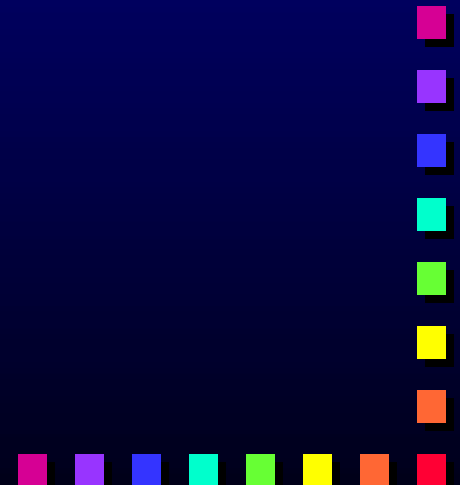




# Trees

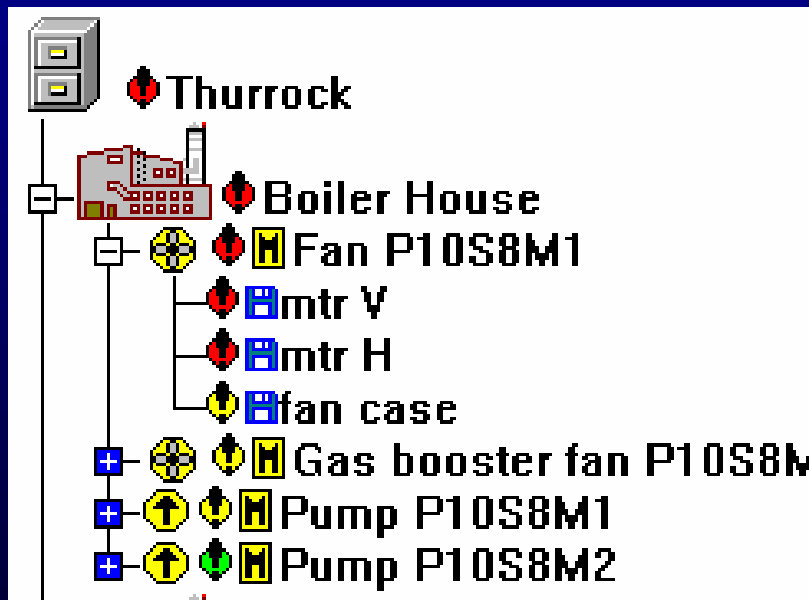


- A group can represent another series of machines

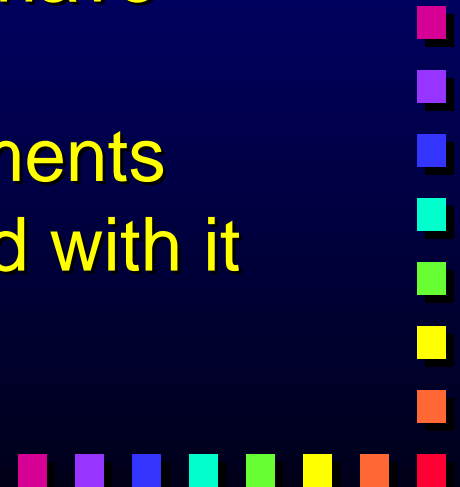




# Trees



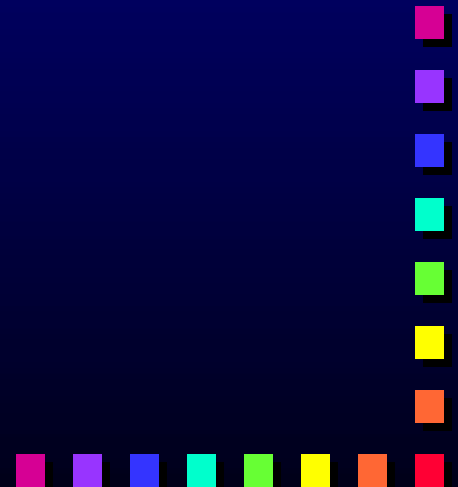
- Each machine can contain a number of measurement points
- Each measurement point can have several measurements associated with it





# Data collection

- Collecting data is NOT a pleasure
- Success lies in making data collection easy:
  - Quick
  - Easy-to-use equipment
  - Easy to load, easy to unload
  - Easy to deal with the data
  - Reliable and repeatable results





# Data collection in DDS

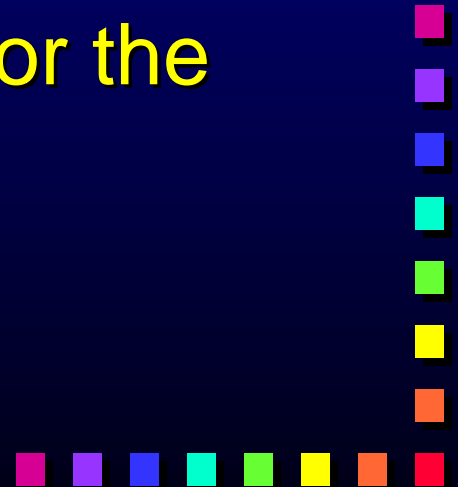
- There are no fixed routes in DDS
- Routes are created by the customer from the tree by drag and drop
- Data collection can therefore be anything from a specific machine to an area of the factory





# The SDT170 interface

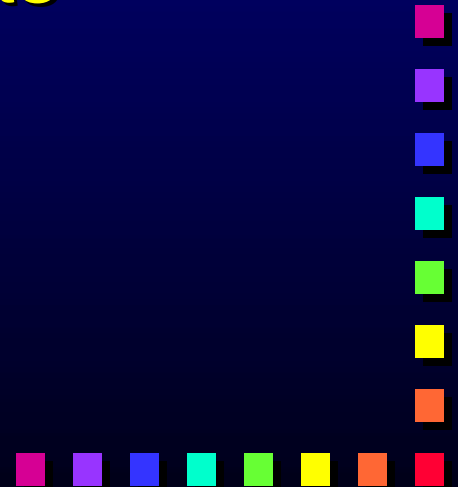
- DDS is a tree-based database, Datamanager is a list.
- Drag and drop to create a route
- DDS automatically converts the tree to a list and generates a text file for the user to follow.





# What to do with the data

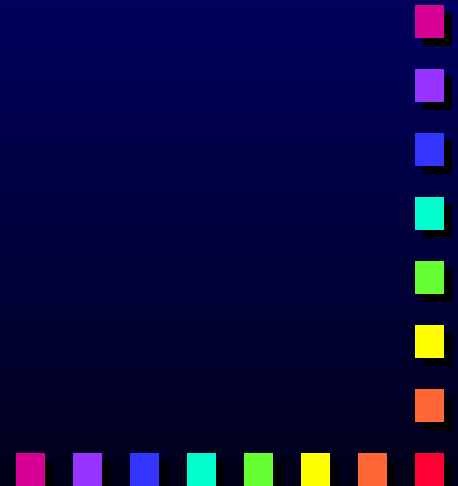
- Look at it
- Trend it
- Set alarms
- Communicate to others - reports





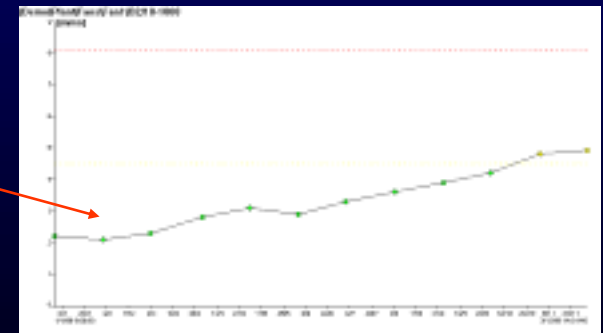
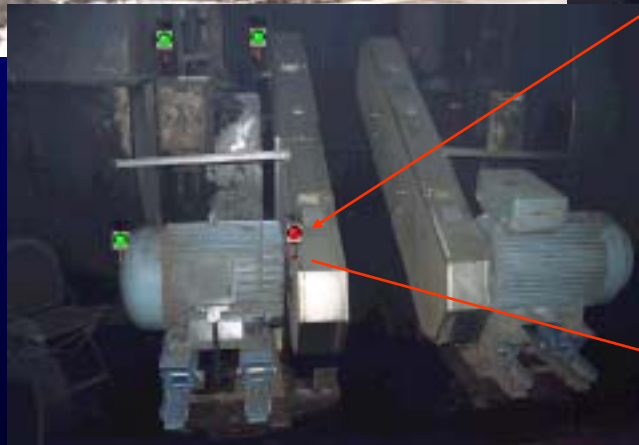
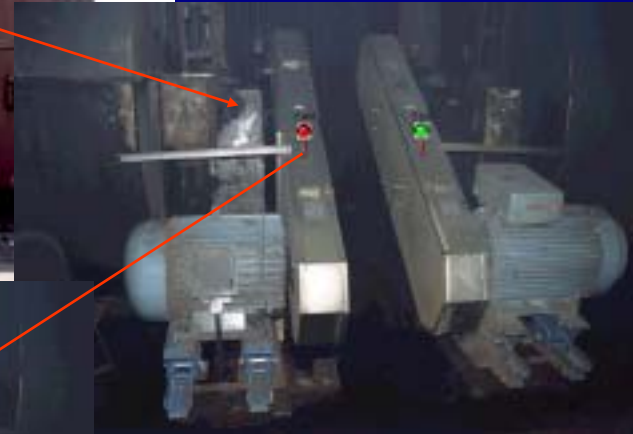
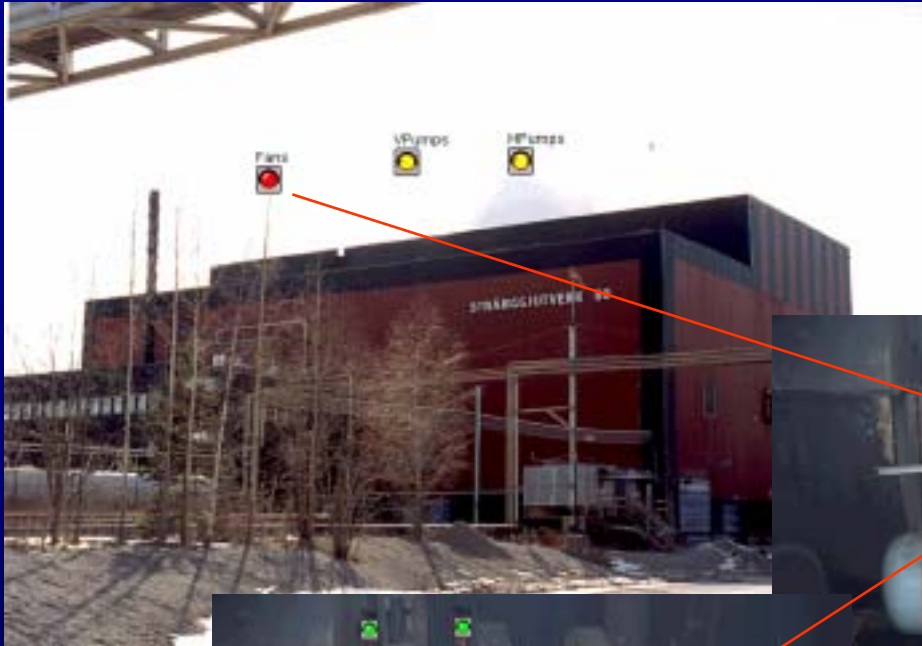
# Look at the data

- Use the tree
- Use a graphical interface





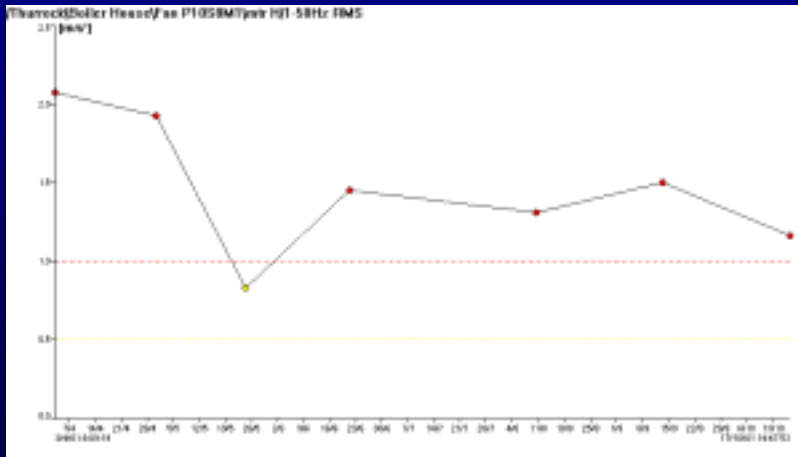
# Technology and Training for Total Productivity





# Looking at trends

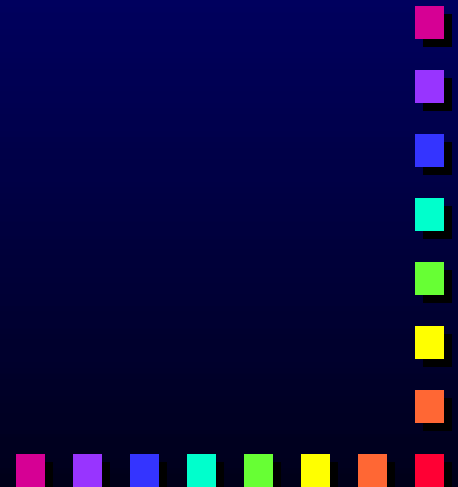
- Each measurement has alarms
- Alarms can be absolute or relative
- BEWARE dB's





# Multiple trends

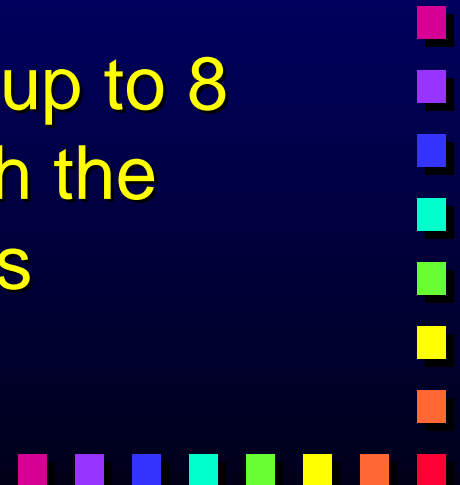
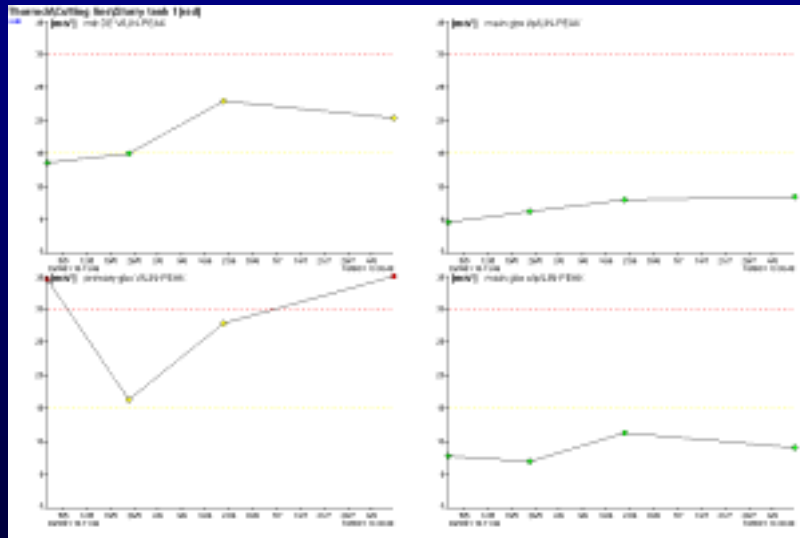
- Comparing data is the most powerful diagnostic tool we ever use
  - Historical comparison
    - trends
  - Reference comparison
    - alarms
  - Peer comparison
    - multiple trends





# Peer comparison

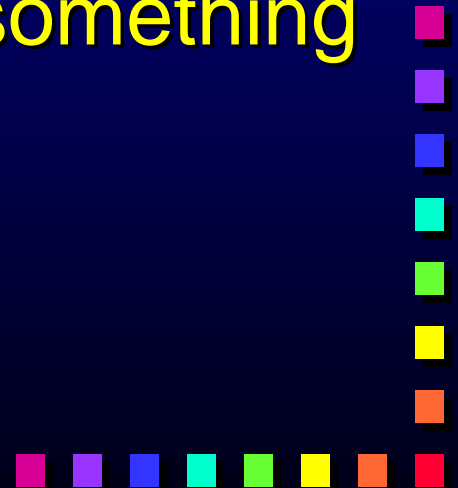
- Compare data from multiple sources
- Compare the same point on different machines
- Compare up to 8 trends with the same axes





# Communication

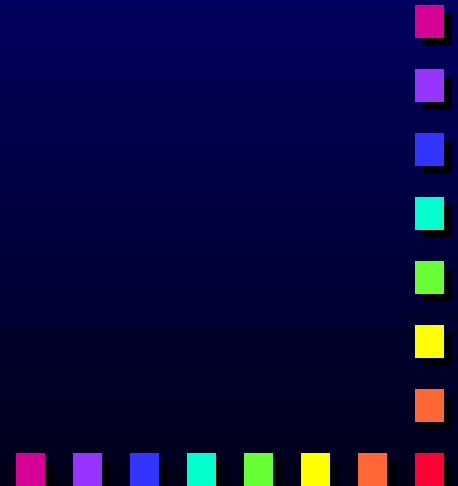
The success of condition monitoring lies in getting the message of imminent failure across to those people who need to know in a way in which they are likely to believe it and then do something about it.





# Interfacing with the world

- Emphasis on using what the customer already has on his PC:
  - MS Office
    - Word
    - Excel
  - Sound cards
  - Email





# Creating reports

- All graphs created in DDS can be copied to the clipboard and then pasted into any other program
- Data can also be accessed and exported in such a way that it can be read into Excel





# Creating reports

- DDS2000 also contains a simple template for rapid reporting of a problem
- Because the interface is always through Windows, the user can communicate the information through their own chosen method





# Using sound

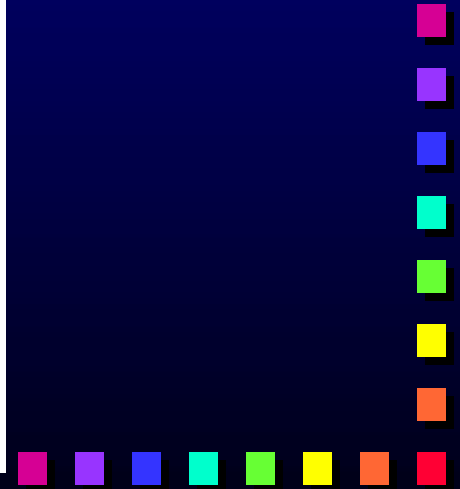
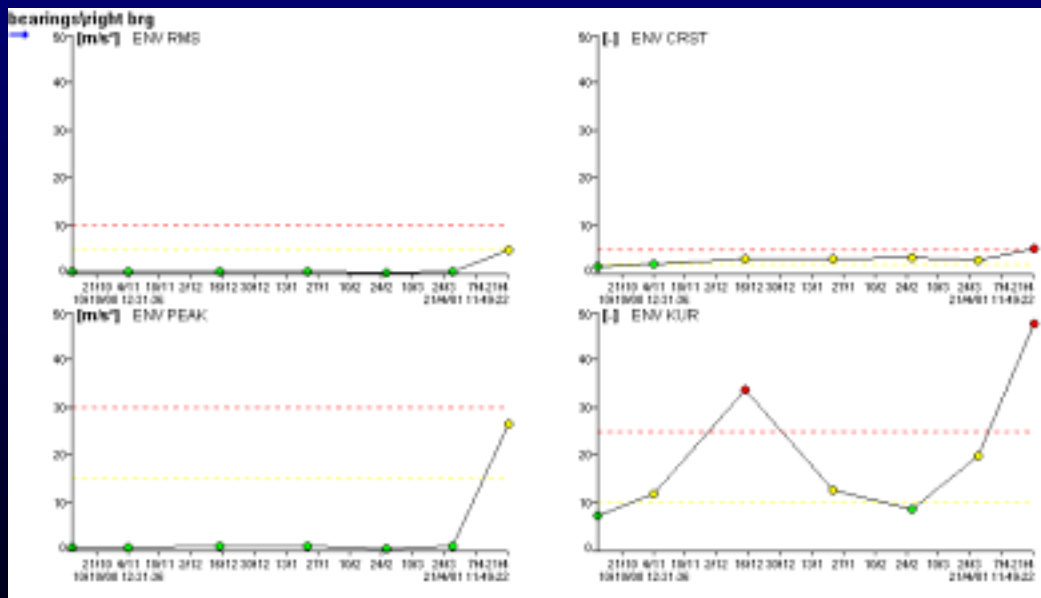
- There is no escaping the fact that most of the diagnostics we do with the 170 we do by ear
- Allan Reinstra refers to the use of recording signals and comparing them for several applications in his web training





# Using sound

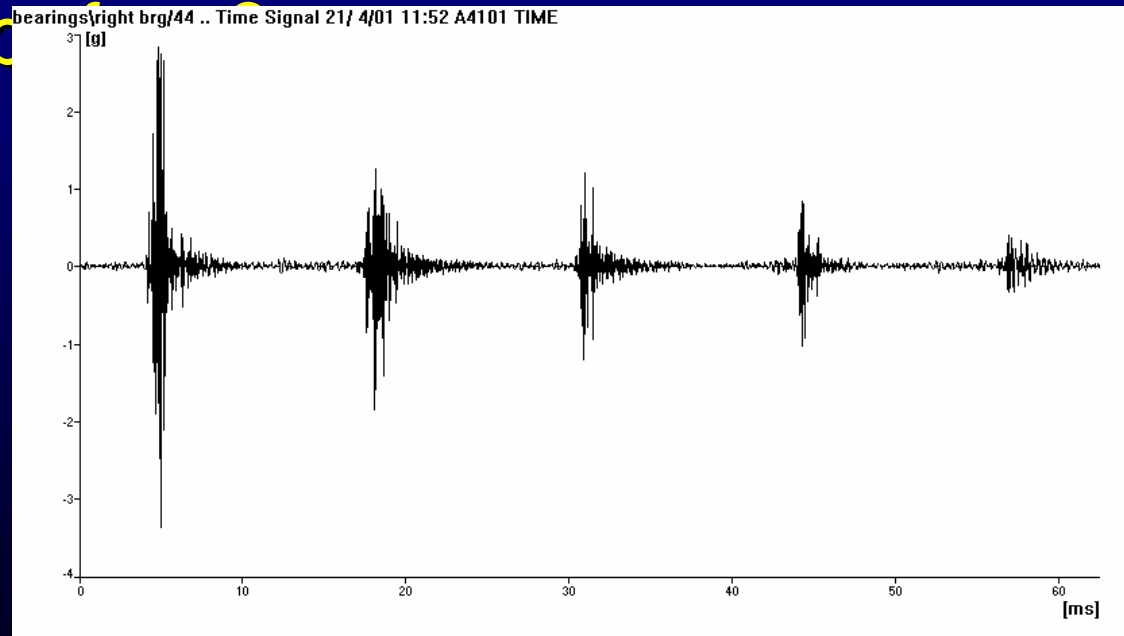
If you are going to convince someone to stop a production process you need a strong argument. Is this strong?





# Using sound

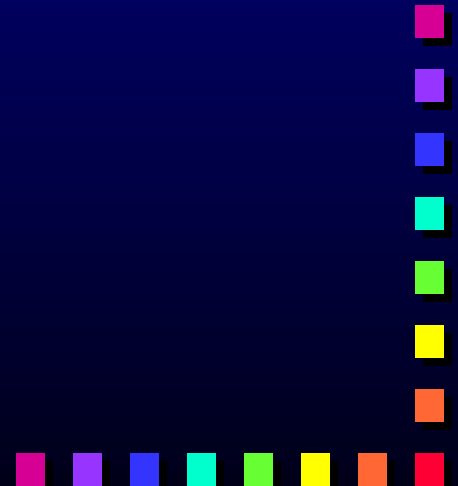
Is this stronger – even if I tell you that this is FOUR times higher than anything we've had before





# Using sound

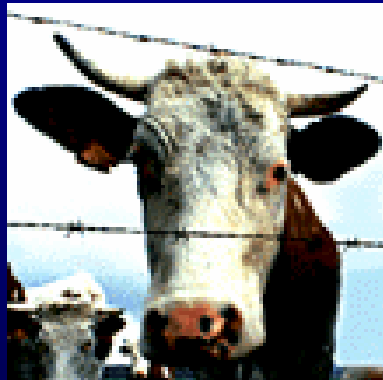
Or does this help to finally get the message across?





# Using sound

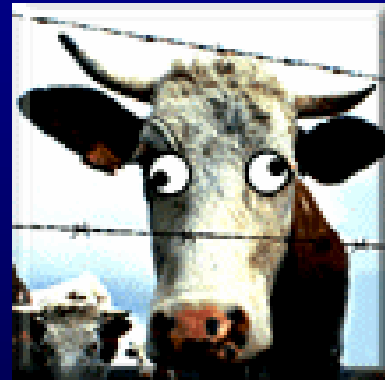
How to identify if your cow has mad cows disease..



If your cow sound like this



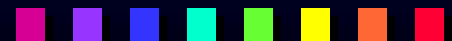
then fire up the barbecue.



If your cow sounds like this



may we suggest the fish.





# Using sound

A new feature within DDS means that you can store a time trace inside DDS and play it as a wave file.

You can also then save that wave file separately and send it to someone.





# Communication

- Think of using sound the other way:
  - Customer records a suspicious noise and can then email that wave file to his SDT distributor for assistance or advice.
  - Build up a library of SDT170 sounds





# DDS2000

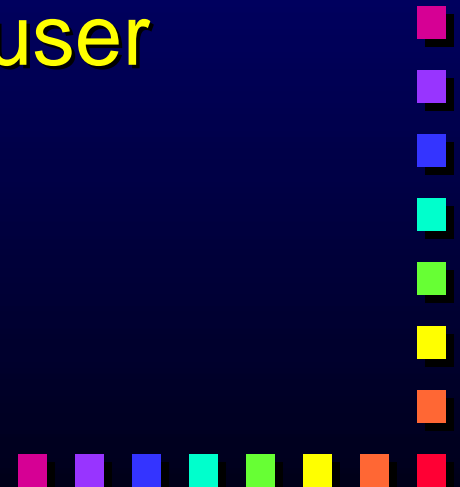
- Works with anything above Windows 98
- Can run as single-user or on a network
- Each copy is hardlock key protected
  - You can install the software on any PC but it will only work on the one with the key
  - Prevents illegal copying
  - Increases software revenue





# DDS2000

- Available on the network in a combination of read-only and read-write.
- All expansions continue to use the same database and the same user interface.





# Integrating Ultrasound with Vibration methods

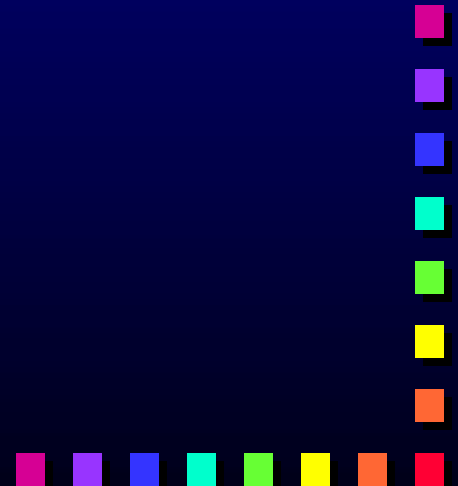
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Adash 3TP Limited, Manchester





# Background

- Big interest in integrating ultrasound (U/s) with vibration to cover areas such as bearing condition, corona characterisation and steam trap testing.





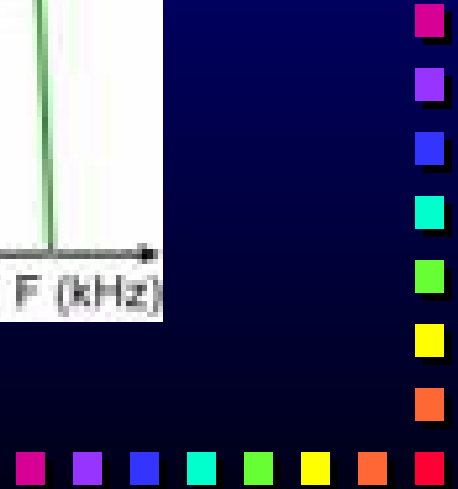
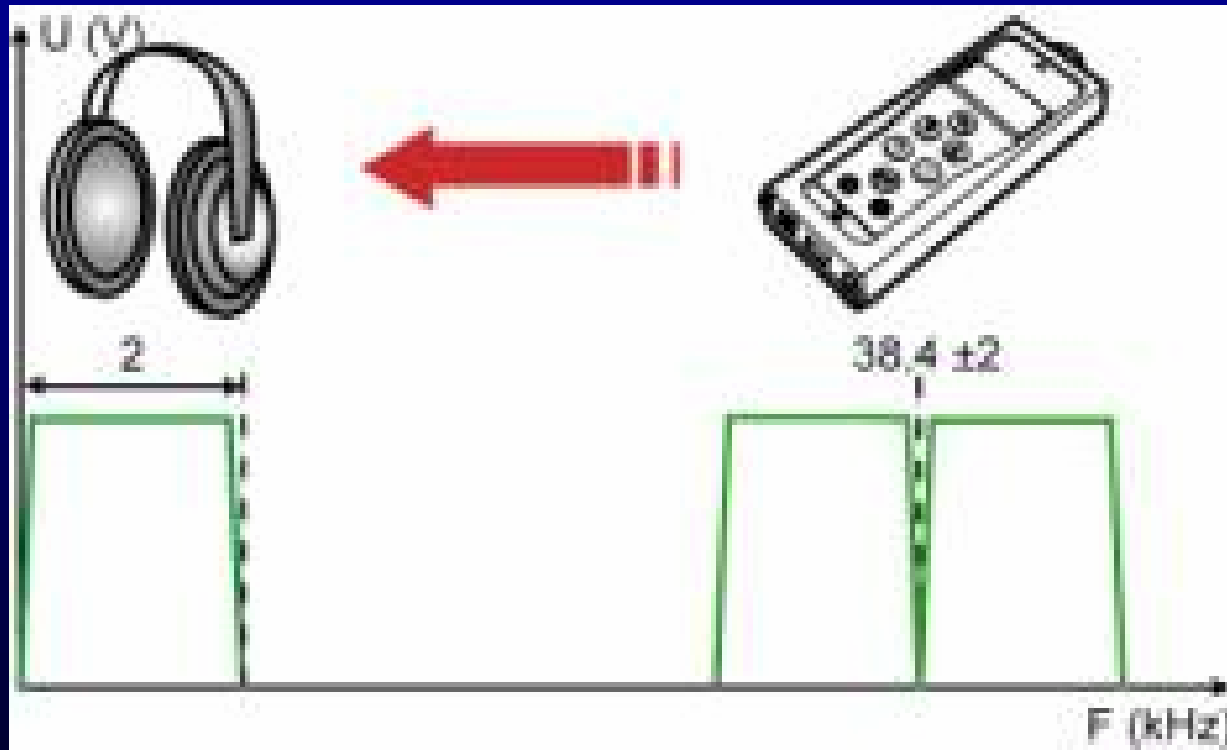
# Objectives

Ultrasound works over a much higher frequency range than vibration.

- Can U/s be used as a diagnostic tool?
- Can U/s be used as an “intelligent sensor”?
- Can existing vibration analysis methods (time, FFT) be useful?

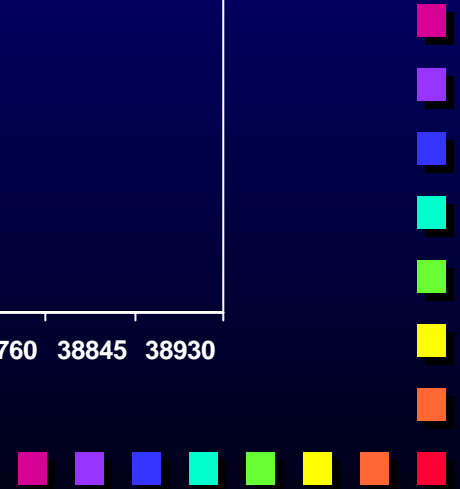
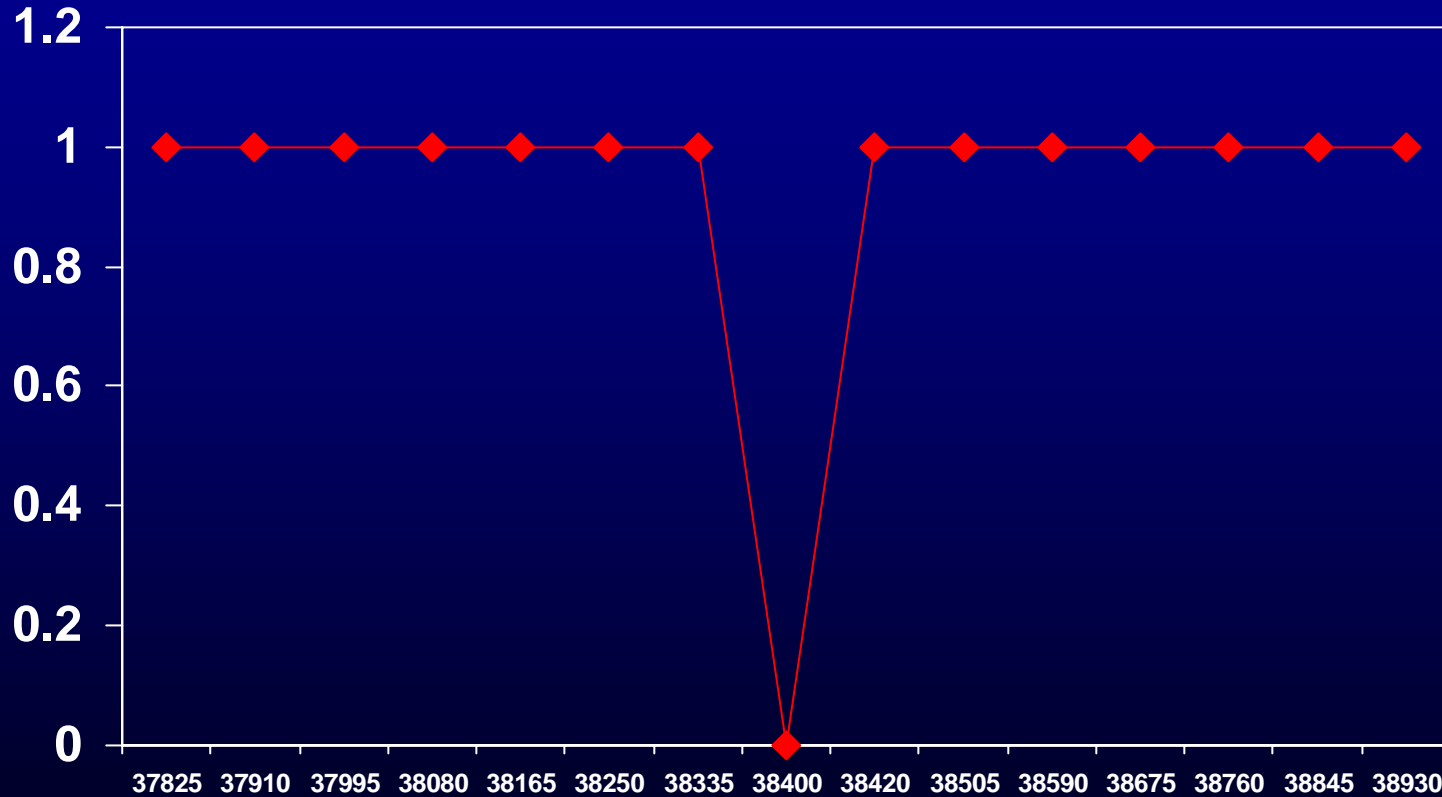


# SDT170 filter





# Example with 85Hz modulation





# Action of the 170

- Notch filter
- Calculates sum and difference frequencies
- Folds one set of frequencies over the other
- Not a heterodyne, a demodulation

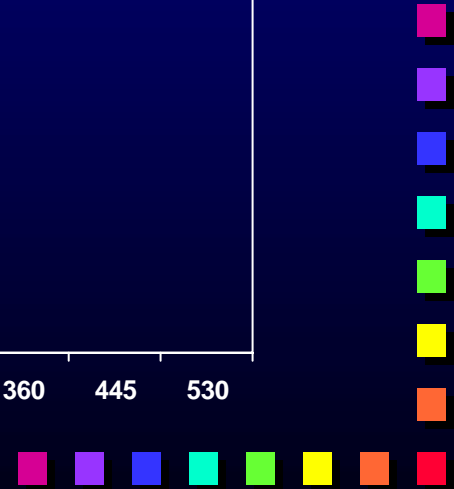
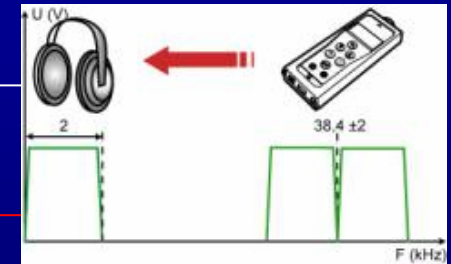
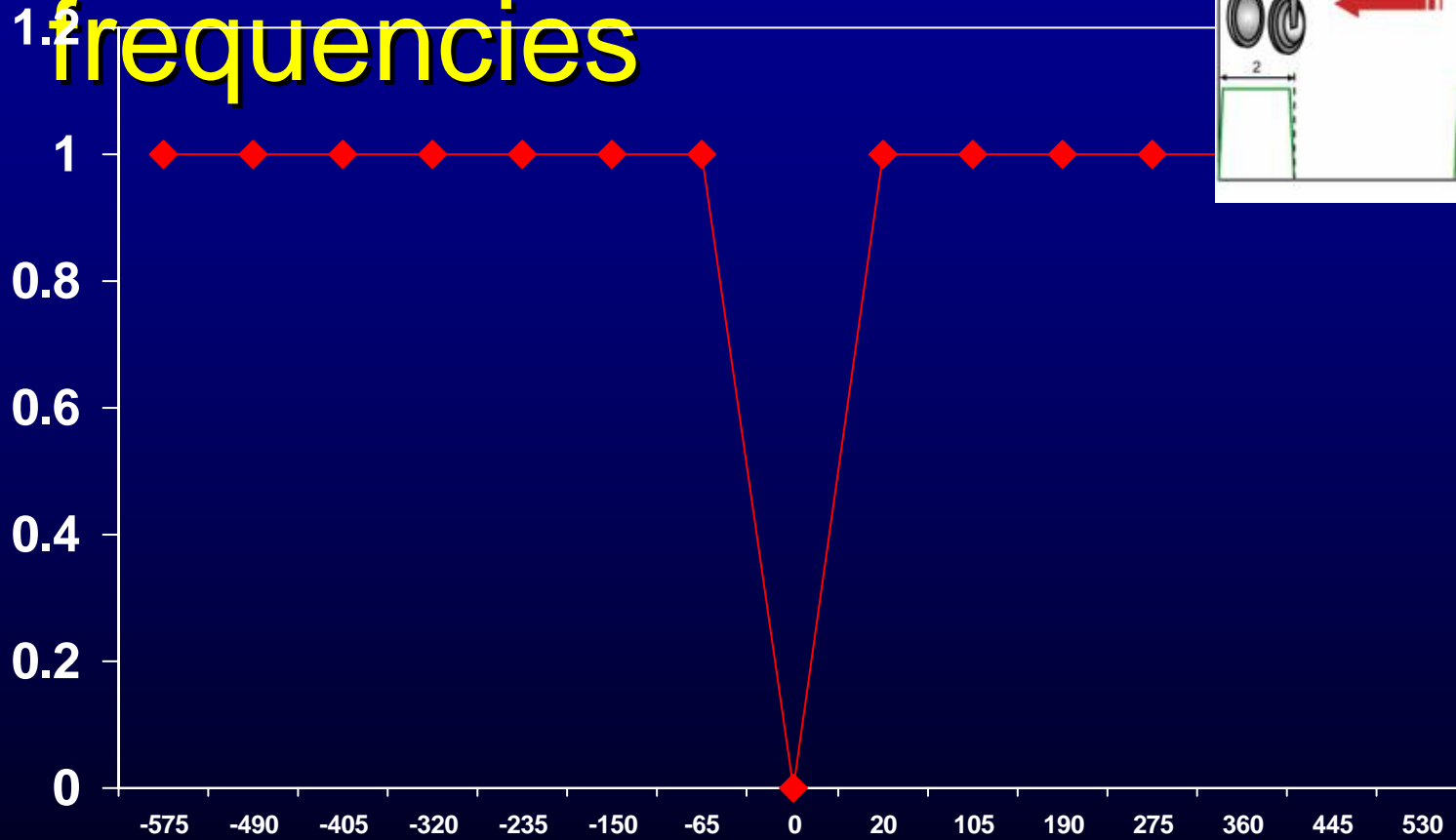




# Example with 85Hz

Technology and Training for Total Productivity

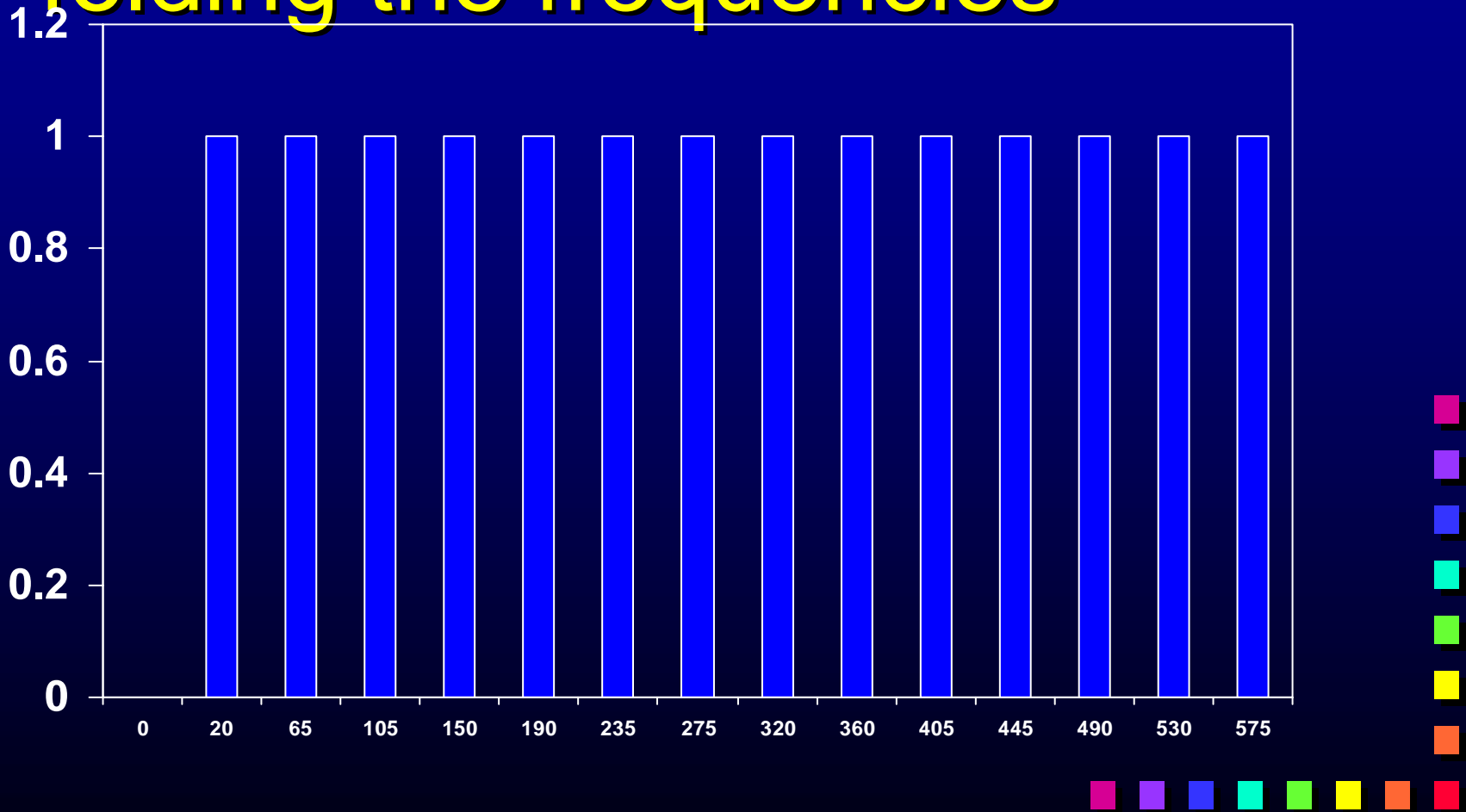
## modulation – sum and difference frequencies





# Example with 85Hz *Technology* and *Training* for *Total Productivity*

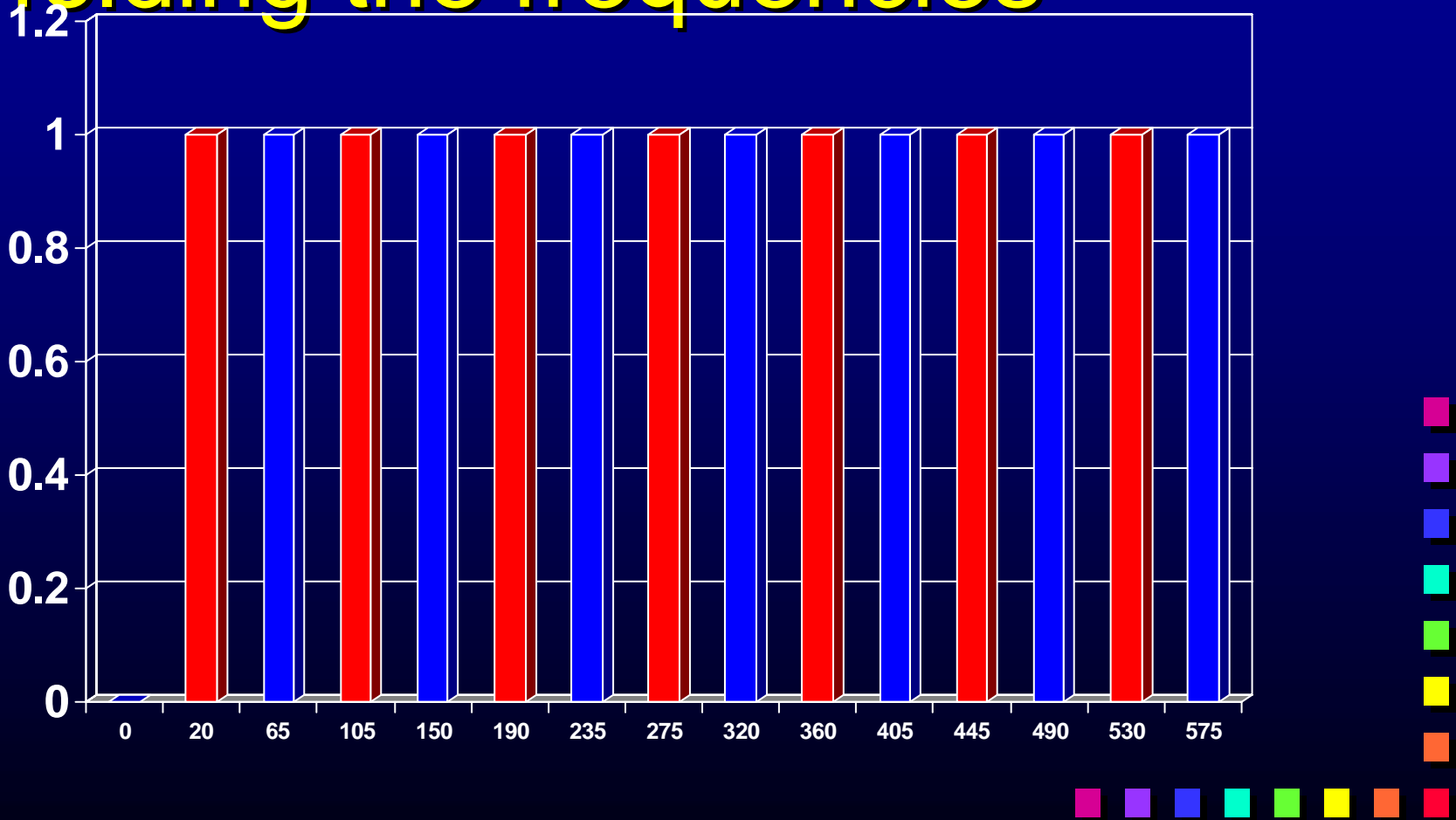
## modulation – folding the frequencies





# Example with 85Hz *Technology and Training for Total Productivity*

## modulation – folding the frequencies





# SDT170 filter

- In the new version of firmware this filter is adjustable
- 16kHz to 190kHz
- Use the 170 as an intelligent sensor for the 4100 or VA3
- A swept filter with almost 200kHz bandwidth





# Procedure

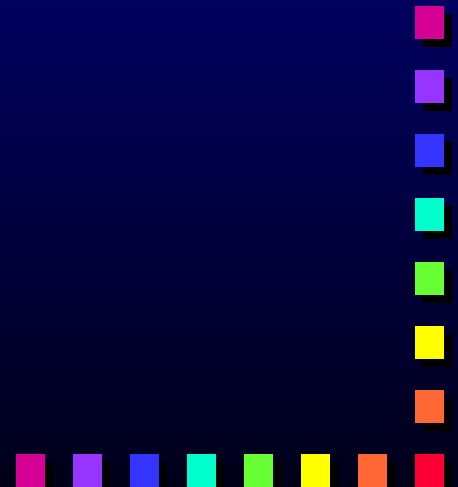
- Connect the SDT170 to 4101/VA3 using special cable from SDT
- Switch off ICP power supply on Adash instrument
- Use ultrasound sensor with either stinger or magnet
- Take spectrum up to 2kHz bandwidth





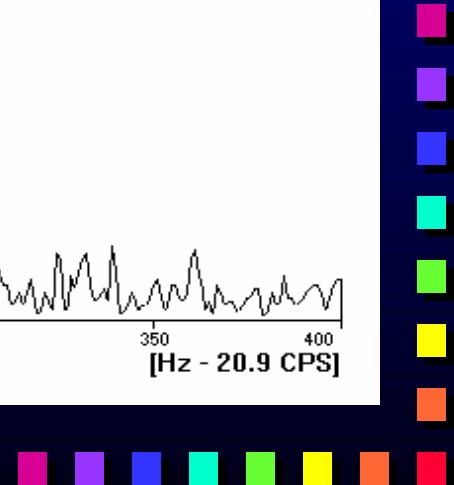
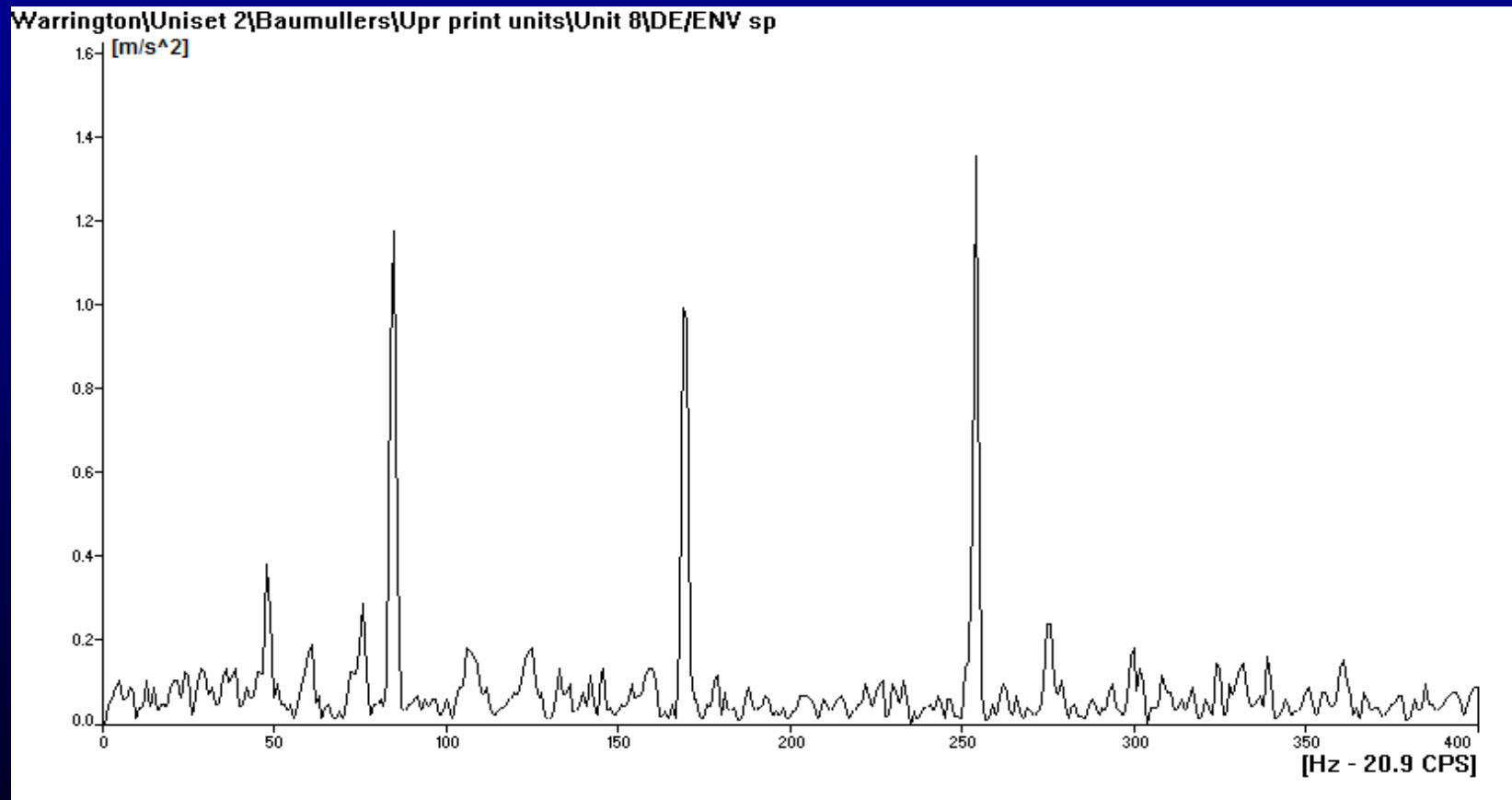
# Example: Inverter driven motors

- This data is taken from some printing machine motors
- These motors exhibit a strong outer race defect frequency when current leakage is occurring





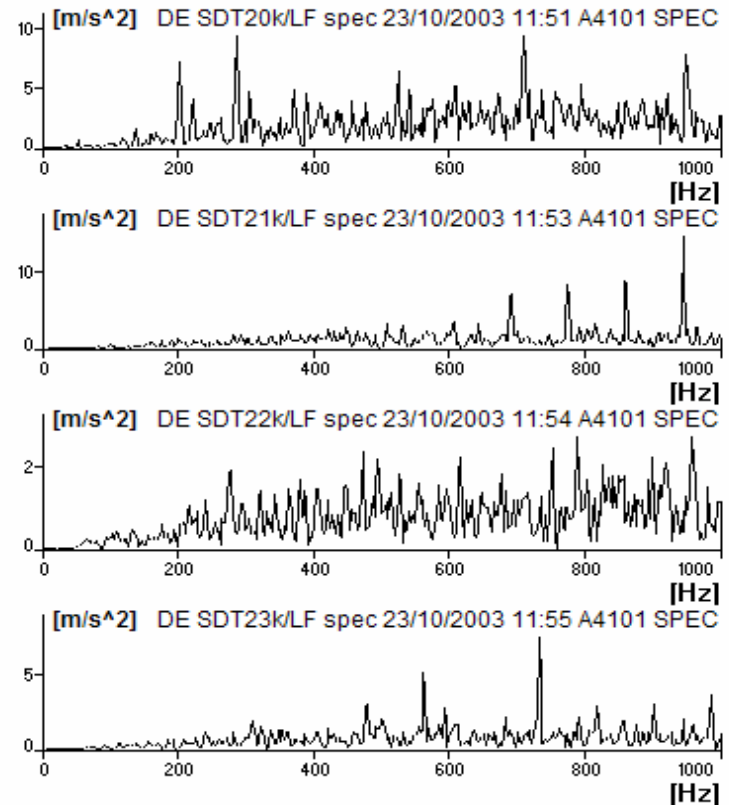
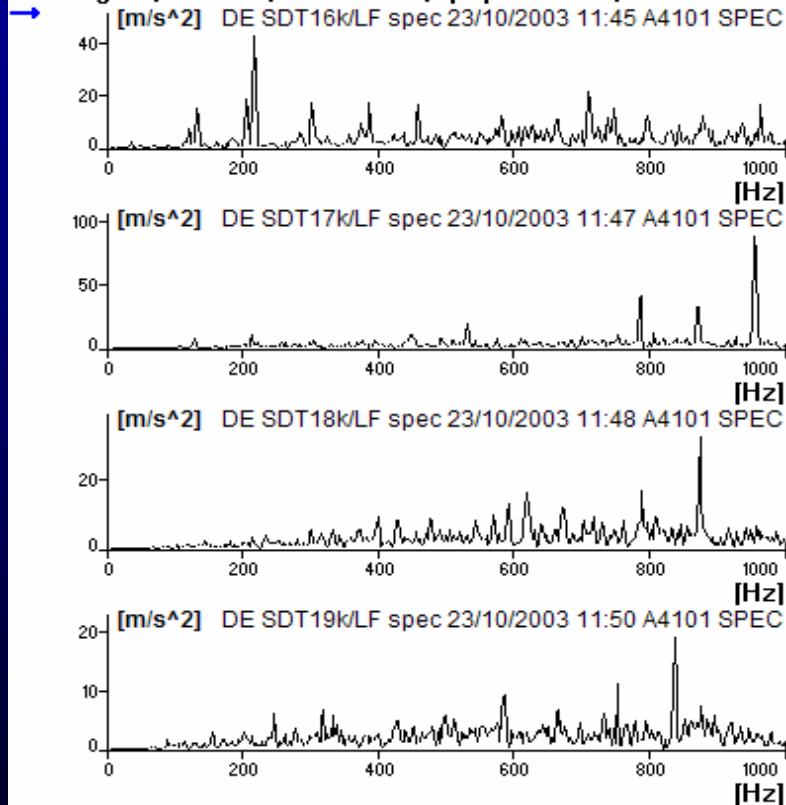
# Envelope data taken with 4101





# Scan of data from 16-23kHz

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8

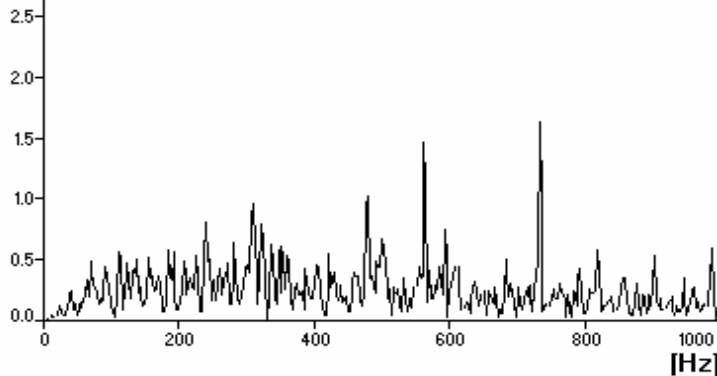




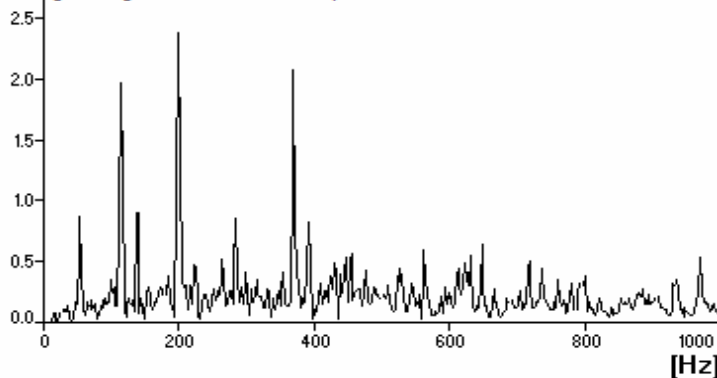
# Scan of data from 23-64kHz

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8

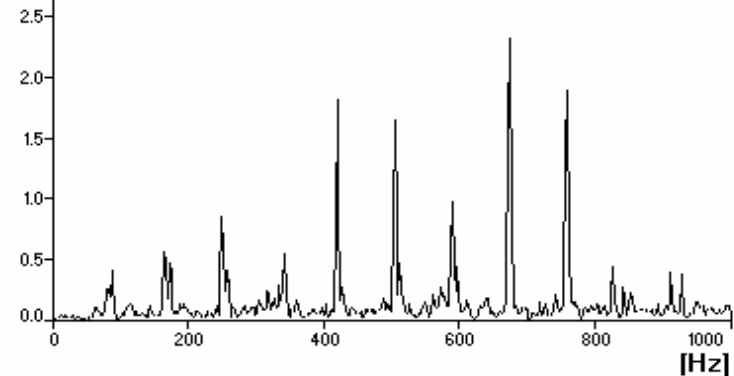
[mm/s] DE SDT23k/LF spec 23/10/2003 11:55 A4101 SPEC



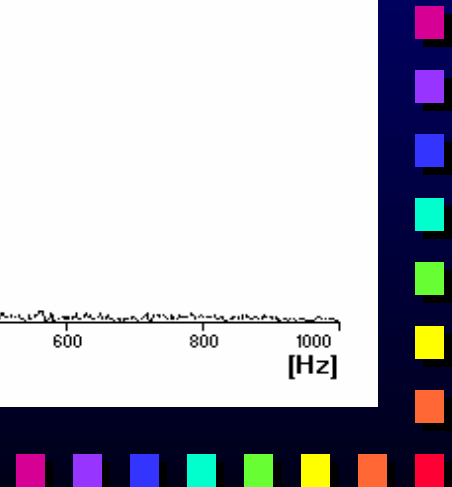
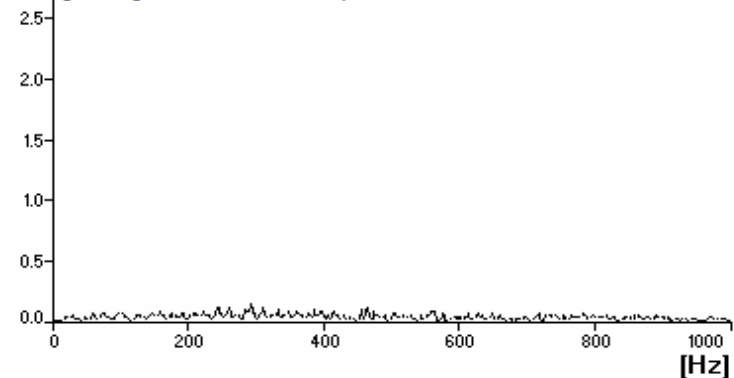
[mm/s] DE SDT32k/LF spec 23/10/2003 11:59 A4101 SPEC



[mm/s] DE SDT48k/LF spec 23/10/2003 12:01 A4101 SPEC



[mm/s] DE SDT64k/LF spec 23/10/2003 12:03 A4101 SPEC

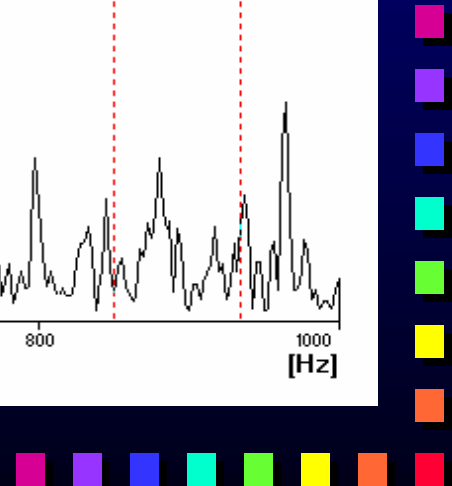
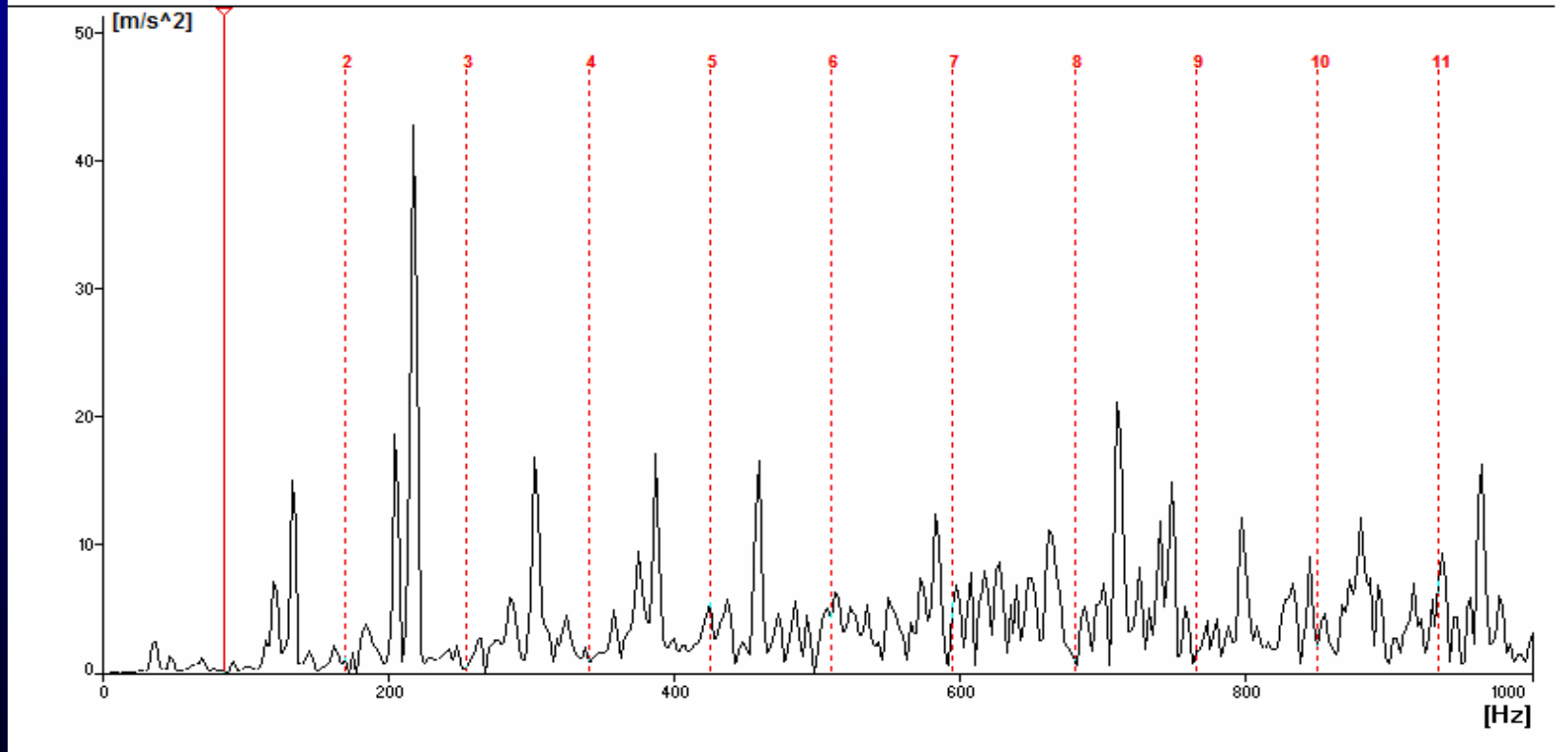




# Looking at one spectrum

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE SDT16k

Freq  [Hz]  [m/s<sup>2</sup>]

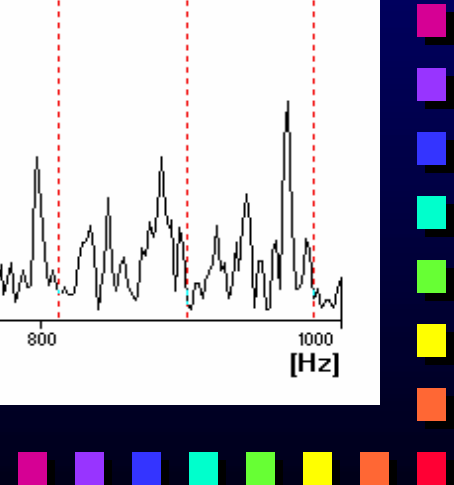
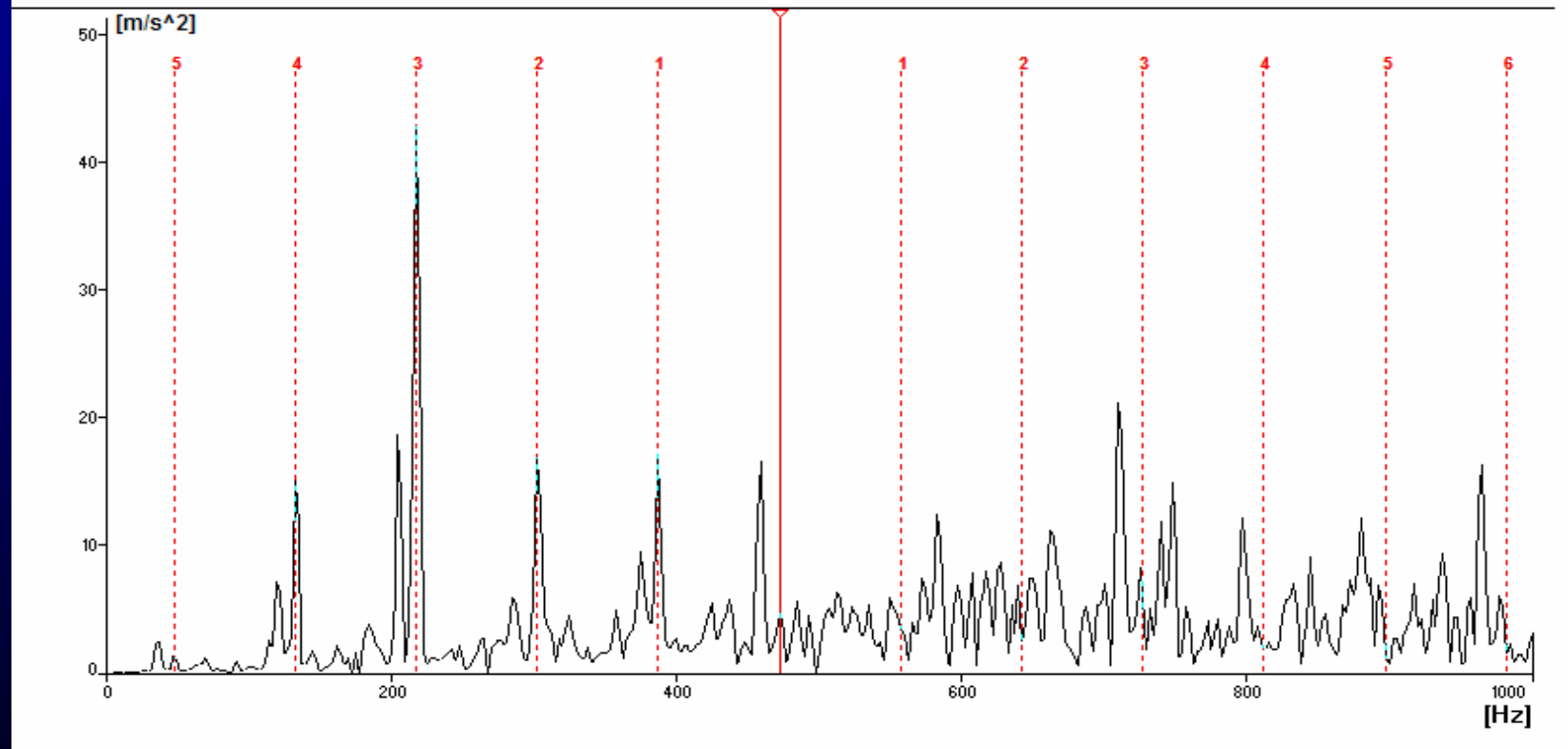




# Looking at one spectrum

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE SDT16k

Freq   $\Delta$   [Hz]  [m/s<sup>2</sup>]

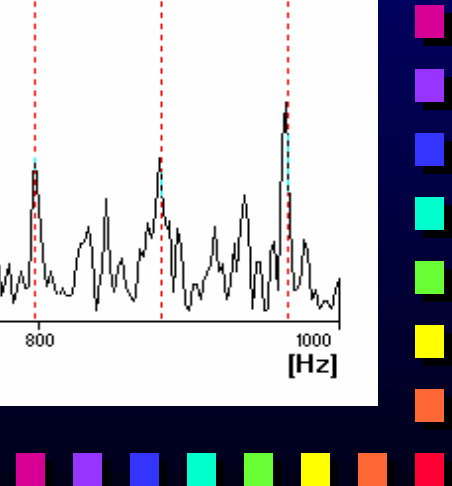
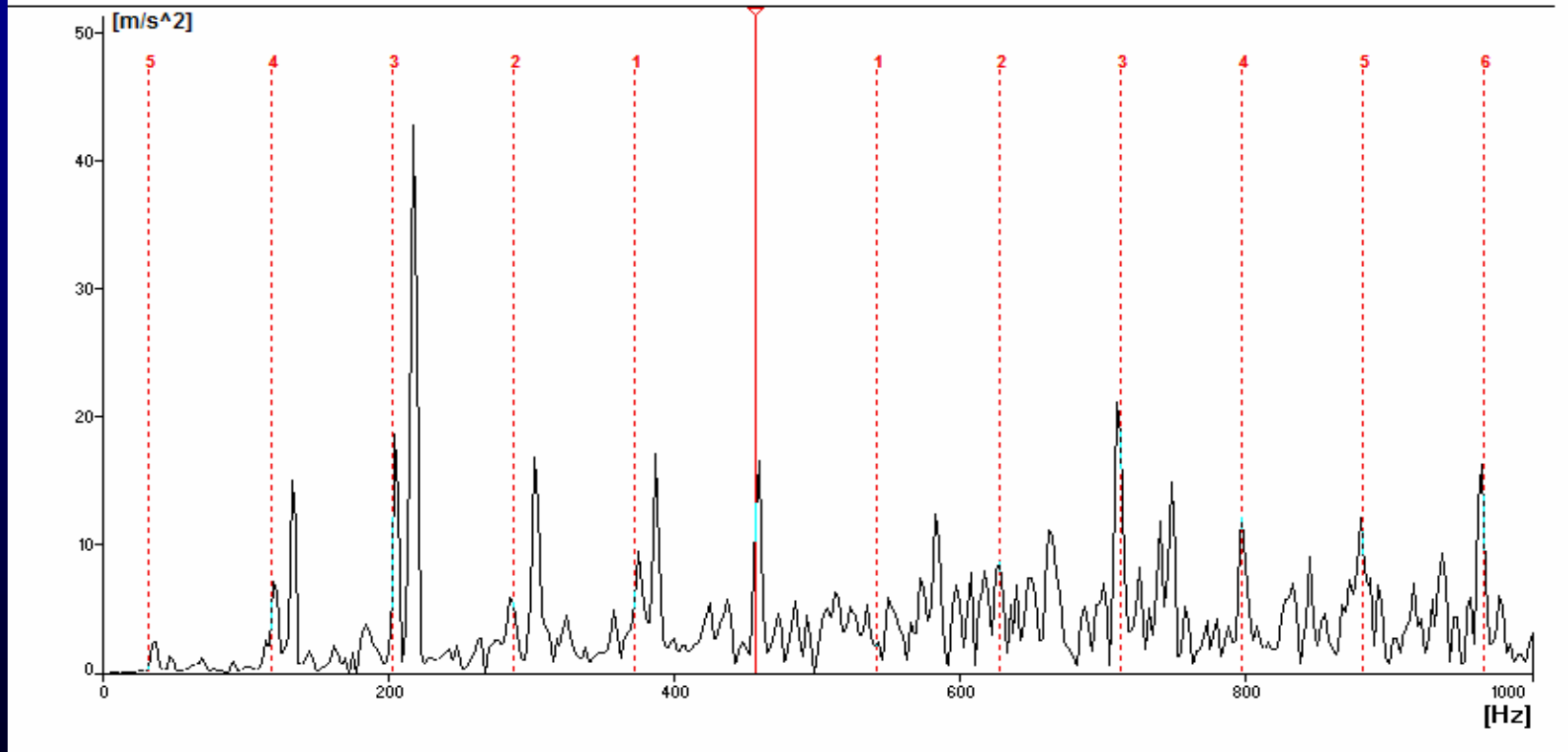




# Looking at one spectrum

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE SDT16k

Freq   $\Delta$   [Hz]  [m/s<sup>2</sup>]

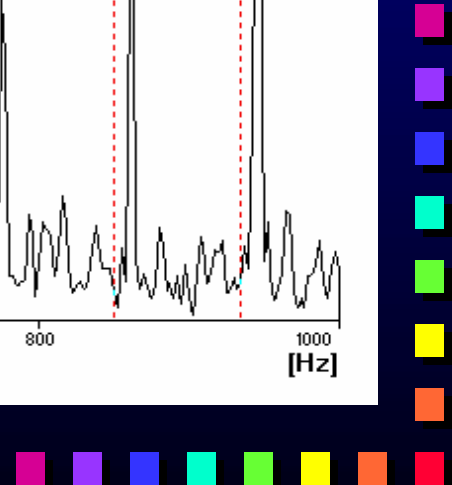
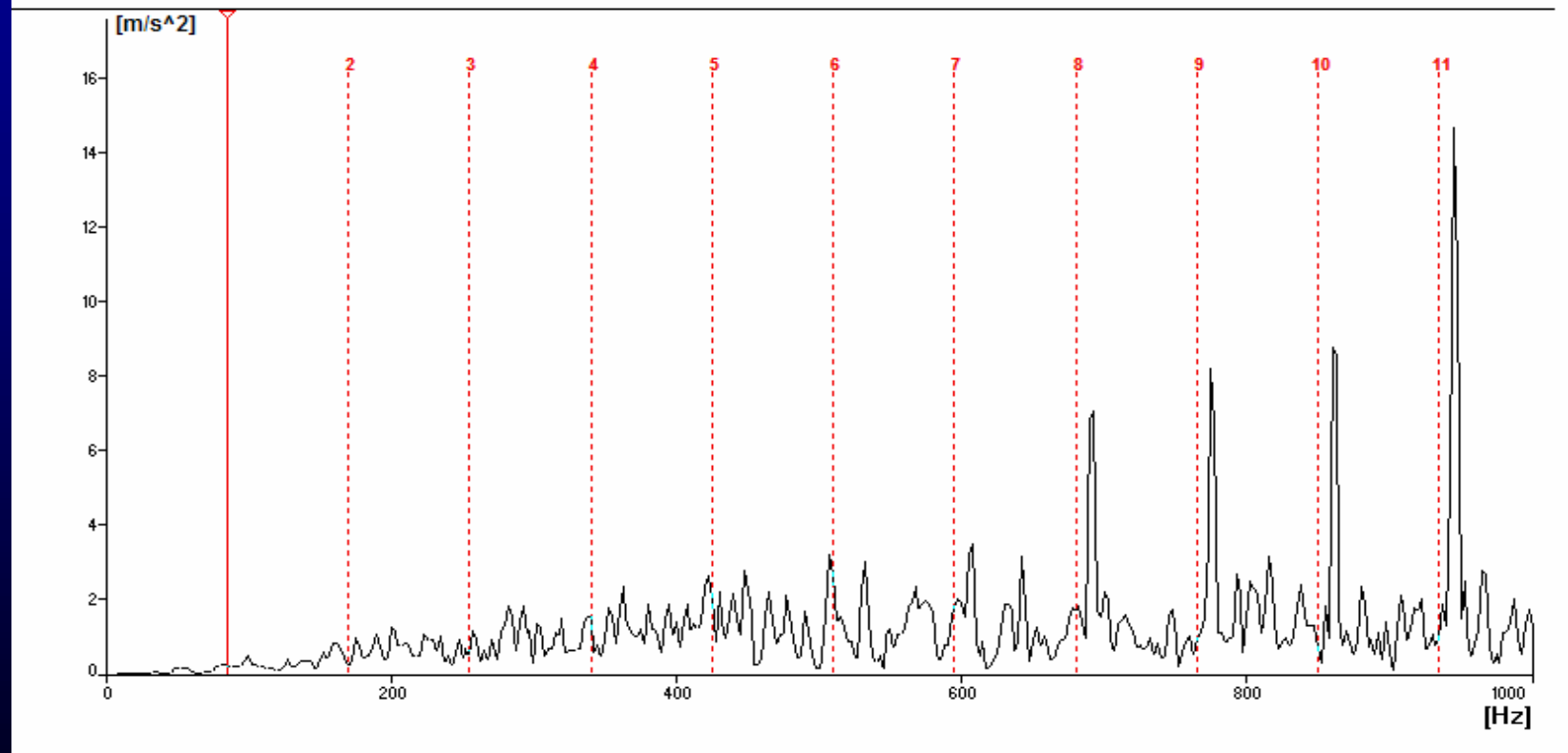




# Looking at another

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE SDT21k

Freq 85 [Hz] 0.2378 [m/s<sup>2</sup>]

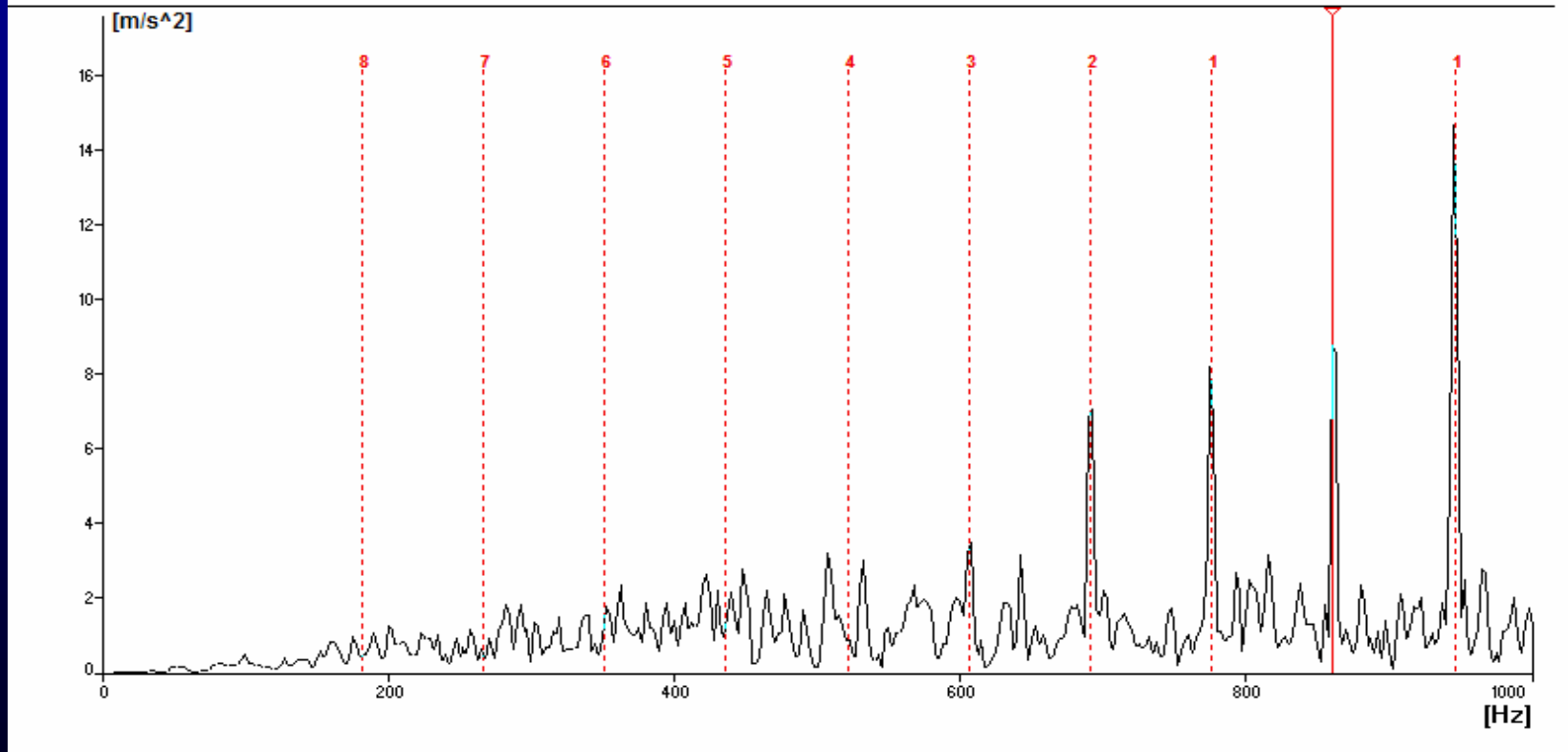




# Looking at another

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE SDT21k

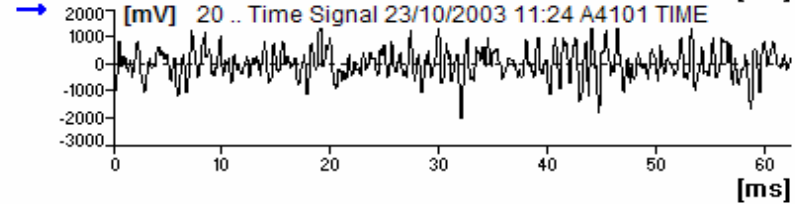
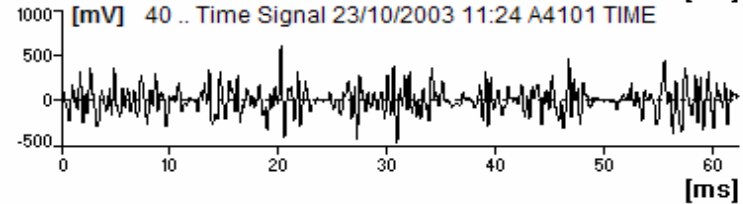
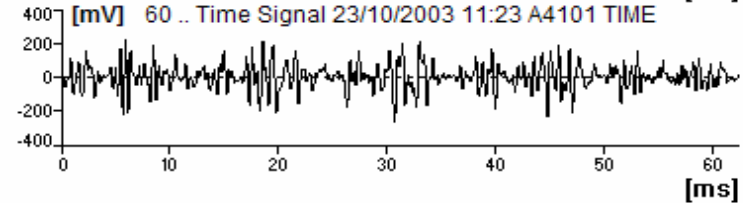
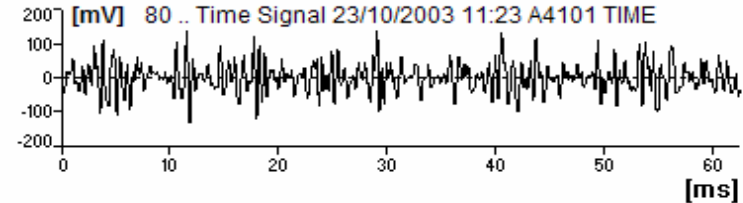
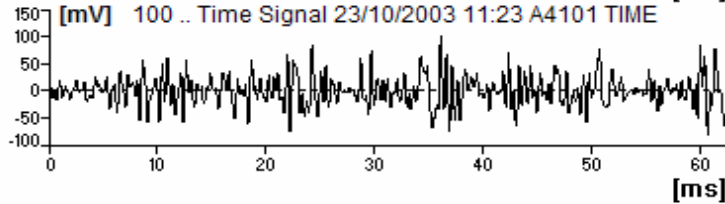
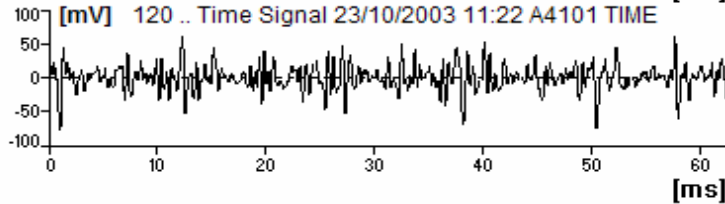
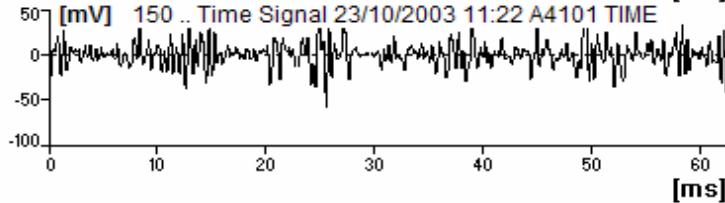
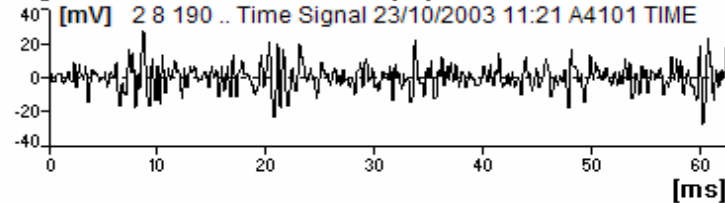
Freq 860.963  $\Delta$  84.893 [Hz] 8.7954 [m/s<sup>2</sup>]





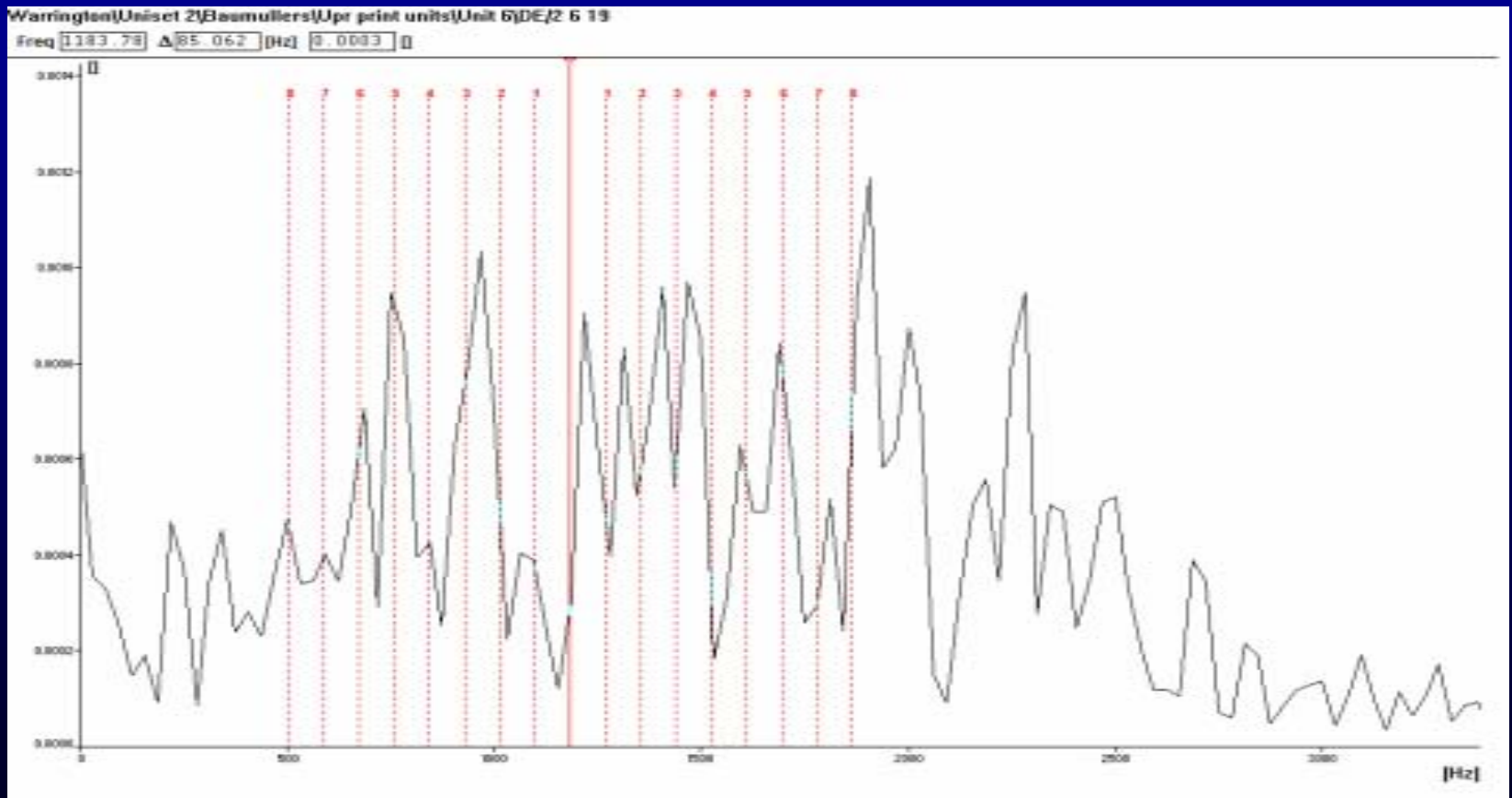
# Time comparisons

Warrington\Uniset 2\Baumullers\Upr print units\Unit 8\DE





# Time data





# Time data

- The world-wide industry standard method for testing steam traps is using U/s.
- This test is currently just by listening to the noise from the trap and making simple measurements of the dB readings
- Using standard vibration methods would allow more detailed characterisation of the sound made by the steam trap





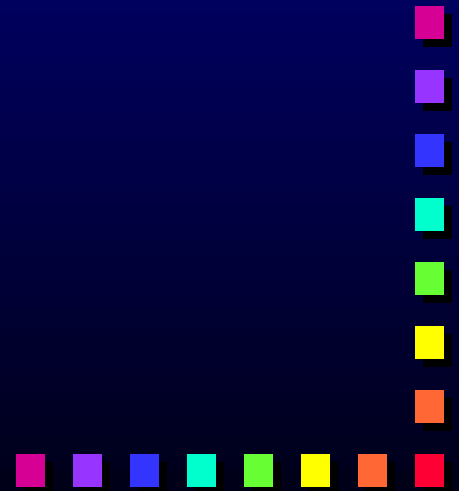
# Comments

- Ultrasound can provide condition data
- The analysis is slightly more complex
- Trending is not yet so simple
- There is a lot of work to do yet, but there does seem to be some benefit in terms of data which cannot be found by another method



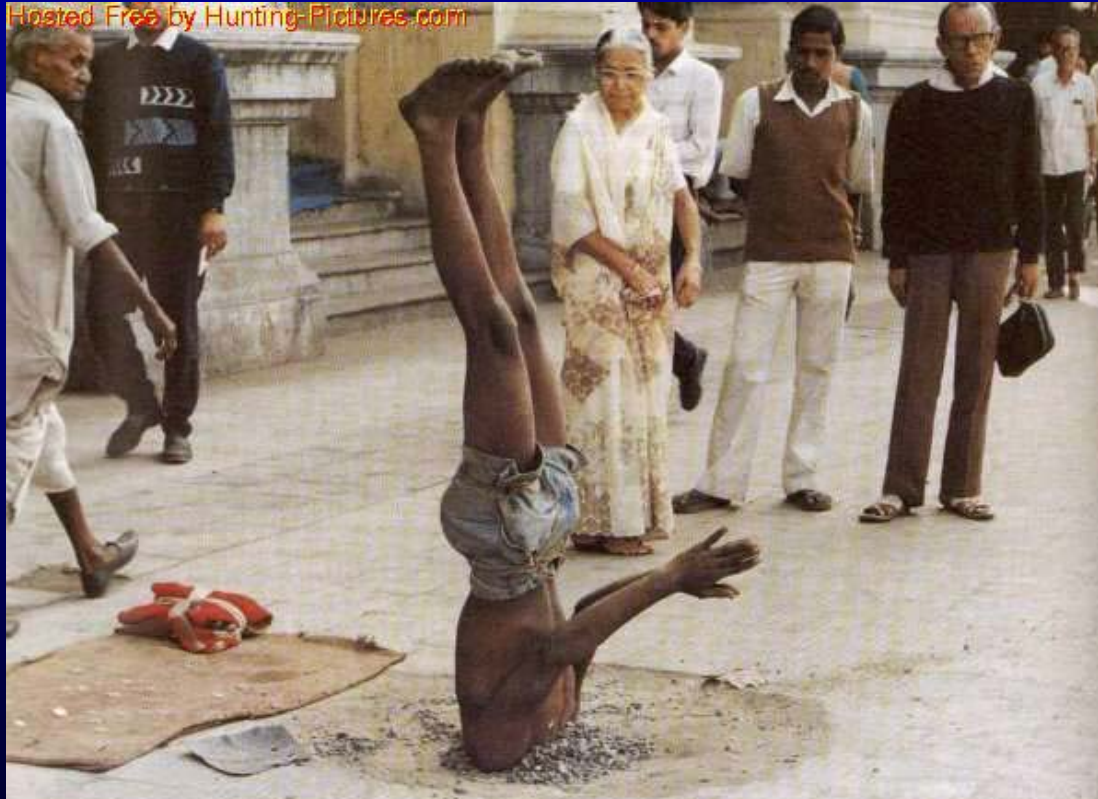


# *Technology and Training for Total Productivity*





# First weapons of mass destruction failed to explode





**Thank you for  
your attention-  
Any  
questions?**

