NPL – Data Capture and Signal Processing in Hostile Working Environments

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Early Brüel & Kjær Measuring Equipment

Minimal Signal Processing Options

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Brüel & Kjær 2032

Virtually all analysis options visible on screen

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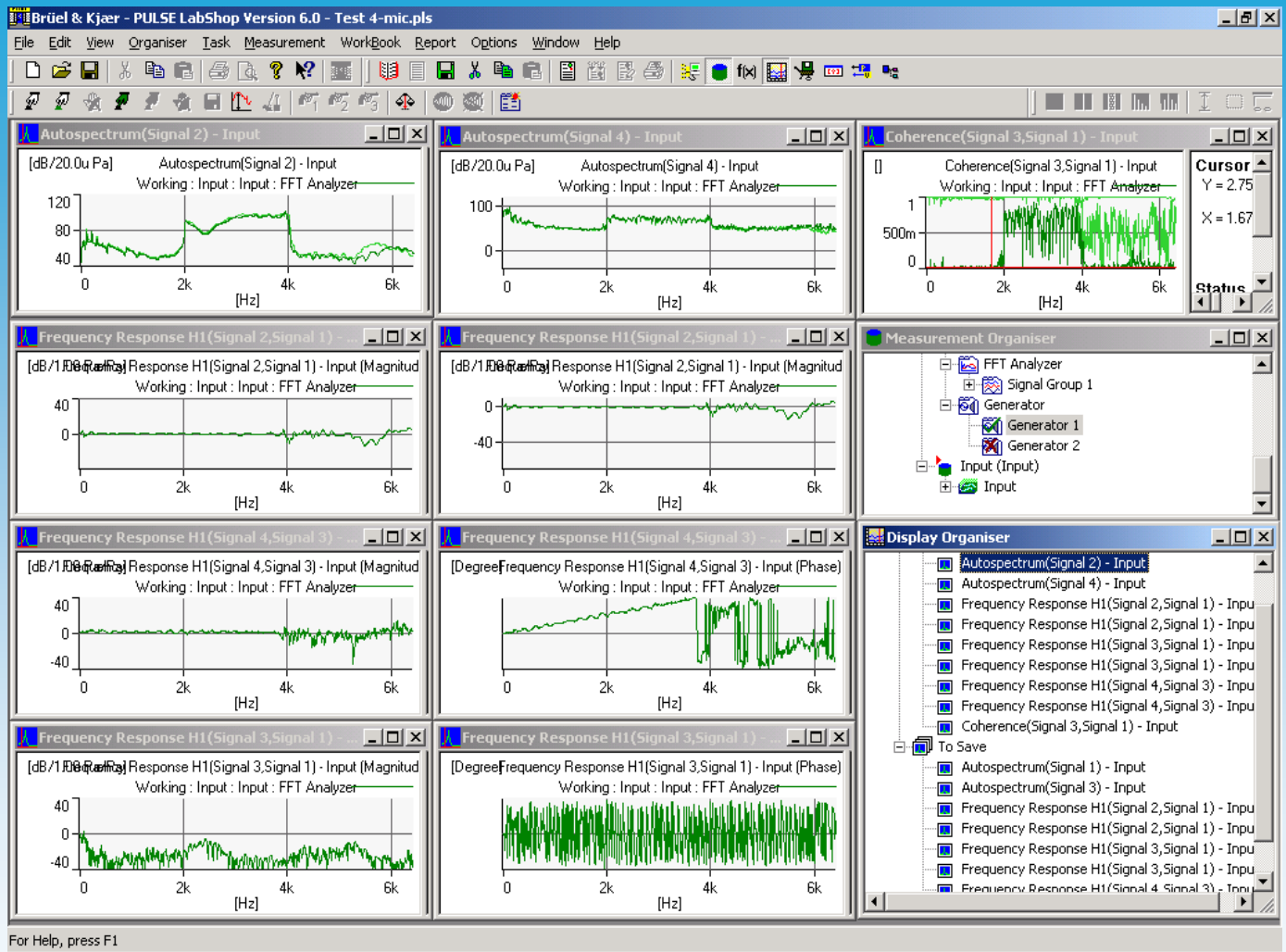

Brüel & Kjær PC based 'Pulse' System

Powerful and flexible, but not easy to use

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Typical Working Environment

“Not easy to do reliable signal processing here”

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- Limited access to test machines
- Repeat tests expensive or even impossible
- Can analyse recorded data in detail later
- Must know immediately if data is good
  - “Go home or instant repeat needed”
- For new and unusual work must be prepared for Real Time Investigation of Signal Processing options

Errors Associated with Data Capture, Data Analysis and Signal Processing

Types of Error:

- **Real Error: Defective data**
- **Suspected Errors: data can not be believed**
- **Inadequately documented data**

All may lead to a need to repeat testing

Sources of Error

1. **Defective cables and connectors**
   Auto scale/ auto calibration may “find” a defective signal despite major errors.

2. **Poor documentation during result taking**

3. **Various small frequency response errors**

4. **Calibration errors**
   “TEDS” can help

Sources of Error (Cont)

5. Loose accelerometers and “abused” microphones are a real problem

6. Real or suspected incorrect analysis settings
   - Sample rate
   - Frequency range and resolution

7. Inadequate understanding of Window and Trigger requirements
   - Primarily during impact testing and other transient capture

Sources of Error (Cont)

8. **Failure to understand limitations of filters.**
   Not appreciating filter time domain characteristics.

9. **Aliasing**

10. **Poor use of Dynamic Range**

Sources of Error (Cont)

- Difficulty in seeing any computer screen when working outdoors.

This substantially increases the probability of all of the above errors going unnoticed.

Solutions

- **Highly skilled engineers with a good knowledge of what results to expect.**

  In most cases a measurement should not be made unless the engineer has a good idea of what the result will look like.

- **A fundamentally different software architecture is required when working in the field**

Conventional systems

Current systems optimised for comprehensive features and flexibility

Most suitable for laboratory use

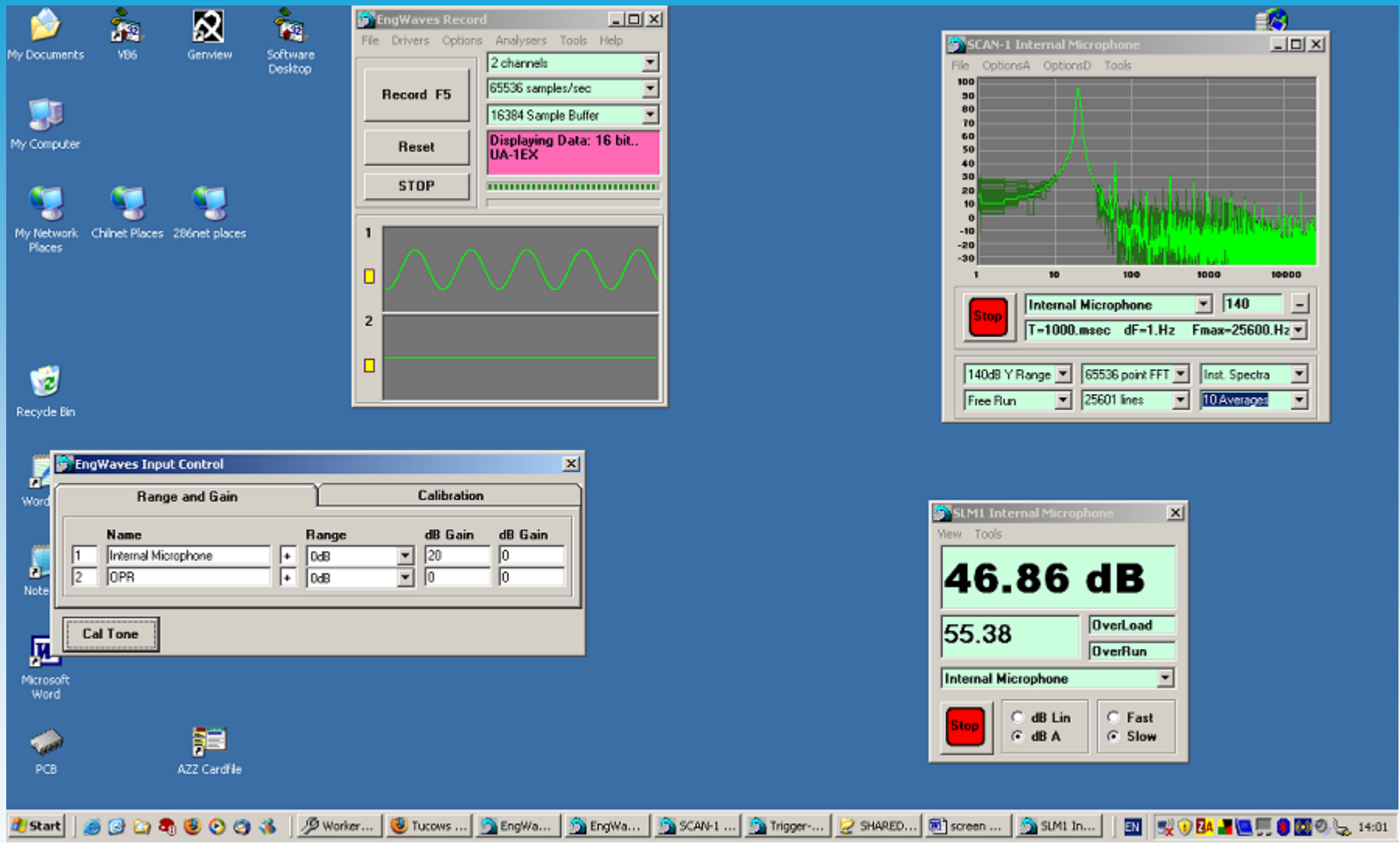
- **Very flexible and powerful … but**
  - **Complex screen displays**
  - **Far too many options**
  - **Far too many “hidden options”**

Requirements of Systems for Field Data Capture & Analysis

- Simple screen display
- Simple and obvious system architecture
- Major analysis options displayed on screen and easy to change
- Avoid “Hidden Destructive” options
- Modular architecture
- Immediate visual feedback of results
- Flexible real time display of spectra/results
- Ability to record time histories for detailed analysis later
- Audit trail – saving of all analysis settings within data format
- Encourage comprehensive note taking

Possible Future Developments

- On screen display of obvious errors
  - Overload
  - “Underload”
  - Unusual settings (e.g. no windows)
- Intelligent help with common tasks
- Checking against database of typical results



EngWaves Record

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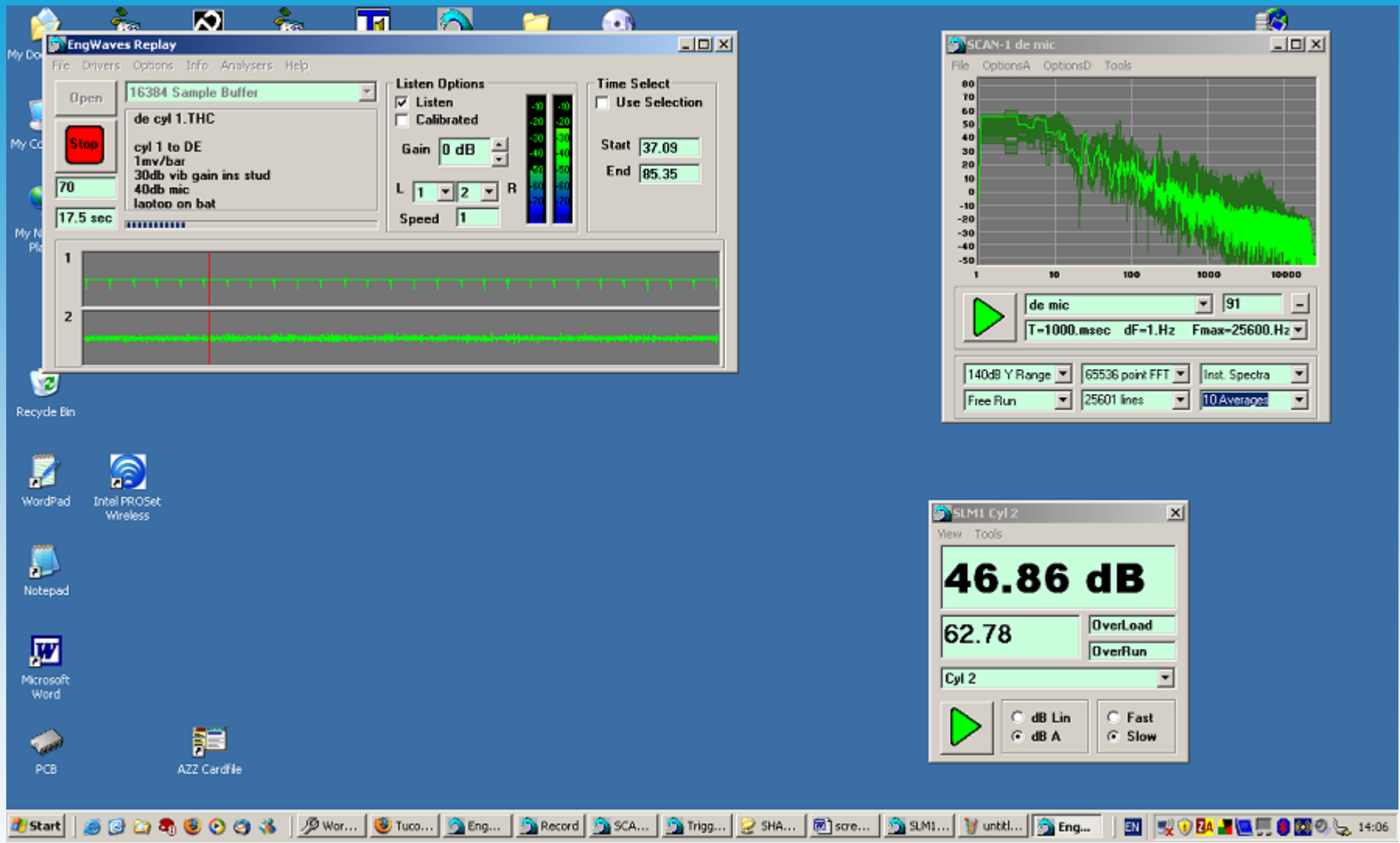

EngWaves Replay

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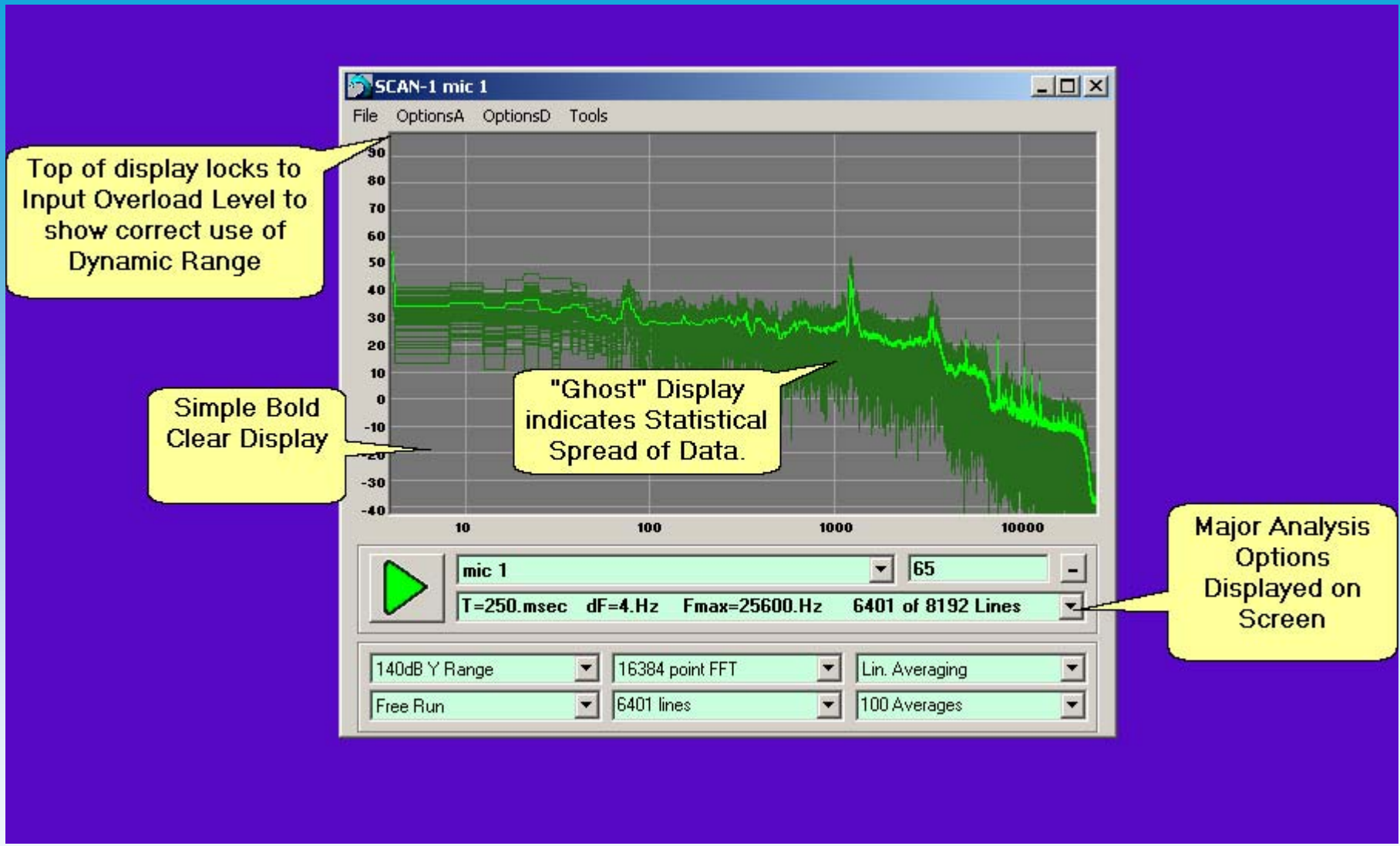

EngWaves Analyser

"An analyser module showing some of the 'integrity' features

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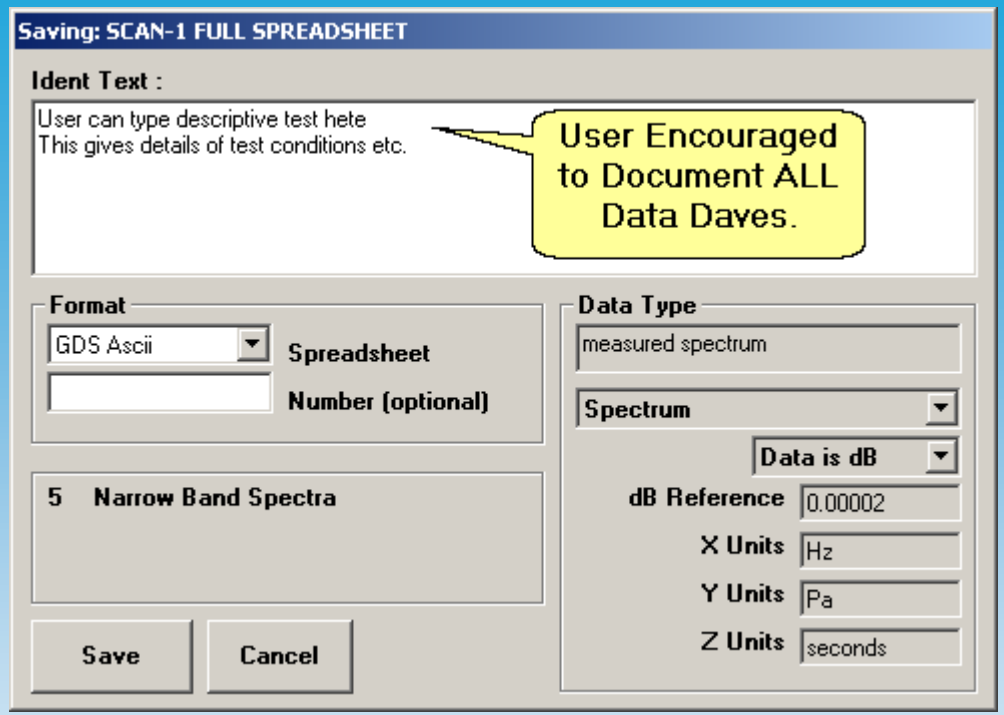

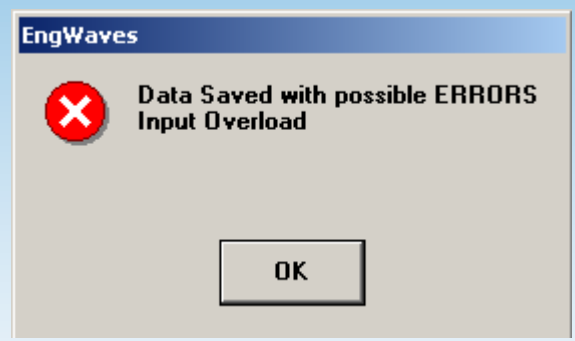

Data Saving

User encouraged to document all data, and clear warnings of all 'integrity' issues

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Summary

1. Achieving high integrity in field data capture is a very real issue.

2. Signal processing plays a major role in this.

3. ‘Low tech’ and mundane issues are often as important.

4. Making signal processing robust in the hands of non-experts, or experts working under pressure, is an important and over looked subject.