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Signal processing and the Software Support for Metrology programme: helping ensure good practice in metrology applications

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This talk is about:

- Introducing the Software Support for Metrology (SSfM) programme
- How signal processing became part of DTI's SSfM programme – SSfM2 New Directions study.
- Why metrologists need a guide to good practice in DSP
- How today's event will work

Mathematics and Scientific Computing Group

- Mathematics and Scientific Computing Group (MSCG) has 16 Mathematicians, Statisticians, Software Engineers and Physicists
- Part of the Division of Enabling Metrology
- We support all areas of metrology in other NPL Divisions & NMS programmes
- Our own NMS programme is Software Support for Metrology (SSfM)
- We also do 3rd party work

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Software Support for Metrology programme (SSfM)

- The Software Support for Metrology programme is worth £3.1m over 3 years
- SSfM covers metrology, mathematics, statistics and software
- We develop and promote best/good practice in the application of mathematics and software to metrology
- We support NMS programmes, industry & public sector
- We provide generic solutions

The programme has four main technological themes

- Modelling tools and techniques
- Uncertainties and statistical techniques
- Software development, testing and validation
- Applications and supporting techniques

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SSfM-3 has a number of new topics

- Supporting metrologists in signal processing, filtering and feature detection
- Establishing good practice in grid and distributed computing systems
- Modelling to support nanotechnology
- New Good Practice Guide on continuous modelling
- Interfaces for enabling Internet metrology

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SSfM-2 New Directions study questions

- What do metrologists know?
- What do they need to know?
- Do they understand their own limitations?
- How can SSfM help?
- Study available on NPL web site: http://www.npl.co.uk/ssfm/download/download.php?name=documents/cmsc17_03.pdf

Signal processing: new topic in SSfM-3

- Develop a Good Practice Guide for metrologists
- Case studies in different metrology areas
- Specific guidance on techniques for filtering and feature detection, including non-stationary signals and wavelets

DSP requirements in metrology

- Data analysis involves three stages: acquisition, processing, interpretation.
- First two stages introduce artefacts in raw unprocessed data that may be observed in third stage
- Important to understand how signal conditioning and processing affect original data: “improving” the data may introduce errors

Categories of signal

- Deterministic
  - Periodic
  - Non-periodic (transient and ‘almost’ periodic)
- Random (not predictable exactly)
  - Stationary (e.g white noise)
  - Non-stationary
- In reality processes may be mixed and required analysis procedure may not be obvious

Fundamentals of digitised data

- Two processes: sampling and quantisation
- Sampling converts analogue signal into a discrete signal
- Quantisation turns discrete signal into binary data
- Metrologists need to understand errors arising from sample-and-hold circuits and from quantisation

Today's event

- Learn about and share experiences in signal processing in metrology
- Identify material and suitable approach for the Good Practice Guide
- Guide is due March 2007
- We need your help in identifying and "calibrating" what should be in the Guide

Seminar questionnaire

- You are NOT being asked to comment on the speaker's style or delivery, only on the technical level as you perceived it
- Was the talk the right length for you, was it at the right technical level, was there enough detail?
- We need your replies to help us in drafting the Good Practice Guide
- Panel discussion at end of day allows more general debate about content of day's events

Software demonstrations

- Jonathan Williams, LabVIEW for remote capture and analysis of signals
- Pierre Gélat, Monte Carlo analysis of uncertainties in deconvolution
- Patrick Gaydecki, applications and systems for DSP