

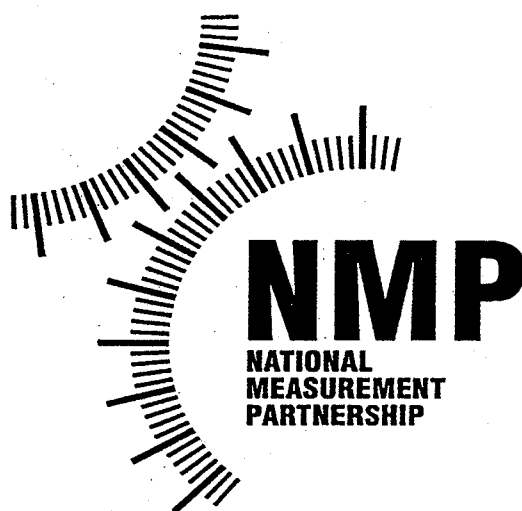
National Measurement Conference 99

AT

BRIGHTON METROPOLE

2-4th November 1999

organised by



CONFERENCE DIGEST

This Conference Digest is sponsored by:

Wavetek Ltd
Agilent Technologies

The Papers numbered 1, 8, 11, 19, 20, 29, 39, 41, 49, 60, & 63 are
© Crown Copyright 1999
Reproduced by permission of the Controller of HMSO

For all other papers the copyright is retained by the authors

ISBN 0 946754 34 9

The opinions and recommendations expressed in this digest are those of the authors concerned and are not necessarily those of the National Physical Laboratory, except where the work is attributed to NPL authors.

Overview of the Software Support for Metrology Programme

From weak-link to best-practice

D. Rayner

National Physical Laboratory, Teddington, Middx., UK, TW11 0LW
E-mail: dave.rayner@npl.co.uk

The UK Department of Trade and Industry funds 15 National Measurement System programmes, of which one of the most recent is the Software Support for Metrology programme. This paper gives an overview of this NPL managed programme and identifies its achievements in its first 18 months.

1. Introduction

The UK National Measurement System (NMS) programme on Software Support for Metrology (SSfM) has just passed its mid-point, being a three year programme running from April 1998 to March 2001. It is one of 15 NMS programmes funded by the Department of Trade and Industry (DTI). It has begun to address the fact that there has been insufficient investment in recent years in the mathematics and software used in metrology. Software could be said to have become the *weak link* in the measurement chain and practice varies widely from one metrology area to another. The programme is managed by NPL and interacts positively with all other UK NMS programmes.

The general guidelines set for the programme by the DTI were that it should

- be a metrology focused programme,
- meet the real needs of industry and metrologists,
- be generic in that all its activities should be applicable to more than one metrology area,
- have its emphasis on technology transfer, and
- not produce large amounts of code.

It is, therefore, actively seeking to spread *best practice* more consistently through the NMS and providing generic solutions to common problems. It will, for example, be providing guidance on best practice in uncertainty estimation and developing an in depth training course. It is also starting to tackle the issue of the poor quality algorithms supplied for some mathematical functions in common spreadsheet packages and other software packages used in metrology. Examples are known where functions are too unstable or insufficiently accurate for use with measurement data. A thorough analysis of the problem is being made and appropriate advice and solutions are being disseminated.

The following gives a brief overview of the programme. The programme has four technical themes, a fifth to survey the practice in various areas of metrology, and a sixth on general technology transfer.

2. THEME 1: Modelling Techniques

There are four projects on Modelling Techniques:

- Methods of Modelling Measurement Data (with input from NEL)
- Uncertainties and Statistical Modelling (with input from NEL and UKAS)
- Visual Modelling and Data Visualisation (competitively tendered, won by Sira Ltd.)
- Data Fusion

3. THEME 2: Validation and Testing

There are four projects on Validation and Testing:

- Testing Spreadsheets and Other Packages used in Metrology
- Model Validation
- Measurement System Validation
- Validation of Simulated Instruments

4. THEME 3: Metrology Software Development Techniques

There are three projects on Metrology Software Development Techniques:

- Guidance on developing software for metrology (competitively tendered, won by Logica)
- Software reuse (including library, legacy and mixed-language issues) (competitively tendered, won by NAG Ltd and NPL)
- Development of virtual instruments (competitively tendered, won by Adelard)

5. THEME 4: Support for Measurement and Calibration Processes

There are three projects on Support for Measurement and Calibration Processes:

- Automation of measurement and calibration processes (i.e. Laboratory Information Management Systems) (competitively tendered, won by Sira Test and Certification and UKAS)
- Format standards for measurement data (competitively tendered, won by NEL)
- A road-map to the results of the whole programme

6. THEME 5: Status Reports for each Metrology Area

There is set of projects to produce the following Status Reports:

- Initial and interim reports covering 12 metrology areas, on the state of the art of software and mathematics used in each area, covering the following metrology areas:
 - foundation metrology
 - length, i.e., dimensional metrology
 - mass, including force and pressure

- electrical metrology
- photonics
- optical radiation
- ionising radiation
- thermal metrology, including humidity
- time and frequency
- acoustics
- flow measurements (from NEL)
- valid analytical measurements (led by LGC)
- Initial and interim reports on metrology software activities world-wide

These are informing the current programme and the formulation a follow-on programme.

7. THEME 6: Generic Technology Transfer

There are six Generic Technology Transfer projects:

- SSfM club
- Web site, including generic JAVA work
- SSfM newsletters
- Links to the INTERSECT Faraday Partnership
- EUROMET and Framework 5 project monitoring
- Advanced Mathematical and Computational Tools in Metrology conferences in Oxford in April 1999 and in Portugal in May 2000

8. Deliverables

The typical deliverables of projects in the programme will be

- best practice guides and other guidance documents
- feasibility and case studies
- awareness articles
- seminars, workshops and club activities
- training courses
- reports to recommend and inform future activities
- specifications of tools, key functions and basic algorithms.

9. Achievements in the first 18 months

The SSfM programme has completed a good first 18 months. Its key achievements are as follows:

- production and widespread distribution of a Programme Brochure [1]

- establishment of the SSfM Club, with 124 members and 19 international associates from a total of about 90 organisations in its first year when membership was free; in the first 6 months of the second year, when an annual membership fee has been introduced, this has changed to 30 full members and 32 international associates
- establishment of the SSfM web site, including a download area for accessing relevant open reports and a restricted area for Club members to review draft reports and to get early sight of deliverables
- two successful SSfM Club meetings in September 1998 and March 1999
- two uncertainties workshops in September 1998 and July 1999
- a continuous modelling workshop in November 1998
- production of two SSfM Newsletters in July 1998 and May 1999, a development of the already existing "Counting on IT" Newsletter, with a distribution of 2200 copies
- production of 15 NPL Reports [2-16], including five from the work on spreadsheet testing, including a report on testing many of the intrinsic functions of Microsoft Excel
- completion of a case study illustrating the use of Java to produce interactive web pages to demonstrate aspects of metrology
- establishment of a EUROMET project on Key Comparisons Statistical Development and the preparation for an international workshop on Statistical Analysis of Interlaboratory Comparisons to be held at NPL on 11-12 November 1999
- production of awareness papers and presentations, particularly on the SSfM programme as a whole, uncertainty estimation and numerical testing of software packages, including:
 - "The evaluation of uncertainties in the analysis of calibration data" presented at IMTC99, May 1999
 - "Design and use of reference data sets for testing scientific software" in *Analytica Chimica Acta*
- establishment of good links with the INTERSECT Faraday Partnership and with NMIs around the world
- the Advanced Mathematical and Computational Tools for Metrology 1999 conference held in Lady Margaret Hall, Oxford on 12-15 April 1999
- completion by DTI of the competitive tendering of seven SSfM projects and the establishment of links between the chosen contractors and the programme management
- completion of a successful Annual Review with the Measurement Advisory Committee's Software Working Group in April 1999
- production by NAG Ltd. and NPL of reports on a) the Impact of Year 2000 on metrology programmes in the UK, b) Legacy Systems in Metrology, c) Design of the Metrology Software Environment (METROS), d) Specification of METROS Key Functions

For more information, visit the SSfM web site (<http://www.npl.co.uk/ssfm/>).

10. Acknowledgements

We acknowledge the support of the UK Department of Trade and Industry's National Measurement Policy Unit for funding the Software Support for Metrology programme.

11. References

1. National Measurement System Software Support for Metrology Programme (1998-2001), programme brochure (NPL, 1998).
2. Butler, B. P., Initial Status Report on Software Activities Worldwide, NPL Report CISE 17/98 (NPL, 1998).
3. Rayner, D., Initial Report on Status of Software and Mathematics in Each Metrology Field, NPL Report CISE 18/99 (NPL, 1999).
4. Butler, B. P., Cox, M. G., Forbes, A. B., Harris, P. M. and Lord, G. J., Model Validation in the Context of Metrology: A Survey, NPL Report CISE 19/99 (NPL, 1999).
5. Butler, B. P., Cox, M. G. and Harris, P. M., Report on Discussions with other National Measurement Institutes (1998/99) on Testing Spreadsheets and Other Packages used in Metrology, NPL Report CISE 21/99 (NPL, 1999).
6. Cox, M. G., Dainton, M. P., Harris, P. M. and Wichmann, B. A., Survey Report on Testing Spreadsheets and Other Packages used in Metrology, NPL Report CISE 22/99 (NPL, 1999).
7. Cook, H. R., Cox, M. G., Dainton, M. P. and Harris, P. M., A Methodology for Testing Spreadsheets and Other Packages used in Metrology, NPL Report CISE 25/99 (NPL, 1999).
8. Cook, H. R., Cox, M. G., Dainton, M. P. and Harris, P. M., Testing Spreadsheets and Other Packages used in Metrology - A Case Study, NPL Report CISE 26/99 (NPL, 1999).
9. Cook, H. R., Cox, M. G., Dainton, M. P. and Harris, P. M., Testing Spreadsheets and Other Packages used in Metrology - Testing the Intrinsic Functions of Excel, NPL Report CISE 27/99 (NPL, 1999).
10. Goodman, T. and Rayner, D., Interim Status Report on the Optical Radiation Metrology Area, NPL Report CISE 33/99 (NPL, 1999).
11. Lord, G. J., Interim Status Report on the Ionising Radiation Area, NPL Report CISE 34/99 (NPL, 1999).
12. Lord, G. J., Interim Status Report on the Thermal Area, NPL Report CISE 35/99 (NPL, 1999).
13. Chorley, B. J., Interim Status Report on the Time and Frequency Area, NPL Report CISE 36/99 (NPL, 1999).
14. Hardcastle, W. A., Ellison, S. L. R. and Rayner, D., Interim Status Report on the Valid Analytical Measurements Area, NPL Report CISE 39/99 (NPL, 1999).
15. Cox, M. G., Interim Status Report on Software Activity World-wide, NPL Report CISE 40/99 (NPL, 1999).
16. Cooper, A., Guidance and Tools for Interactive Web Pages, NPL Report CISE 41/99 (NPL, 1999).