REPORT OF WORKSHOP ON NEUROINFORMATICS IN THE UK

1 Background

In the context of the ongoing OECD Global Science Working Group on Neuroinformatics [1], MRC recently commissioned a workshop on neuroinformatics in the UK. The purpose of the workshop was to establish the current state of neuroinformatics within the UK and to discuss possible ways forward. This document is made up of a report of the workshop followed by a summary and recommendations, accompanied by (i) the workshop programme, including the list of invited talks; (ii) the list of participants; (iii) possible neuroinformatics projects suggested by the participants.

2 Neuroinformatics

The term *neuroinformatics*, of relatively recent coinage, refers to the application to the neurosciences of methodologies drawn from the mathematical/physical/IT and computer sciences. This activity stretches back over some 50 years but has only recently come to the fore in the light of the rapid advances in these disciplines. It may be useful to divide the field into the following four activities:

Databases The development and use of databases within neuroscience

Computational neuroscience Mathematical and computer based modelling of the nervous system

Analytical tools Tools for the analysis of neuroscience data

Simulation tools Tools to support neural modelling by computer simulation

In addition, the idea of using ideas from neuroscience to inspire new computational paradigms has been discussed within neuroinformatics.

3 Workshop organisation

72 UK scientists with interests in neuroinformatics were identified, some of whom had attended the joint EPSRC/BBSRC/MRC workshop on neuroinformatics at Abingdon in November 1999. 52 were invited, together with representatives from MRC, EPSRC and BBSRC. 38 people attended the workshop, representing 21 HEIs and one Research Council. 4 colleagues attended from overseas, to give the international perspective. The workshop, jointly funded by MRC and EPSRC, took place in Edinburgh on September 3rd and 4th 2001. It was spread over two half-days, with a mixture of stage-setting talks and discussions in small groups. On the first half-day we concentrated on mapping out the current state of play in UK neuroinformatics and on the second half-day we discussed possible ways forward.

4 Current state of UK Neuroinformatics

1. Databases: Much interest here but there are only three UK-centred databases, with only the first of them currently being active: (1) Fly-trap (gene expression for *Drosophila* nervous system); (2) Ion channel database; (3) Neuronal morphologies.

2. Computational neuroscience: there is a large number of UK groups carrying out modelling work on a wide range of topics, particularly vision, hippocampus, motor systems and motor control, single cell properties and neural connectivity.

3. Analytical tools: several tools have been developed, most used locally rather than more widely. Exceptions are: tools for imaging analysis and tools for analysis of intracellular recordings.

4. Simulation tools: significant activity and growth here (STOCHSIM, NEOSIM), but restricted to only a few centres.

[1] See http://www1.oecd.org/dsti/sti/s_t/ms/act/cont-e.htm

Much of the discussion related to the problems encountered in developing and applying computer-based methods/techniques/results (called here *NI resources*) which involve sharing/making use of/communicating such resources electronically with other people; in addition, traditionally this activity has not been a part of neuroscience. Points **1-4** below address these issues; points **5-7** are more general.

1. Access, interoperability, quality - making intercommunication easy, including making it possible for NI resources developed elsewhere to be used in one's own application.

- Some discussants felt that common standards have to be established before significant progress can be made (the *Microsoft* model). Others felt that neuroscience is too diverse for this and people will develop the system that works best for them; in time, the best system will prevail (*cottage industry* approach).
- As a general principle for developing computing software, it was suggested that open source development is preferable and modularity is important, to maximise the chance that software developed in one domain can be combined with software developed in another.

2. IPR, ethical issues - safeguarding ownership and taking account of ethical issues surrounding the sharing of NI resources in this distributed culture.

3. Funding - the problems of obtaining funding for NI resources and for maintaining the resources once they are have been set up.

- It was recognised that the recent MRC e-Science scheme gave a possible route for funding.
- Maintenance of already developed resources could be carried out in partnership with the host institute or with commercial enterprises. It was pointed out that both MRC and NIH highlight this issue in their current funding schemes.

4. Intellectual standing - the lack of credit currently assigned to developers of NI resources as in the neuroscience community this activity is not normally regarded as having the same status as original research.

5. USA - we may be able to learn from current advances in the USA.

6. Cross-fertilisation - there are specific challenges here for other disciplines, particularly computer science, relating to, for example, interoperablity and the development of common ontologies and of intelligent databases.

5 The future of UK Neuroinformatics

5.1 Challenges to be met

7. Lack of focus. There is no focus for neuroinformatics activity within the UK. This may be not surprising given the nascent nature of the activity coupled with the highly distributed focii of different types of neuroinformatics activity carried out in very different types of department throughout the UK.

8. Common standards. There is need for integration and standardisation between different focii of activity. There was no consensus on how to do this but on balance the cottage industry approach was favoured over the Microsoft model.

9. Recruitment/retainment. Flexible methods of employing neuroinformatics specialists are needed to cope with competition for their services from other sectors.

10. Life long use. The issue of maintenance of existing computing software and systems has not yet been solved.

11. Industrial/commercial involvement. There is great scope for partnership with commercial undertakings; drug design, generic simulators are two examples, but significant progress has yet to be made.

12. **Lessons from bioinformatics.** In respect to links with industry particularly, it may be possible to learn from bioinformatics. However, it was appreciated that there are significant differences. For example, neuroinformatics techniques encompass many different levels of analysis, from molecular through cellular, network to behavioural levels and there is also a more widespread use of modelling techniques.

5.2 The way forward

13. **Critical mass.** UK neuroinformatics activity is small and growing. One way to maintain and develop critical mass is to expand UK neuroinformatics in a European and/or a USA context. Alternatively, it would help considerably to introduce measures to help integrate (in a logical sense) the already flourishing existing neuroinformatics activity being carried out across the UK.

14. **Communication.** As an interdisciplinary field, neuroinformatics potentially engages scientists from many different disciplines. Better channels of communication are needed between scientists, particularly between neuroscientists and computer scientists and mathematicians and between scientists and administrators.

15. **Education.** Knowledge of the current state and potential of neuroinformatics is extremely patchy within the UK. There is a great need for mutual education of neuroscientists and of computer scientists; and in addition mathematicians and other non-biological scientists, particularly bearing in mind the spin-offs into other disciplines.

16. **Funding possibilities.** MRC, EPSRC and BBSRC all support neuroinformatics; as does Wellcome Trust (under post-genomic programs), and coordination of the various schemes may aid integration.

17. **Don't reinvent the wheel.** There has been significant progress made in neuroinformatics and before embarking on new projects, people should be convinced that the solution that they are looking for does not already exist.

18. **Specific projects.** Finally it was suggested that enthusiasm clearly manifest at the workshop be translated into specifics and a portfolio of possible neuroinformatics research topics be developed as examples of the possibilities within neuroinformatics. This is attached as Appendix XX.

6 Summary of workshop and recommendations

- Neuroinformatics is a new, fast growing, international, e-Science related field. It builds on the rapid advances in both neuroscience and the mathematical, physical and computer sciences & IT.
- There was great enthusiasm at the workshop for the development of this field.
- The UK has made significant contributions in a number of areas in this field and there are great opportunities for future development.
- There is great potential for advances not only with reference to the neurosciences but also in computer science and also branches of mathematics and other disciplines.
- Better channels for intercommunication and mutual education are needed.
- Future development will require coordinated action on the part of individual groups.
- **It is recommended that**
  1. The existing neuroinformatics community within the UK (in excess of 70 senior scientists within academia) establish a neuroinformatics forum to act as a focal point for UK neuroinformatics.
  2. The funding needs for projects in neuroinformatics as a new and interdisciplinary subject should be addressed by the respective funding bodies.