Chapter 116
Neuroinformatics in the Netherlands

Jaap van Pelt and Arjen van Ooyen

Abstract In the past decade the Netherlands has actively participated in the OECD initiatives for an international program in neuroinformatics. Simultaneously, many activities have been unfolded towards a national program in neuroinformatics in the Netherlands. This paper briefly summarizes these activities within the national context and opportunities.

Introduction

From the beginning on, the OECD Global Science Forum initiative to promote Neuroinformatics was supported by the Netherlands. Several factors contributed to this interest. Neuroscience takes a prominent place among the life sciences. Theoretical biology programs at several universities have created a community of researchers trained in modeling in the life sciences, including the neurosciences (computational neuroscience). The Netherlands has an excellent high-speed IT infrastructure for higher education and research (SURFNET), and advanced super-computing facilities, supported by the Netherlands national computing facilities foundation (NWO-NCF). A steering group was established to promote a national neuroinformatics program, by (i) building a neuroinformatics community, (ii) organizing workshops (twice a year), working on awareness of neuroinformatics among governmental and industrial organizations, and (iii) launching a website [1]. It resulted in a Masterplan Neuroinformatics with recommendations to the Netherlands Organization for Scientific Research (NWO). At the 21th of March 2007 NWO signed the agreement with INCF through the joint support of the NWO departments for Health R&D (ZonMw), Earth and Life Sciences (ALW), Social Sciences (MaGW) and Physical Sciences (EW), making the Netherlands the 12th member of INCF.

J. van Pelt
Department of Experimental Neurophysiology, Center for Neurogenomics and Cognitive Research, VU University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands
e-mail: jaap.van.pelt@falw.vu.nl

R. Wang et al. (eds.), *Advances in Cognitive Neurodynamics*,

Masterplan Neuroinformatics

Mission

The mission of a Dutch Neuroinformatics Program is to provide a general framework of computational tools and modeling approaches in order to advance our understanding of the working of the brain. The program aims at taking away barriers in neuroscience research of data integration and conceptual insight by enabling research at higher levels of complexity, dynamics and integration. The focus is on three topics: data-basing/data-sharing (developing and applying tools to improve accessibility, sharing, and integration of neuroscientific data); data analysis and visualization (developing and applying mathematical and statistical methods to analyze and visualize the huge quantity and great complexity of neuroscientific data, such as originating from micro-, multielectrode- and photodiode arrays, and brain imaging); and computational and mathematical modeling across all levels, from gene to synapse to cognition).

National Node

The national node is aimed at coordinating neuroinformatics activities at the national level. These include actions towards an education and training program, acquiring enabling resources, and plans for sustainability.

Organization

The size of the Netherlands and the state of modern technology may permit a first stage of organization into research clusters that operate as virtual (distributed) expertise centers composed much more on a content-based definition than on a geographical or institutional organization. The field could get organized around a few common themes to create focus and critical mass such as (Fig. 116.1): (i) Web-based Data-sharing Infrastructure, (ii) Computational Platforms for Data Analysis, and (iii) Computational Modeling as typical neuroinformatics themes, and (iv) Brain Imaging and (v) Brain-Machine Interfacing as typical integrative themes. These centers should also implement a neuroinformatics educational program. Two tracts are foreseen, one aimed at (PhD/Master) students from informatics(-like) science that need education in neuroscience and another one for students in neuroscience that need education in informatics and computational and mathematical modeling.

Funding

Funding for a national neuroinformatics program need to be obtained by the neuroinformatics community itself through regular mechanisms. These include larger

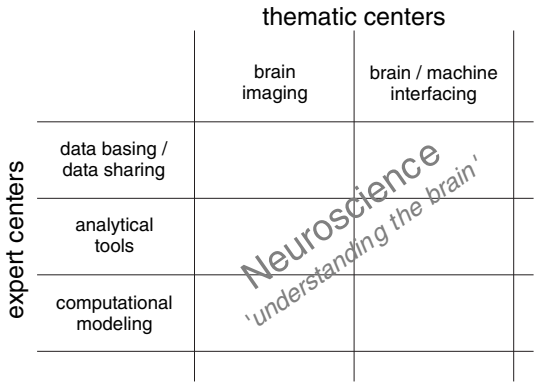

Fig. 116.1 Illustration of how expert centers and thematic centers may form an integrated field of research providing a neuroinformatics platform to help furthering our understanding of the brain

public programs, support from universities and research institutes, as well as the European Commission. Industrial interest for neuroinformatics will create a source for private funding. It is anticipated that these institutions are in particular interested in supporting (joint) expert centers for neuroinformatics research and education/training.

Neuroinformatics Community

Many research groups have expressed their interest in a national neuroinformatics program. They represent a large community of scientists from a full range of specializations encompassing basic, clinical and computational neuroscience, biophysics, mathematics, informatics and computer sciences, cognitive and psychological sciences, and biomedical engineering. Almost all general universities and all technical universities are represented, as well as several research institutes. The scientific programs of these research groups include common themes as (i) physiological processes and information processing in the brain, (ii) structural organization of the brain, (iii) computational platforms for the analysis of images and physiological data, (iv) computational platforms for modeling brain structure and function, (v) non-invasive brain imaging, (vi) data basing and data mining, grid technology, (vii) bio-informatics, and (viii) neural control and man-machine interfacing.

Within these themes research groups have build up specific expertise in experimental and computational studies at a variety of topics such as morphological and functional development of neuronal networks, firing dynamics in neuronal networks, membrane excitability, information processing in biological and artificial neural networks, electrophysiology of cortical micro-circuits, structural and functional brain imaging in development and cognition research, and in neurological (epilepsy) and psychiatric (schizophrenia) disorders, scientific visualization and computer graphics, computational geometry and geometric modeling, pattern

recognition and segmentation in computer vision, analysis and modeling of EEG, MEG, fMRI and VEP time series, neural control of human motor system, data mining and algorithmic analysis of complex data, and autonomic and self-organizing databases.

The inventory also made clear that the participating research groups provide possibilities for a full range of education and training programs on neuroinformatics topics. The neuroinformatics community has the expertise, the quality, the research and educational facilities and, above all, the enthusiasm, for making the Netherlands well prepared to execute a national neuroinformatics program at the highest international competitive standards.

Related National Initiatives

BIG GRID

A proposal for the organization of a national infrastructure for e-science on the basis of grid technology (BIG GRID) has recently been awarded by NWO [2]. The e-Science infrastructure to be built is intended to provide Grid based facilities for data-basing/archiving, data communication and computing power for data analysis. Because these facilities implement basic resources for a neuroinformatics program, the NI steering group has strongly supported this Big Grid proposal. Big Grid facilities are especially beneficial when resource demands are high, such as in the case of image data bases requiring large amounts of storage capacity, and in the case of large scale brain modeling, requiring substantial compute power. Facilities for secure communication with on the fly encryption via dedicated optical links may be highly relevant for ethical and IPR-sensitive applications. The optimal architecture concerning centralized/distributed facilities needs further to be investigated.

Neurofederation

In December 2005 the Dutch Neurofederation formulated her vision on next decade brain research in the *Strategy Plan Brain Research 2005-2015* [3]. There is a great societal need for brain research because of brain diseases, aging, educational challenges, understanding human behavior, and for the development of man-machine interfaces. New challenges are identified at gene-environment interaction, brain & cognition, plasticity and (de)regeneration. Integrative neurosciences and neuroinformatics are seen as key approaches for the realization of these challenges.

Systems Biology

In line with international developments Systems Biology is also an emerging field in the Netherlands, not in the least by the activating work of the Dutch Platform for

System Biology [4]. With the promotion of computational modeling approaches to integrate data and knowledge over different levels of biological organization, there is great resonance with neuroinformatics, focussing on the nervous system.

National Initiative Brain & Cognition

A National Initiative Brain & Cognition is presently in preparation [5]. This initiative aims at bundling and integrating national research of the brain and cognition into a coherent program for fundamental and applied research. Such an integrated program is timely because of the advancements in science and technology now enabling the bridging of cognitive and brain science. With this initiative a platform is formed for applied research towards learning and memory, communication, brain disorders, and integrative cognition and neuroscience. The initiative will put a strong requirement on the integration of data and knowledge and the availability of tools for data analysis and exploration and for computational modeling. Neuroinformatics will therefore play a crucial role in the realization of this initiative.

References

1. http://www.neuroinformatics.nl
2. http://www.nikhef.nl/grid/BIG/
3. http://www.neurofederatie.nl/publications/index.htm
4. http://www.systembiology.net/sbnl/
5. http://www.nwo.nl/nwohome.nsf/pages/NWOA_6TTC8C