

Policy Workshop Neuroinformatics
in the Netherlands and the International Perspective
Friday, January 30th, 2004, The Hague

Inventories on Neuroinformatics Resources in The Netherlands

(February 3, 2004)

I. Research Groups

II. Education and Training

III. Graduate Schools and other Organizations

IV. Journals, Publications and References

I. Research Groups

Research group:

KUN – Department of Biophysics – Prof C.C.A.M. Gielen

Research theme:

Neuronal information processing in biological and artificial neural networks

Data resources and databases:

- Action potentials from single-unit recordings in the monkey auditory system and oculomotor system (time of action potentials related to auditory/visual stimuli and eye/head movements)
- Models and simulated responses of various types of neurons
- Models and simulated responses of various types of neuronal networks

Acquisition tools:

- Single-unit recordings in trained monkeys

Analysis tools:

- Matlab
- Software in C++

Modeling tools:

- Software written in Matlab and C++

Research group:

VUA – Institute for Neurosciences, Department of Experimental Neurophysiology – Prof A.B. Brussaard

Research theme:

Electrophysiological research in brain slices

Data resources and databases:

- Activity of synapses, neurons, microcircuits and neural networks
- Ion currents and (sub)cellular morphology
- Synaptic (plasticity) mechanisms

Acquisition and analysis tools:

Modeling tools:

- Neuron (Hines)
- Matlab

Research group:

UU – RMI – Clinical Neuroscience – Prof N.F. Ramsey

Research theme:

Clinical Neuroscience,
Functional brain imaging in neurological (epilepsy) and psychiatric
(schizophrenia) disorders. Research on mechanisms of fMRI, experimental and
task design, neurophysiology of executive functions and language

Data resources and databases:

- FMRI data sets and EEG data sets stored as raw data in LINUX data storage and processing systems

Acquisition tools:

- MRI and direct cortical recording systems

Analysis tools:

- Own programs in IDL, Matlab, C, Minc (Montreal), SPM, FSL toolbox

Modeling tools:

- IDL and Matlab signal processing and image processing toolboxes
- Task design: MEL, E-prime, Presentation

Research group:

RUG – Department of Mathematics and Computer Graphics – Prof J.B.T.M.
Roerdink
Participation in BCN via the Neuroimaging Centre of the University of
Groningen.

Links:

Research Group: <http://www.rug.nl/informatica/onderzoek/programmas/svcg/>
Personnel home page: <http://www.cs.rug.nl/~roe>
School BCN: <http://www.rug.nl/bcn>
Groningen Visualization Center (GVC): <http://www.rug.nl/gvc/>

Reality Centre: <http://www.rug.nl/gvc/facilities/realitycentre>

Research theme:

Scientific Visualization and Computer Graphics, Computational Geometry and Geometric Modeling

Data resources and databases:

- Type of data: 2D-3D image data (MRI, fMRI, PET, EEG, EMG).
- Data acquired at the Neuroimaging Centre are stored and archived at the Storage Area Network of the Computing Centre of the University of Groningen.
- Data acquired at the Academic Hospital Groningen are stored locally at the Department of Radiology and the Pet Centre

Acquisition tools:

At Academic Hospital Groningen:

- Neuroimaging Centre of the University (3T Philips MRI scanner),
- Department of Radiology (1.5 T MRI scanner)
- PET Centre (several PET cameras)

Analysis tools:

- General image processing software,
- Signal analysis software,
- Wavelet routines (Matlab tool boxes, IDL, ImageJ, in-house software in C++ and Java),
- Volume rendering software (AVS, VTK, Amira),
- Software for statistical analysis of functional neuroimaging data (SPM toolbox under Matlab, in-house software),
- Brain imaging software (Brain Voyager), EEG analysis software (Besa).
- Visualization facilities include a CAVE Virtual Environment and a Reality Theater, located in the Visualization Center of the University.

Modeling tools:

- Multidimensional signal processing,
- Fourier and wavelet transforms,
- Geometrical object modeling,
- Mathematical morphology,
- Pattern recognition,
- Graph theory,
- Network modeling,
- Statistical models for brain activation.

Research group:

VUA – Institute for Neurosciences, Department of Experimental
Neurophysiology – Dr. N. Cornelisse

Research theme:

Synaptic vesicle release

Data resources and databases:

- Voltage / current clamp data in Axon binary files

Acquisition tools:

- Pclamp / HEKA software (for Axon amplifiers and HEKA amplifiers)
- Matlab

Analysis tools:**Modeling tools:**

- Matlab
- C

Research group:

NIH – Research Group Neurons & Networks – Dr. Jaap van Pelt, Dr. Arjen van
Ooyen

Research theme:

Plasticity and information processing in neurons and networks

Data resources and databases:

- Data sets of multi-electrode firing activity in cultured neuronal networks
- High-resolution time-lapse video microscopy of outgrowing neurons in tissue culture
- 3D reconstructions of neuronal branching patterns of pyramidal and multipolar nonpyramidal rat cortical neurons

Acquisition tools

- Semi-automatic dendrite reconstruction system
- Multi-electrode array action potential recording systems
- High resolution time lapse video microscopy system

Analysis tools:

- Home-made software tools (Fortran) for the reconstruction and analysis of dendritic branching patterns

- Home-made software tools (Fortran, Matlab) for the analysis of multi-electrode spike trains

Modeling tools:

- Home-made software tools (Fortran) for modeling the outgrowth and the geometry of dendritic branching patterns
- Home-made software tools (C++) for modeling the firing dynamics and spatio-temporal patterning in neuronal networks
- Home-made software tools (Neuron) for modeling the signal integration and action potential generation in neurons with specified geometries

Research group:

KUN – F.C. Donders Center – Prof P. Hagoort

Research theme:

Cognitive Neuroscience
Functional brain imaging, focusing on cognition in perception, action, memory and language

Data resources and databases:

- 2D and 3D fMRI, EEG and MEG data sets obtained in experiments on perception, action, memory and language.
- Advanced analysis tools for source localization
- Models and simulated responses of various types of neuronal networks

Acquisition tools:

- 1.5 and 3.0 Tesla fMRI scanners
- A whole-head, 151-channel MEG scanner
- Three EEG laboratories
- Integrated stimulus presentation facilities

Analysis tools:

- General image processing software
- Brain Voyager for analyzing brain imaging data.
- EEG analysis software

Modeling tools:

- Software written in Matlab and C++
- Pattern recognition,
- Neural Network modeling,
- Statistical models for finding temporal structure in brain-imaging signals.

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Research group:

RuG - Institute of Mathematics and Computing Science - Research group
Intelligent Systems - prof.dr.sc.techn. N. Petkov, dr. M. Biehl, dr M. Wilkinson
Links: www.cs.rug.nl/~petkov, www.cs.rug.nl/~imaging

Research theme:

Development of models of the visual cortex and their use in computer simulations and practical computer vision algorithms (Petkov). Fundamentals of neural networks and machine learning (Biehl).

Data resources and databases:

Database of natural images with associated subjectively defined object contour maps. This database can be used for performance evaluation of computer models of contour detection mechanisms.

Acquisition tools:

— n.a.

Analysis tools:

— n.a.

Modeling tools:

- Computer programs (mostly in MatLab) for the simulation of populations of orientation selective visual neurons (simple, complex, and grating cells, augmented with non-classical receptive field modulation).
- Computer algorithms for texture and contour detection.

Some recent publications:

- C. Grigorescu, N. Petkov, and M. A. Westenberg. Contour and boundary detection improved by surround suppression of texture edges, J. Image and Vision Computing, 2004, in press.
- C. Grigorescu and N. Petkov. Distance sets for shape filters and shape recognition, IEEE Trans. on Image Processing, 2003, 12 (10) 2003, 1274-1286.
- C. Grigorescu, N. Petkov, and M. A. Westenberg. Contour detection based on non-classical receptive field inhibition, IEEE Trans. on Image Processing, 12 (7) 2003, 729-739.
- N. Petkov and M. A. Westenberg. Suppression of contour perception by band-limited noise and its relation to non-classical receptive field inhibition, Biological Cybernetics, 88, 2003, 236--246.
- S.E. Grigorescu, N. Petkov and P. Kruizinga. Comparison of texture features based on Gabor filters, IEEE Trans. on Image Processing, Vol. 11, No. 10, pp.1160-1167, 2002.
- P. Kruizinga and N. Petkov. Nonlinear Operator for Oriented Texture. IEEE Transactions on Image Processing, 8 (10), 1999, 1395-1407.
- N. Petkov, and P. Kruizinga. Computational models of visual neurons specialized in the detection of periodic and aperiodic oriented visual stimuli: bar and grating cells, Biological Cybernetics, 76 (2), 1997, 83-96.

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Research Group:

UVA - Department of Psychology - Prof J. van der Pligt
UVA - Psychonomics - Prof J. Raaijmakers, Prof V. Lamme, Prof. A. Kok
UVA - Developmental Psychology - Prof M. van der Molen, Prof. H. van der Maas, Prof K.R. Ridderinkhof
UVA - Psychological Methods - Prof P. Molenaar

Research Themes:

Cognitive Processes, Arousal and Information Processing, Brain and Development, Developmental Processes.

Data Resources and databases:

- EEG, ERP, MEG, fMRI data sets obtained in experiments on perception, attention, memory, cognitive control
- Tools for ERP source analysis, single trial and habituation analysis, adaptive signal analysis (for interaction between cortical areas)
- Models and neural networks, simulation data

Acquisition tools:

- fMRI (1.5 Sonata, 3T Philips), EEG (Biosemi), MEG (CTF), TMS (magstim), single en multi unit recordings equipment (custom build), basic histological unit, Neural Networks (Python, C++), 64 channel BrainProducts EEG DC system, EEG (NeuroScan), eye-tracking (iView), ECG, integrated stimulus presentation facilities

Analysis tools:

- Spike, BrainVoyager, BrainVision Analyser, MRIReg, Matlab, SPM, Python.,ASA (Advanced Source Analysis, ANT Software), Redux, Soft, dedicated software

Modeling tools:

- Software in Matlab, C++, SPM, Python, BrainVoyager, Transform techniques (Fourier, wavelet), neural networks, recursive filtering techniques

Education and training

- Methods in Cognitive Neuroscience, (Advanced) Signal analysis, Mathematical Psychology

Research group:

TUE – Department of Biomedical Engineering – Group Biomedical Image Analysis – Prof B.M. ter Haar Romeny

Research themes:

Medical imaging, pattern recognition and segmentation
Computer vision

Data resources and databases:

- Type of data: 2D, 3D, 4D and tensorial image data (CT, MRI, fMRI, PET, US, SPECT, DTI, 2-photon fluoroscopy and confocal microscopy);
- We are connected by secure ftp to the clinical imaging database of the University Hospital Maastricht (access to several millions of images), the Eindhoven Maxima Medical Center and the Magnetic Resonance Laboratory of TUE;

Analysis tools:

- MathVisionTools, our own library written in Mathematica;
- EasyScil, Philips research libraries for medical workstation development;
- Volume rendering software: EasyVision, Vital Images, many own routines;
- Mathematica, for general symbolic and numerical calculations;
- Packages for wavelets, statistics, signal analysis, image processing;
- C++, Java, Matlab

Modeling tools:

- Primarily Mathematica (www.wolfram.com);

II. Education and training

KUN – Stichting Neurale Netwerken SNN:

- **Computational Neuroscience.** (Masterfase fysica opleiding)
Inhoud: modellen/theorie over neuronen, biologische neuronale netwerken en informatieverwerking. Zie Handbook of Biological Physics IV, Elsevier.
- **ASCI-cursus Adaptieve Intelligentie** (samen met groep IAS (Krose) van UvA)
Onderwerp: adaptieve modellen voor patroonherkenning en database-mining. Deze cursus is nu vooral ge-ent op machine learning aspecten, maar kan ook worden aangepast voor soortgelijke problemen in de Neuroinformatica.
 - o Introduction Pattern Recognition (Bishop, 6 EC points, Spring 2004)
 - o Machine Learning (Mackay, 6 EC points, Spring 2004)
 - o ASCI course advanced issues Neurocomputing (1 week course, carol.science.uva.nl/~krose/aicn)
- Toolkit for Neuroimaging: data-acquisition and analysis

TUE - School for Information and Knowledge Systems SIKS

- Databases and Interactive systems
- Implementation intelligent search in XML data

VUA - Institute for Neurosciences – Department of Experimental Neurophysiology

- Institute for Integrative Bioinformatics
- Bachelors / Masters courses in Bioinformatics

UU - RMI

- Masters Neuroscience – Functional Imaging

RUG – Department of Mathematics and Computing Science

- Master Courses in Scientific Visualization and Pattern Recognition

RUG – School for Behavioral, Cognitive and Neurosciences BCN

- Courses, master classes and special lectures in Behavioral and Cognitive Neuroscience

ONWA – Graduate School Neurosciences Amsterdam

- General Advanced Course in Neuroscience
- Course Experimental Neurophysiology
- Course in Morphometry and Stereology in Neurosciences

UVA - Department of Psychology

- Methods in Cognitive Neuroscience, (Advanced) Signal analysis, Mathematical Psychology

TUE – Advanced School for Computing and Imaging ASCI

- Yearly national PhD course Front-End Vision and Multi-Scale Image Analysis (<http://www.bmi2.bmt.tue.nl/image-analysis/education/courses/FEV/course/index.html>) (25-35 participants each year).

III. Graduate Schools and Other Organizations

Graduate Schools

European Graduate School of Neuroscience (EURON)
<http://www.euron.unimaas.nl/>

Graduate School Neurosciences Amsterdam (ONWA)
<http://www.onwa.med.vu.nl/>

The Graduate School for Behavioral and Cognitive Neurosciences (BCN)
<http://www.rug.nl/bcn>

Rudolf Magnus Institute for Neurosciences / Graduate School Pathophysiology of the Nervous System, University of Utrecht (NPZ)

Experimental Psychology Graduate School (EPOS)
<http://www.epos.fmg.uva.nl/>

Nijmegen Institute for Cognition and Information (NICI)
<http://www.nici.kun.nl/>

Helmholtz Research Institute
<http://www.phys.uu.nl/~wwwfm/Home.html/>

School for Information and Knowledge Systems (SIKS)
<http://www.siks.nl/index.html>

Organizations involved in Neuroinformatics

KNAW: Royal Netherlands Academy of Arts and Sciences
<http://www.knaw.nl/>

NWO: Netherlands Organisation for Scientific Research
<http://www.nwo.nl/>

STW / NWO: Dutch Technology Foundation
<http://www.stw.nl/>

ZONMW / NWO - Medical and Health Research Council
<http://www.zonmw.nl/>

ALW / NWO – Earth and Life Sciences Foundation

SION / EW / NWO - Foundation for Informatics Research in the Netherlands

NCF - National Computing Facilities Foundation

http://www.nwo.nl/nwohome.nsf/pages/ACPP_4X6R5C

Dutch Society for Biophysics and Biomedical Technology

<http://www.vvb-bmt.nl/>

SNN - Foundation for Neural Networks

<http://www.mbfys.kun.nl/SNN/>

Neurofederation

<http://www.neurofederatie.nl/>

IV. Journals, Publications and References

Neuroinformatics Journals

Neuroinformatics Journal

<http://www.neuroinformaticsonline.com>

J. Integrative Neuroscience

<http://www.worldscinet.com/jin/jin.shtml>

Network: Computation in Neural Systems

<http://www.iop.org/Journals/ne>

Some recent publications

Eckersley, P., Egan, G.F., Amari S-I., Beltrame, F., Bennett, R., Bjaalie, J.G., Dalkara, T., De Schutter, E., Gonzalez, C., Grillner, S., Herz, A., Hoffman, K.P., Jaaskelainen, I.P., Koslow, S.H., Lee, S-Y., Matthiessen, L., Miller, P.L., Da Silva, F.M., Novak, M., Ravindranath, V., Ritz, R., Ruotsalainen, U., Subramaniam, S., Toga, A.W., Usui, S., Van Pelt, J., Verschure, P., Willshaw, D., Wrobel, A., and Yiyuan, T. - Neuroscience data and tool sharing - A legal and policy framework for neuroinformatics. *Neuroinformatics Journal* 1 (2003) 149-166.

Van Pelt, J. (Ed) Special issue on quantitative neuroanatomy and neuroinformatics. *Network: Comput. Neural Syst.* 13 (2002) 243-428

Cannon, R.C., Howell, F.W., Goddard, N.H., and De Schutter, E. Non-curated distributed databases for experimental data and models in neuroscience – *Network: Comput. Neural Syst.* 13 (2002) 415-428.

Kaspirzhny, A.V.B. Cogan, P., Horschelle-Bossavit, G., Tyc-Dumont, S. Neuronal morphology data bases: morphological noise and assessment of data quality – *Network: Comput. Neural Syst.* 13 (2002) 357-380.

Bjaalie, J.G., Opinion: Localization in the brain: new solutions emerging - *Nat Rev Neurosci.* 3(4) (2002) 322-325

Koslow, S.H., Sharing primary data: a threat or asset to discovery? - *Nat Rev Neurosci.* 3(4) (2002) 311-313.

Roland, P. Svensson, G., Lindeberg, T., Risch, T., Baumann, P., Dehmel, A., Frederiksson, J., Halldorson, H., Forsberg, L., Young, J., Zilles, K. A database generator for human brain imaging. *TINS* 24 (2001) 562-564.

Aldhous, P. Prospect of data sharing gives brain mappers a headache. *Nature* 406 (2000) 445-446.

Opinion - Whose scans are they, anyway? *Nature* 406 (2000) 443.

Jennings, C., Aamodt, S. (Eds) Computational approaches to brain function. *Nature Neuroscience* 3 (2000) Supp pp 1160 - 1211

Smaglik, P. Internet gateway planned for neuroinformatics data. *News, Nature* 405 (2000) 603.

Editorial - A debate over fMRI data sharing - Nature Neuroscience 3(9) (2000) 845-846.

Chicurel, M. - Databasing the brain. News Feature, Nature 406 (2000) 822-825.

Koslow, S.H., commentary – Should neuroscience community make a paradigm shift to sharing primary data? Nature Neuroscience 3(9) (2000) 863-865.

Shepherd, G.M., Mirsky, S., Healy, M.D., Singer, M.S., Skoufos, E., Hines, M.S., Nadkarni, P.M., Miller, P.L. The Human Brain Project: neuroinformatics tools for integrating, searching and modeling multidisciplinary neuroscience data. Trends Neurosci. 21(11) (1998) 460-468.

Huerta, M., Koslow, S.H. Neuroinformatics: Opportunities across disciplinary and national borders. Neuroimage 4 (1996) S4-S6.

References

OECD

OECD: <http://www.oecd.org>

Report of the OECD MegaScience Forum Working Group on Biological Informatics (January 1999)
<http://www.oecd.org/dataoecd/24/32/2105199.pdf>

Report of the OECD GSF Working Group on Neuroinformatics (June 2002)
<http://www.oecd.org/dataoecd/58/34/1946728.pdf>

Proposal to Establish the International Neuroinformatics Coordinating Facility – presented at the 9th OECD GSF meeting in Paris.
Accessible via <http://www.nih.knaw.nl/~jaapvanpelt/>

Neuroinformatics portals

<http://www.neuroinf.org>

<http://www.neuroinf.de>