David C. Somers, Ph.D.

Massachusetts Institute of Technology, E25–618
Department of Brain & Cognitive Sciences
45 Carleton Street, Cambridge, MA 02139
phone: (617) 253-5428 fax: (617) 253-9829
email: somers@ai.mit.edu

156 Raymond Street
Cambridge, MA 02140
phone: (617) 497-2316

Research Overview

Research focuses on construction of model neural circuits that incorporate significant cellular and anatomical detail. Large-scale computer simulations are used to investigate mechanisms underlying physiological response properties of visual cortical neurons and their relation to perception. Dynamical systems analysis is employed to study non–linear effects in cortical circuits containing massive excitatory feedback. Related research in the dynamics of coupled neural oscillators and in neural network models of visual perception.

Training

Postdoctoral Research, Computational and Cognitive Neuroscience,
MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA. – September 1992 - present. Neuroscience research and training in the experimental laboratory of Mriganka Sur. Computational research focused on the role of local, recurrent excitatory connections in the generation of visual cortical orientation selectivity and related properties. Exposure to experimental techniques for *in vivo* and *in vitro* whole-cell patch-clamp recording, extracellular recording, and optical recording of intrinsic signals. Also exposed to various anatomical methods for studying sensory (visual, auditory, somatosensory) cortex and thalamus in adult and developing mammals.

Ph.D., Cognitive and Neural Systems,
BOSTON UNIVERSITY, Boston, MA. – August 1992. Performed thesis research under Prof. Stephen Grossberg (founder of the International Neural Network Society) and Prof. Nancy Kopell (MacArthur Fellow) on rapid synchronization of neural oscillatory activity in visual cortex and the "feature binding" problem of perception. Research and training in neural network modeling, dynamical systems analysis, and computer simulation. Coursework included Neuroanatomy, an 8 course concentration in Applied Mathematics, and neural network approaches to: Vision; Attention, Reinforcement, & Motivation; Sensory-Motor Control; Learning & Pattern Recognition; and Speech & Audition.

B.S., Mathematics and Computer Science,
HARVEY MUDD COLLEGE, Claremont, CA. May 1987. Psychology Minor.

Awards & Honors

NIH Postdoctoral Research Fellow, Theoretical and Computational Neuroscience, NIMH, 1994+.
McDonnell–Pew Fellow in Cognitive Neuroscience. 1992-1994.
NASA Graduate Student Research Fellow. 1989–1992.
Presidential University Fellow, Boston University, 1988–89.
Thomas J. Watson Fellow, Independent Study in England, India, & Nepal, 1987–88.
Who's Who Among Students in American Colleges and Universities, 1987.
College Fellow, Harvey Mudd College, 1986–87. Awarded for academic ability and independence.
Student Body President, Harvey Mudd College, 1985–86.

Professional Activities

NSF, Program in Computational Neuroscience. Special Grant Reviewer. 1994.
Neural Networks. Manuscript Reviewer. 1991-1994.
McDonnell-Pew Cognitive Neuroscience Colloquium Series at MIT. Series Coordinator. 1993-1994.
Computational Neuroscience Journal Club at MIT. Founding Organizer. 1994.

Computing Skills

Expert in numerical simulation of ordinary differential equations. Wrote SPIKETIME/CORTEX Neural Simulation package for use on Unix Workstations and CM-5 Connection Machines. Fluent in C, Pascal, and UNIX shell tools. Familiar platforms include CM-5 Connection Machine, SUN, Silicon Graphics, IBM PC, and Apple Macintosh.

Research Papers

Publications

1. Grossberg, S., and Somers, D. (1991) Synchronized oscillations during cooperative feature linking in a cortical model of visual perception. *Neural Networks*, **4**, 453–466.

2. Grossberg, S., and Somers, D. (1992) Synchronized oscillations for binding spatially distributed feature codes into coherent spatial patterns. *Neural Networks for Vision and Image Processing.* G.A. Carpenter and S. Grossberg (Eds.) Cambridge, MA: MIT Press.

3. Grossberg, S., and Somers, D. (1992) Synchronized oscillations for binding spatially distributed features into preattentive brain representations. *Structure: From Physics to General Systems.* E. R. Caianello, M. Marinaro, and G. Scarpetta, (Eds.) World Scientific Press.

4. Somers, D., and Kopell, N. (1993) Rapid synchronization through fast threshold modulation. *Biological Cybernetics* **68**, 393-407.

5. Somers, D., Nelson, S.B., and Sur, M. (1995) An emergent model of visual cortical orientation selectivity. *Computation and Neural Systems, III.* J.M. Bower (Ed.) Norwell, MA: Kluwer Academic Press, in press.

6. Kopell, N., and Somers, D. (1995) Anti-phase solutions in relaxation oscillators coupled through excitatory interactions. *Journal of Mathematical Biology* **33**, 261–280.

7. Somers, D., and Kopell, N. (1995) Waves and synchrony in networks of oscillators of relaxation and non-relaxation type. *Physica D: Nonlinear Phenomena*, in press.

8. Somers, D., Nelson, S.B., and Sur, M. (1995) An emergent model of orientation selectivity in cat visual cortical simple cells. *Journal of Neuroscience*, in press.

9. Somers, D., Nelson, S.B., and Sur, M. Surround suppression and facilitation in a visual cortical circuit with fixed synaptic strengths. In preparation.

10. Somers, D. Temporal dynamics of orientation tuning in a recurrent excitatory visual cortical circuit. In preparation.

Abstracts

11. Grossberg, S., and Somers, D. (1991) Synchronized oscillations during cooperative feature linking in visual cortex. *Proceedings of the International Joint Conference on Neural Networks, 1991 SEATTLE, Vol. 2*, 249–254.

12. Somers, D., and Grossberg, S. (1991) Synchronized oscillations during cooperative feature linking in a model of visual cortex. *Society for Neuroscience Abstracts*, **17**, 479.2.

13. Somers, D., and Kopell, N. (1992) Threshold properties of individual model neural oscillators contribute to rapid network synchronization and may potentially play a role in perceptual feature binding. *Society for Neuroscience Abstracts*, **18**, 131.6.

14. Somers, D. (1993) Dynamic feature binding properties of neural relaxation oscillators. *Invest. Opthalmol. Vis. Sci. Suppl.*, **34** (4), 457.

15. Somers, D., Nelson, S.B., and Sur, M. (1993) A computational investigation of the role of short–range intracortical excitation in orientation selectivity in visual cortex. *Society for Neuroscience Abstracts*, 19:263.5.

16. Somers, D., Nelson, S.B., and Sur, M (1994) Effects of long-range connections on gain control in an emergent model of visual cortical orientation selectivity. *Society for Neuroscience Abstracts*, 20:646.7.

Note: Papers with S. Grossberg were published in accordance with departmental policy of listing authors alphabetically.