BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
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NAME	POSITION TITLE
John P. Donoghue	Professor
eRA COMMONS USER NAME JDONOGHUE	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Boston University	A.B.	1972	Biology
University of Vermont	M.S.	1976	Anatomy
Brown University	Ph.D.	1979	Neuroscience

A. Personal Statement My research investigates fundamental and translational aspects of cortical information processing that leads to skilled motor behavior. We study the way ensembles of neurons represent and transform information through their interactions within local regions and between the primary motor cortex and its major cortical input areas. This work helps to explain how networks of neurons compute motor actions and transform sensory and internal plans into specific movements of the limbs. My lab has developed novel chronic multielectrode recording methods to study these interactions in behaving monkeys and has advanced methods to evaluate neural interactions at the population level during skilled reaching and grasping actions. I have 30 years experience with neural recordings in behaving primates with an active, funded research program that can provide abundant non-human primate multielectrode array data for Dr. Truccolo's project. In our applied work, we have translated our technical and basic neuroscience advances to create a neural interface system, termed "BrainGate", that is designed to connect the brain to the muscles or to assistive devices for people with paralysis. I am the senior investigator in this multidisciplinary project and have led the transformation from basic laboratory studies to human clinical trials. A pilot stage device is being evaluated and developed in a pilot human clinical trial by this interdisciplinary group. Initial results show that people paralyzed after spinal cord injury, stroke or ALS are able to produce useful control signals that are derived from neural signals in their motor cortex, years after their injury. Thus, I have already collected data sufficient for the proposed project and will continue to obtain relevant neurophysiological data from human and non-human primates. My considerable experience in systems neuroscience research as well as mentorship of many graduate, postdoctoral and undergraduate students will also help in my role as co-investigator in this project.

B. Positions and Honors.

Positions and Employment

1979–1980	NIH Postdoctoral Fellow (with Dr. S.T. Kitai), Department of Anatomy, Michigan State University, East Lansing, Michigan
1980–1984	Staff Fellow, Laboratory of Neurophysiology (with Dr. E.V. Evarts) NIMH, NIH, Bethesda, Maryland
1984–1988	Assistant Professor, Center for Neural Science, Brown University, Providence, RI
1988–1992	Associate Professor, Center for Neural Science, Brown University, Providence, RI
1990–1992	Scientific Director, Unit for Parkinson's Disease and Movement Disorders of Clinical Neuroscience, Brown University
1992–2006	Professor and Chairman, Department of Neuroscience
1999–present	*Director*, Brain Science Program (Institute for Brain Science Director as of 2008)
2001–present	Henry Merritt Wriston Professor
2008–present	Senior Research Scientist Department of Veterans Affairs, Providence VAMC
2008-present	Professor of Engineering

Other Experience and Professional Memberships

1986	*March of Dimes Basil O'Connor Fellow*
1991-1995	*Member*, Biopsychology Study Section, NIH
1991-1995	*Associate Editor*, Cerebral Metabolism
1994	Learning and Intelligent Systems Panel, NSF
1994-2002	*Associate Editor*, Journal of Neuroscience
1996-2002	*Associate Editor*, Contemporary Neurology (now Neurology & Clincial Neurophysiology)
1997	National Academy of Sciences - Space Biology Review Panel
1998-	*Special Reviewer*, NINDS, NIH
2004	*Discover Award (Discover Magazine)*
2005	*Fellow* AIMBE
2001	*NINDS NIH Javits Award*
2008	*Fellow* AAAS
2007-	*Scientific Advisory Board,* IEEE Neural Engineering
2007	*Zülch Prize* Reemstma Foundation/Max Planck Germany
2008-	*Editorial Board* Frontiers in Neural Prosthetics
2006-2009	*Scientific Advisory Board* Biodesign Institute Arizona State University
2008-	*Corporation External Review Committee,* Media Lab, MIT
2009-	*In Praise of Medicine Prize,* University of Rotterdam, Netherlands

C. Selected peer-reviewed publications (in chronological order).
(Publications selected from 84 peer-reviewed publications)

Truccolo W, Hochberg LR, Donoghue JP (2009). Collective dynamics in human and monkey sensorimotor cortex: Predicting single neuron spikes. Nature Neuroscience, 6 Dec 2009.

Song YK, Borton DA, Park S, Patterson WR, Bull CW, Laiwalla F, Mislow J, Simeral JD, Donoghue JP, Nurmikko AV (2009). Active microelectronic neurosensor arrays for implantable brain communication Interfaces. IEEE Transactions on Neural Systems and Rehabilitation Engineering vol. 17, issue 4, August 2009 339-345.

Hatsopoulos NG, Donoghue JP (2009). The Science of Neural Interface Systems. Annu Rev Neurosci. 2009 Mar 24.

Donoghue, JP (2008). Bridging the brain to the world: a perspective on neural interface systems, Neuron, Vol. 60, November 6, 2008, pp. 511-521.

Kim SP, Simeral JD, Hochberg LR, Donoghue JP and Black MJ (2008). Neural control of computer cursor velocity by decoding motor cortical spiking activity in humans with tetraplegia. J. Neural Eng. 5 455-476.

Philip BA, Wu Y, Donoghue JP, Sanes JN. (2008). Performance differences in visually and internally guided continuous manual tracking movements. Experimental Brain Research, 2008 July 23, 190, 475-491.

Truccolo W, Friehs GM, Donoghue JP, Hochberg LR (2008). Primary Motor Cortex Tuning to Intended Movement Kinematics in Humans with Tetraplegia. Journal of Neuroscience January 30, 2008, 28(5):1163 1178.

Song YK, Stein J, Patterson WR, Bull CW, Davitt KM, Serruya MD, Zhang J, Nurmikko AV, Donoghue JP (2007). A microscale photovoltaic neurostimulator for fiber optic delivery of functional electrical stimulation. J Neural Eng. Sep;4(3):213-8. Epub 2007 Apr 27.

Vargas-Irwin C, Donoghue JP (2007). Automated spike sorting using density grid contour clustering and subtractive waveform decomposition. J Neurosci Methods. Aug 15;164(1):1-18.

Donoghue JP, Nurmikko A, Black M, Hochberg LR (2007). Assistive technology and robotic control using motor cortex ensemble-based neural interface systems in humans with tetraplegia. J Physiol. Mar 15;579(Pt 3):603-11.

Truccolo W, Donoghue JP (2007). Nonparametric modeling of neural point processes via stochastic gradient boosting regression. Neural Comp. Mar 19(3): 672-705.

Ojakangas CL, Shaikhouni A, Friehs GM, Caplan AH, Serruya MD, Saleh M, Morris DS, Donoghue JP (2006). Decoding movement intent from human premotor cortex neurons for neural prosthetic applications. J Clin Neurophysiol. Dec;23(6):577-84

Hochberg LR, Donoghue JP. (2006) Sensors for brain-computer interfaces. IEEE Eng Med Biol Mag. Sep-Oct;25(5):32-8. No abstract available.

Hochberg LR, Serruya MD, Friehs GM, Mukand JA, Saleh M, Caplan AH, Branner A, Chen D, Penn RD, Donoghue JP (2006). Neuronal ensemble control of prosthetic devices by a human with tetraplegia. Nature. Jul 13;442(7099):164-71.

Wu W, Gao Y, Bienenstock E, Donoghue JP, Black MJ (2006). Bayesian Population Decoding of Motor Cortical Activity Using a Kalman Filter. Neural Computation. Jan 18(1):80-118S

Truccolo W, Eden UT, Fellows MR, Donoghue JP, Brown EN (2005). A point process framework for relating neural spiking activity to spiking history, neural ensemble, and extrinsic covariate effects. J Neurophysiol. 93(2):1074-89.

Shoham S, Paninski LM, Fellows MR, Hatsopoulos NG, Donoghue JP, Normann RA (2005). Statistical encoding model for a primary motor cortical brain-machine interface. IEEE Trans Biomed Eng. Jul;52(7):1312-22.

Song YK, Patterson WR, Bull CW, Beals J, Hwang N, Deangelis AP, Lay C, McKay JL, Nurmikko AV, Fellows MR, Simeral JD, Donoghue JP, Connors BW (2005). Development of a chipscale integrated microelectrode/microelectronic device for brain implantable neuroengineering applications. IEEE Trans Neural Syst Rehabil Eng. Jun;13(2):220-6.

Suner S, Fellows MR, Vargas-Irwin C, Nakata K, Donoghue JP (2005). Reliability of signals from chronically implanted, silicon-based electrode array in non-human primate primary motor cortex. IEEE Transactions in Neural Systems and Rehabilitation Engineering Dec. 13(4):524-541.

Paninski L, Shoham S, Fellows MR, Hatsopoulos NG, Donoghue JP (2004). Superlinear population encoding of dynamic hand trajectory in primary motor cortex. J Neurosci. Sep 29;24(39):8551-61.

Wu W, Black MJ, Mumford D, Gao Y, Bienenstock E, Donoghue JP (2004). Modeling and decoding motor cortical activity using a switching Kalman filter. IEEE Trans Biomed Eng. Jun;51(6):933-42.

Paninski L, Fellows MR, Hatsopoulos NG, Donoghue JP (2004). Spatiotemporal tuning of motor cortical neurons for hand position and velocity, *J Neurophysiol*. Jan;91(1):515-32.

Serruya M, Donoghue JP (2004). Design principles of a neuromotor prosthetic device, *Series on Bioengineering & Biomedical Engineering: Neuroprosthetics: Theory and Practice*, vol 3, World Scientific.

Patterson WR, Song Y-K, Bull CW, Ozden I, Deangellis AP, Lay C, McKay JL, Nurmikko AV, Donoghue JP, and Connors BW (2004). A Microelectrode/microelectronic hybrid device for brain implantable neuroprosthesis applications. IEEE Transactions on Biomedical Engineering, vol. 51, No. 10, 1845-1853.

Fofonoff TA, Martel SM, Hatsopoulos NG, Donoghue JP, Hunter IW (2004). Microelectrode array fabrication by electrical discharge machining and chemical etching. IEEE Trans Biomed Eng. Jun;51(6):890-5.

Donoghue JP, Nurmikko A, Friehs G, and Black MJ (2004). Development of a neuromotor prosthesis for humans. Suppl Clin Neurophysiol. 2004;57:592-606.

Wu W, Shaikhouni A, Donoghue JP, Black MJ (2004). Closed loop neural control of cursor motion using a Kalman filter Proc. IEEE Engineering in Medicine and Biology Society: 4126-4129, San Francisco, September.

Wood FD, Fellows M, Donoghue JP, Black MJ (2004). Automatic spike sorting for neural decoding Proc. IEEE Engineering in Medicine and Biology Society: 4009-4012, San Francisco, September.

Gao Y, Black MJ, Bienenstock E, Wu W, Donoghue JP (2003). A quantitative comparison of linear and non-linear models of motor cortical activity for the encoding and decoding of arm motions. *Neural Engineering, 2003. Conference Proceedings. First International IEEE EMBS Conference*, 20-22 March Pages:189–192.

Serruya M, Hatsopoulos NG, Fellows M, Paninski L, Donoghue JP (2003). Robustness of neuroprosthetic decoding algorithms, *Biological Cybernetics*, vol 88: 219-228.

Hatsopoulos NG, Paninski L, Donoghue JP (2003). Sequential movement representations based on correlated neuronal activity, *Exp Brain Res*, 149 (4): 478-86.

Rioult-Pedotti MS, Friedman D, Donoghue JP (2000). Learning-induced LTP in neocortex. Science. 2000 Oct 20;290(5491):533-6.

D. Research Support

For New and Renewal Applications (PHS 398) – DO NOT SUBMIT UNLESS REQUESTED
For Non-competing Progress Reports (PHS 2590) – Submit only Active Support for Key Personnel

PHS 398/2590 OTHER SUPPORT

Provide active support for all key personnel. **Other Support includes all financial resources, whether Federal, non-Federal, commercial or institutional, available in direct support of an individual's research endeavors, including but not limited to research grants, cooperative agreements, contracts, and/or institutional awards.** Training awards, prizes, or gifts do not need to be included.

There is no "form page" for other support. Information on other support should be provided in the *format* shown below, using continuation pages as necessary. ***Include the principal investigator's name at the top and number consecutively with the rest of the application.*** The sample below is intended to provide guidance regarding the type and extent of information requested.
For instructions and information pertaining to the use of and policy for other support, see Other Support in the PHS 398 Part III, Policies, Assurances, Definitions, and Other Information.
Note effort devoted to projects must now be measured using person months. Indicate calendar, academic, and/or summer months associated with each project.

Format

NAME OF INDIVIDUAL
ACTIVE/PENDING

Project Number (Principal Investigator) Source Title of Project *(or Subproject)* The major goals of this project are…	Dates of Approved/Proposed Project Annual Direct Costs	Person Months (Cal/Academic/ Summer)

OVERLAP *(summarized for each individual)*

DONOGHUE, JP
ACTIVE

5R01EB007401-01(Donoghue) 6/01/07–5/31/12 $909,717 Effort 25%

Bioengineering Research Partnerships
"Implantable Microsystems for Human Neuroprosthesis"
Description: This Partnership is aimed at developing an advanced wireless implantable neural sensor and stimulation device that will serve as a platform for prosthesis, diagnostic and therapeutic applications in humans with neurological disorders.

5R01NS25074(Donoghue) 7/31/98–4/30/09 $427,129 Effort 11.11%

NINDS—"Static and Dynamic Organization of Primate Motor Cortex"
Description: This project uses multichannel recordings in monkeys to examine the role of neural population codes in forming higher-level representations in motor cortex.

Veterans Health Administration (Aaron) 12/4/04–12/03/09 $94,000 Effort 1%

"Rebuilding, Regenerating and Restoring Function After Traumatic Limb Loss"
Description: This project addresses the rebuilding, regeneration and restoring function after traumatic limb loss as part of the center for Restorative and Regenerative Medicine at the Providence VAMC (Brown U).

N00014-07-1-0803 (Nurmikko) 3/01/07–8/01/09 Effort 11.11%
$1,174,512
Office of Naval Research
"Neurotechnology Center at Brown University"
Description: This project addresses a coordinated effort to create safer, more effective brain machine interfaces by elucidating the neural computational processes that lead to a motor action and by developing interfaces that can provide a new means of brain machine interaction.

Veterans Health Administration (Donoghue) 7/1/08-6/30/11 Effort 50%
$93,125
"V.A. Senior Research Career Scientist Award"

1RC1HD63931 (Donoghue)
NIH – 9/30/09-8/31/10
"Cortical Control of an Assistive Robotic Arm"
Description: This grant aims to develop assistive technology that will allow persons with severe paralysis to be able to reach and grasp objects using their own brain signals.

Massachusetts General Hospital (subcontract to NIH proposal, sub-PI: Donoghue)
"Restoring Communication with an Intracortical Neural Interface System"
Description: The proposed research will develop algorithms that allow accurate control of computer cursors from neural signals.

COMPLETED

5R01NS050967 (Black) 8/15/04–5/31/08 Effort 8%
$226,796
NINDS—"CRCNS: Learning the Neural Code for Prosthetic Control"
Description: This project will develop technologies for neural prostheses which promises a new generation of therapies for the severely disabled to allow them to regain the ability to interact with the world.

N00014-06-1-0185 (Donoghue) 12/15/05–9/30/07 Effort 11.11%
$657,129
Office of Naval Research
"Neural Interfaces to Understand Human Motor Performance"
Annual Direct Cost: Description: This multi-investigator project addresses fundamental issues to create safer, more effective human machine interfaces by elucidating the neural computational processes that lead to a motor action and by developing interfaces that can provide a new means of human machine interaction.

N00014-04-1-0823 (Donoghue) 10/4/04–12/30/05 Effort 11.11%
$694,710
Office of Naval Research Contract
"Neural Interfaces to Enhance Human Motor Performance"
Description: This project addresses fundamental issues to create safer, more effective human machine interfaces by elucidating the neural computational processes that lead to a motor action and by developing interfaces that can provide a new means of human machine interaction.

Veterans Health Administration (Aaron) 12/4/04–12/03/09
"Rebuilding, Regenerating and Restoring Function After Traumatic Limb Loss"
Description: This project addresses the rebuilding, regeneration and restoring function after traumatic limb loss as part of the center for Restorative and Regenerative Medicine at the Providence VAMC (Brown U).

PENDING
PI: John Donoghue $485,204
Massachusetts General Hospital (subcontract to NIH proposal)
"Restoring Communication with an Intracortical Neural Interface System"
Description: The proposed research will develop algorithms that allow accurate control of computer cursors from neural signals.