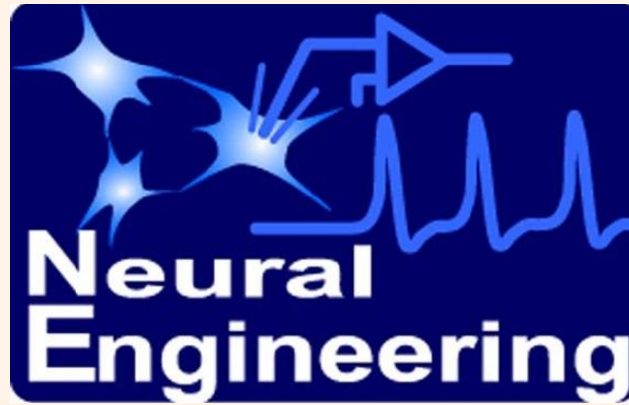# JEB1444S - SPRING TERM

OUTLINE:

Neural Engineering is an emerging field of research at the cross roads of neuroscience, electrophysiology, signal processing, computer science and nonlinear science. *Neural Systems* exhibit an amazing variety of instabilities, fluctuations, richness of forms and structures. They can be modeled at the *micro* and *macro* levels using parametric and nonparametric methods that are based on differential and integral equations, respectively.

Topics covered in the course include the following:
• A general perspective of neurobiology and neural engineering.
• Parametric neural models described by nonlinear rate processes.
• Nonparametric neural models described by the Volterra-Wiener approach.
• Electrical rhythms in neural networks.

REFERENCES:

(I) General
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• B. He (editor), Neural Engineering. Kluwer Academic / Plenum Publishers, 2005.
• V.Z. Marmarelis, Nonlinear Dynamic Modeling of Physiological System Modeling, Wiley, 2004.

(II) Parametric Models
• J. Walleczek (editor), Self-Organized Biological Dynamics & Nonlinear Control. Cambridge University Press, 2000.
• P.G. Drazin, Nonlinear Systems. Cambridge University Press, 1994.
• T.S. Parker and L.O. Chua, Practical Numerical Algorithms for Chaotic Systems. Springer, 1989.
• W. Jacklet (editor), Neuronal and Cellular Oscillators. Dekker, 1989.
• A.T. Winfree, The Geometry of Biological Time. Springer-Verlag, 1980.

(III) Nonparametric Models
• V.Z. Marmarelis (editor), Advanced Methods of Physiological System Modeling. Volumes 1, 2 & 3, Plenum Press, 1987, 1989 & 1994.
• M. Schetzen, The Volterra and Wiener Theories of Nonlinear Systems. Robert E. Krieger Publishing Company, 1989.
• P.Z. Marmarelis and V.Z. Marmarelis, Analysis of Physiological Systems: The White Noise Approach. Plenum Press, 1978.

EVALUATION:
Two Projects.

Month	Day	Topic
January	9	General Perspectives
	16	General Perspectives
	23	General Perspectives
	30	Parametric Neural Models
February	6	Parametric Neural Models
	13	Parametric Neural Models
	20	*Reading Week*
	27	Nonparametric Neural Models
March	6	Nonparametric Neural Models
	13	Nonparametric Neural Models
	20	Applications
	27	Applications
April	3	*Project Presentations*
	10	*Project Presentations*

Project #1
Given: February 6
Due: March 6

Project #2
Given: March 6
Due: April 3