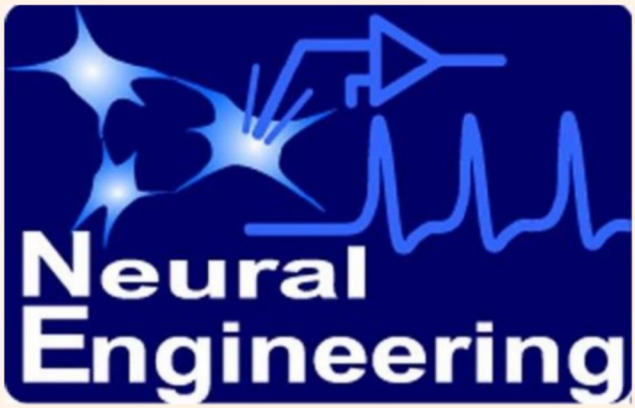
JEB1444S - SPRING TERM



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.
- Biological and artificial neural networks.

REFERENCES:

(I) General

- Bin He (editor), Neural Engineering. Third Edition, Springer, 2020.
- G. Buzsaki, Rhythms of the Brain. Oxford university Press, 2006.
- V.Z. Marmarelis, Nonlinear Dynamic Modeling of Physiological System Modeling, Wiley-IEEE Press, 2004.
- A.T. Winfree, The Geometry of Biological Time. Springer-Verlag, 1980.

(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.

(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.