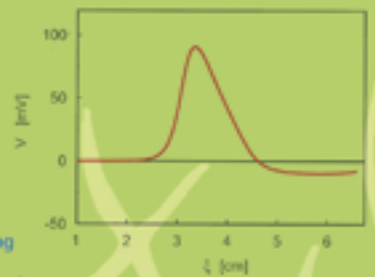
$$\frac{1}{R}\frac{\partial^2 V}{\partial x^2} = C\frac{\partial V}{\partial t} + \left[g_{Na} m^3 h (V - V_{Na}) + g_K n^4 (V - V_K) + g_l (V - V_l)\right] 2\pi r L$$

$$\frac{\partial m}{\partial t} = \alpha_m (1-m) - \beta_m m$$

$$\frac{\partial h}{\partial t} = \alpha_h (1-h) - \beta_h h$$

$$\frac{\partial n}{\partial t} = \alpha_n (1-n) - \beta_n n$$

The 1963 Nobel Prize-winning Hodgkin–Huxley equations model the voltage potential of a single neuron.

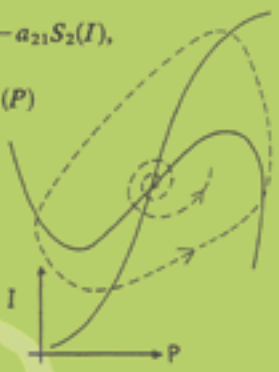


Traveling pulse solution to the Hodgkin-Huxley equations

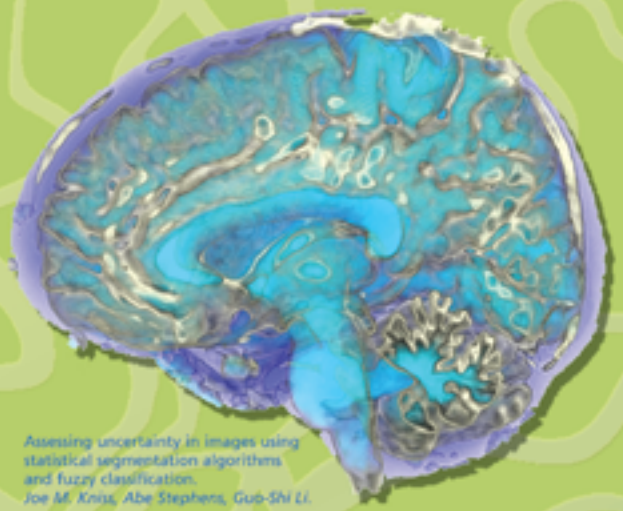
$$\frac{dP}{dt} = -P + a_{11} S_1(P) - a_{21} S_2(I),$$

$$\frac{dI}{dt} = -\kappa I + a_{12} S_1(P)$$

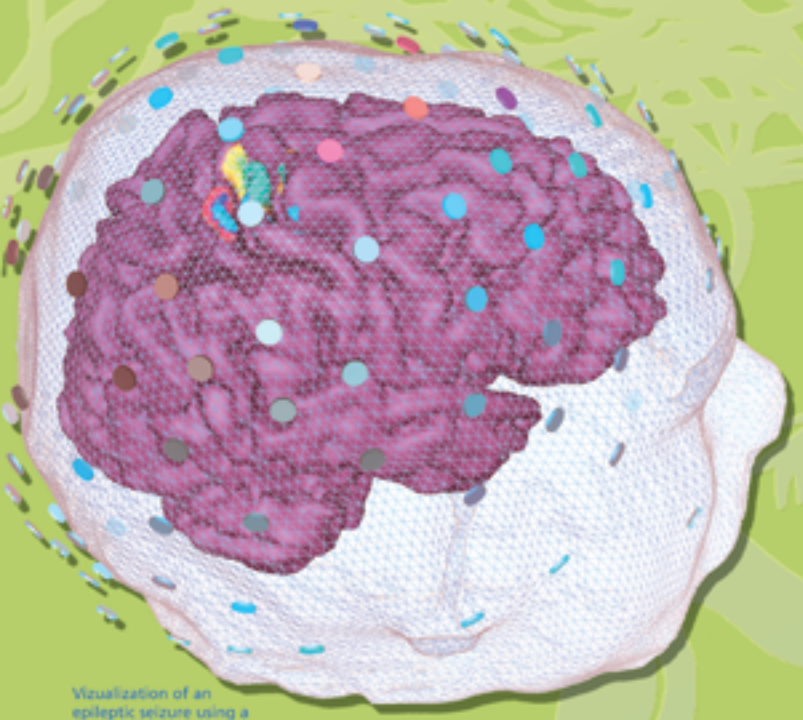
The Wilson–Cowan equations describe the dynamics of networks of neurons.



Math and the Brain



Assessing uncertainty in images using statistical segmentation algorithms and fuzzy classification.
Joe M. Kniss, Abe Stephens, Guo-Shi Li.



Vizualization of an epileptic seizure using a computational model of a patient's brain
David Weinstein and Robert VanUitert

Mathematical scientists are helping to unlock the mysteries of the brain! They have:

- **modeled electrical activity of neurons**
- **designed methods for transforming MRI and other signals into clear images**
- **modeled dynamics of neurological networks, such as those related to epilepsy and Parkinson's disease, learning and memory, schizophrenia**
- **developed algorithms for imaging the brain for diagnosis of tumors, disease and psychological states**
- **...and much more.**

Mathematics Awareness Month April 2007

www.mathaware.org

Angiogram image courtesy of the Scientific Computing and Imaging Institute, University of Utah.

The JPBM thanks Chris Johnson and Nathan Galli of the Scientific Computing and Imaging Institute, University of Utah.

SPONSORED BY
THE JOINT POLICY BOARD FOR MATHEMATICS

American Mathematical Society
American Statistical Association
Mathematical Association of America
Society for Industrial and Applied Mathematics