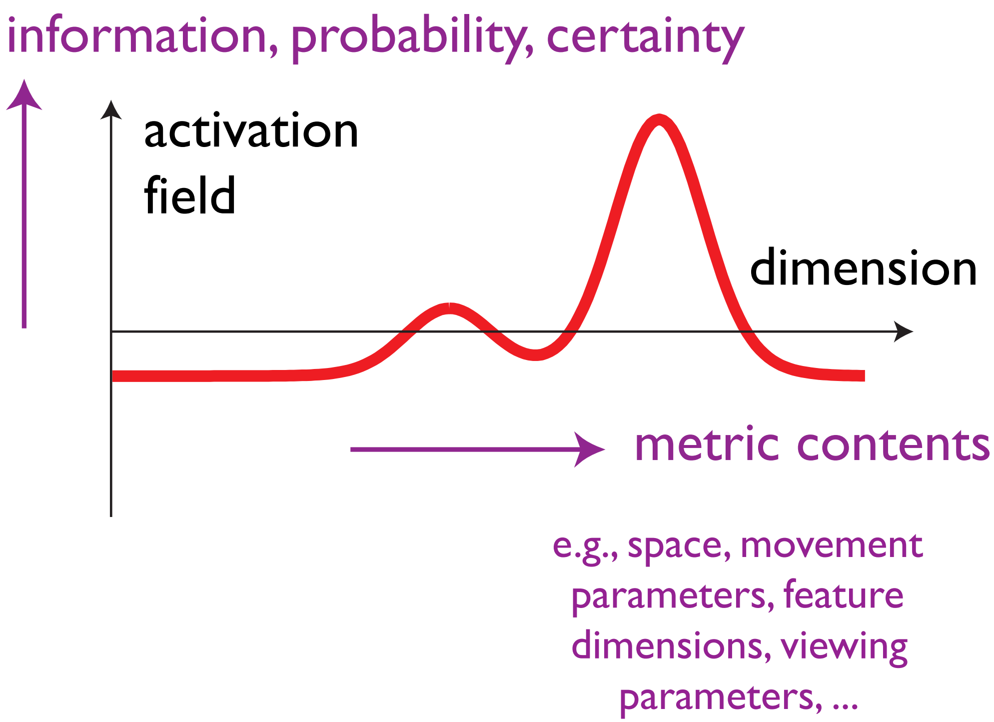
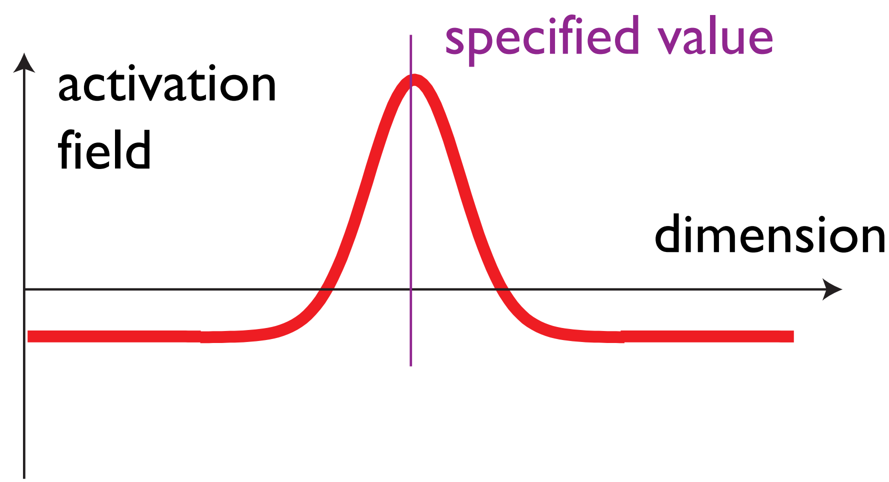
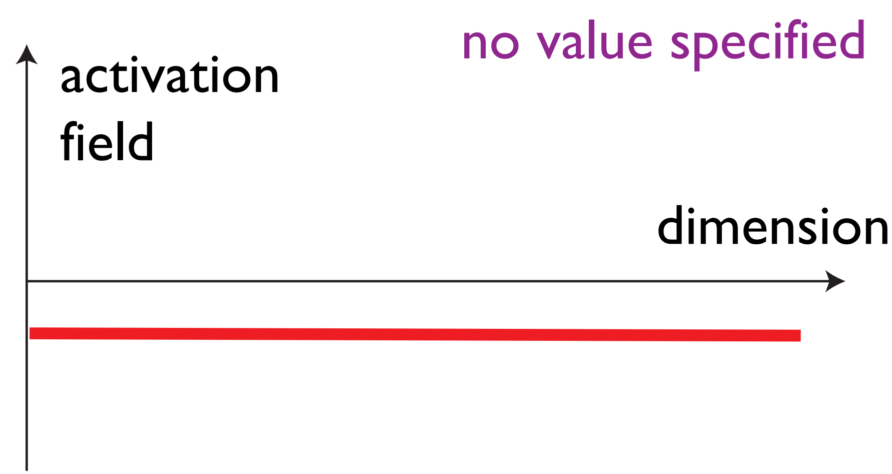
Dynamic Field Theory: Part 2: dynamics of activation fields

Gregor Schöner
gregor.schoener@ini.rub.de

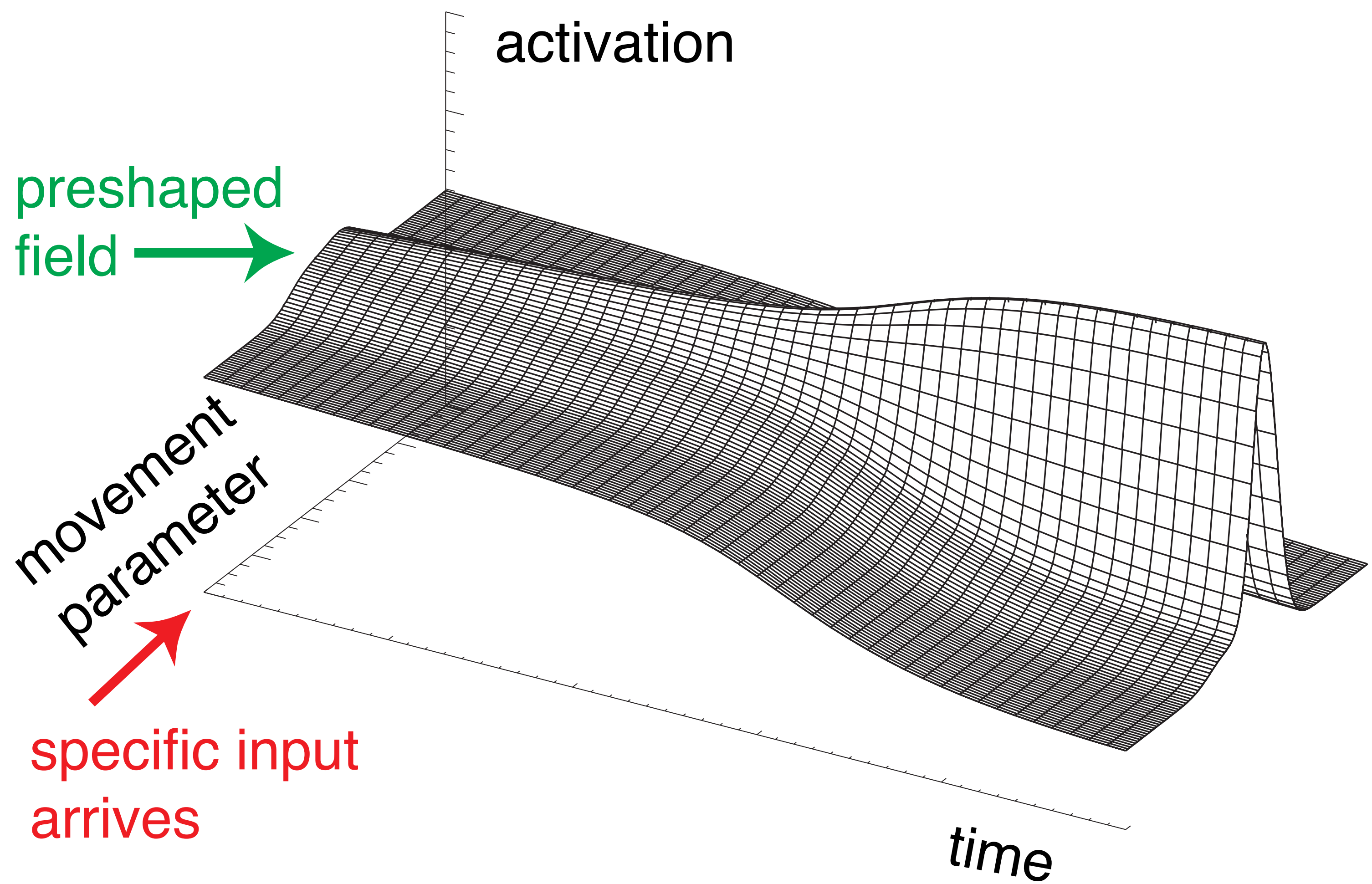
activation fields



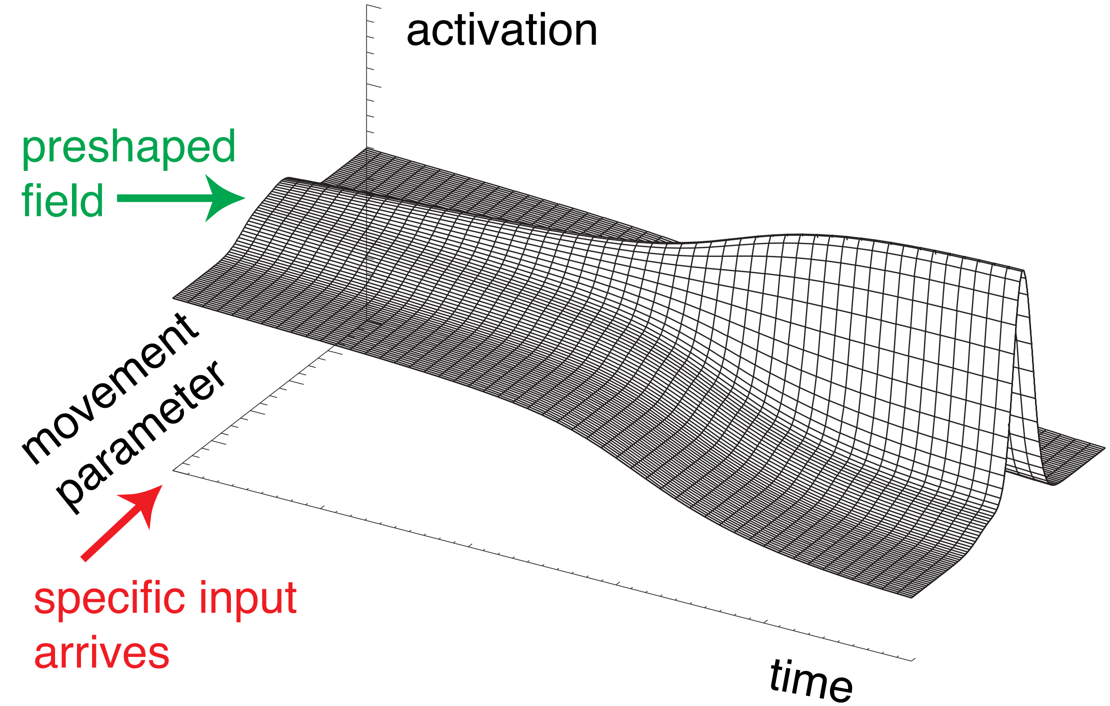


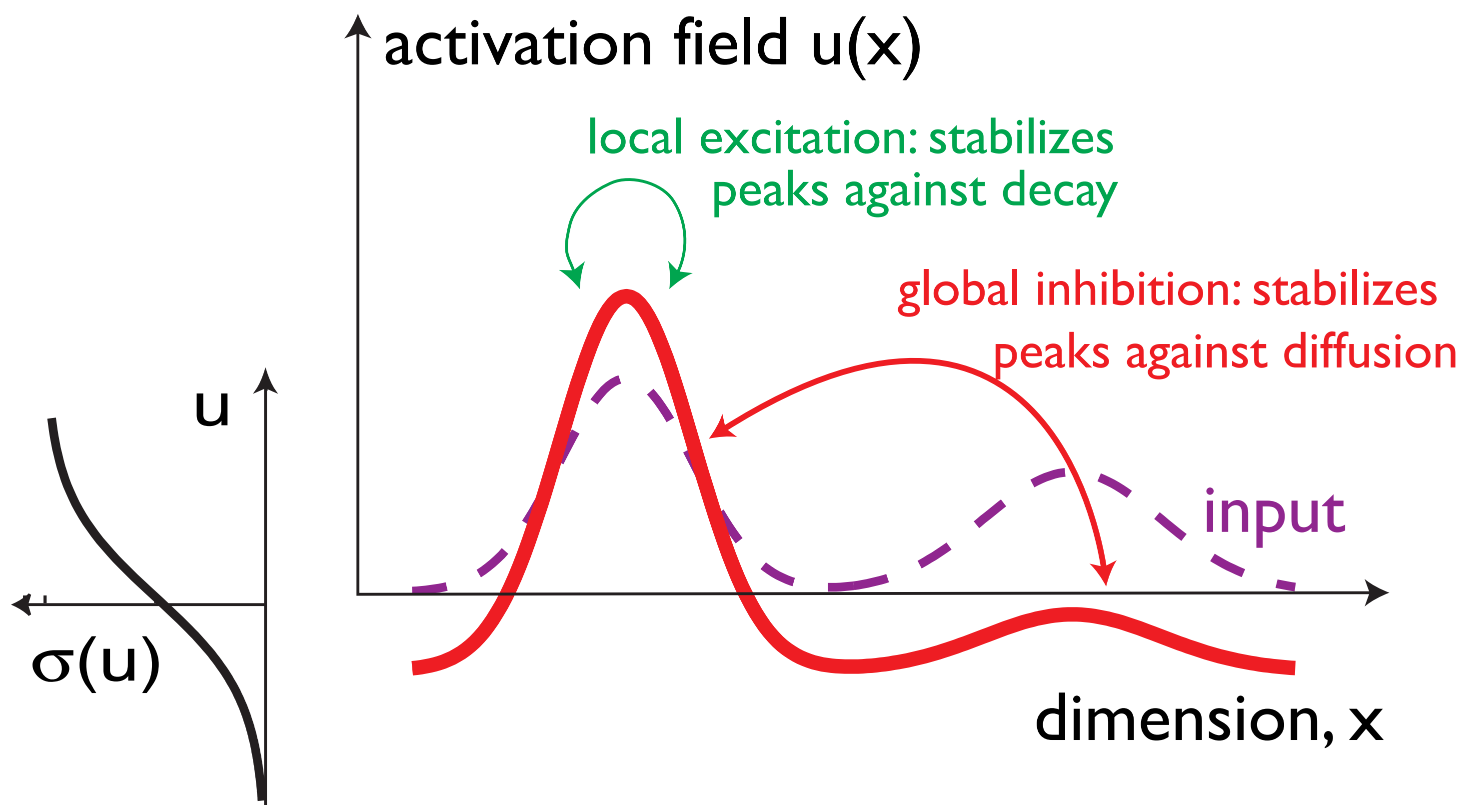


evolution of activation fields in time: neuronal dynamics



the dynamics such activation fields is structured so that localized peaks emerge as attractor solutions





mathematical formalization

Amari equation

$$\tau \dot{u}(x,t) = -u(x,t) + h + S(x,t) + \int w(x-x')\sigma(u(x',t))\ dx'$$

where

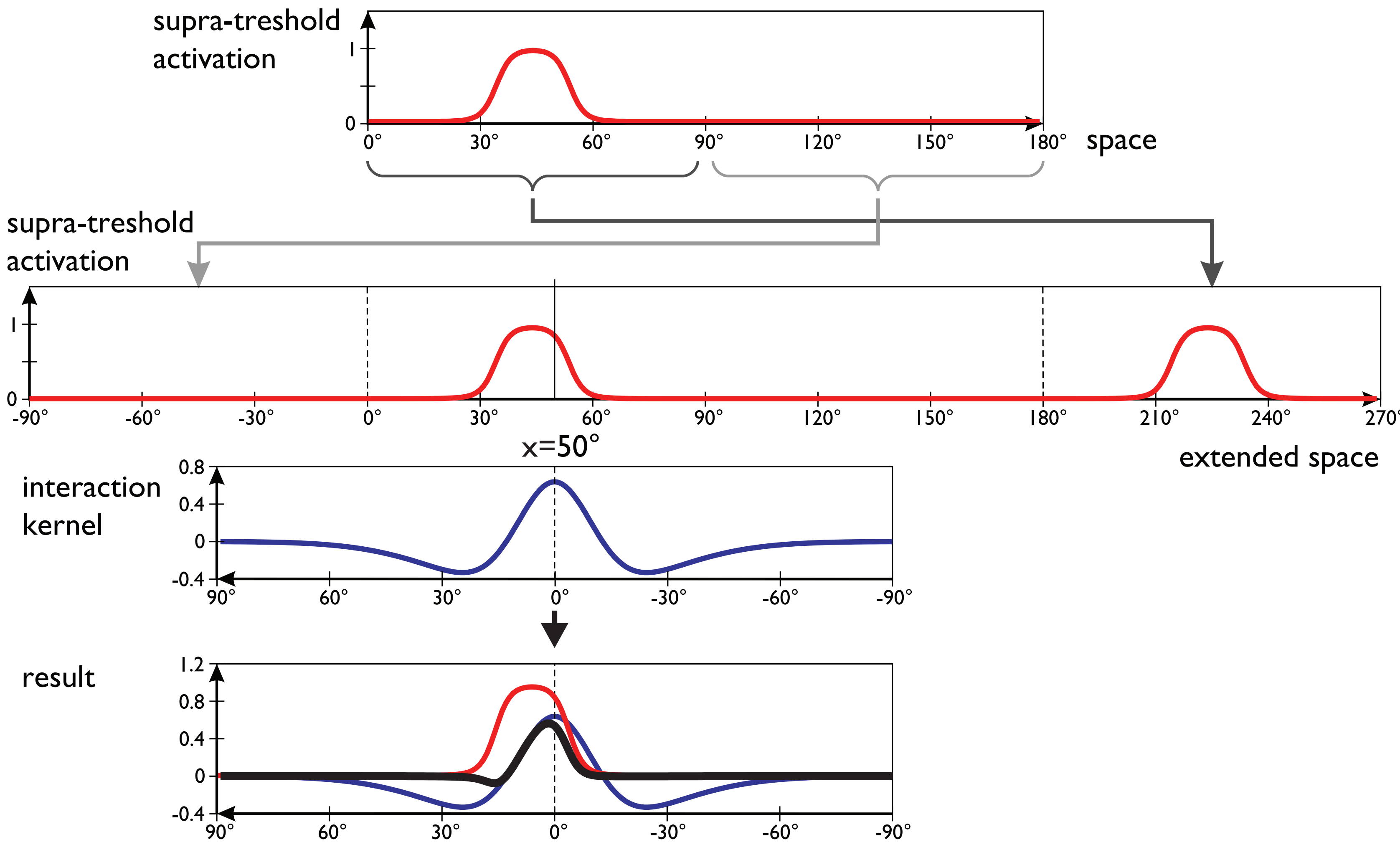
- time scale is τ
- resting level is $h < 0$
- input is $S(x,t)$
- interaction kernel is

$$w(x-x') = w_i + w_e \exp\left[-\frac{(x-x')^2}{2\sigma_i^2}\right]$$

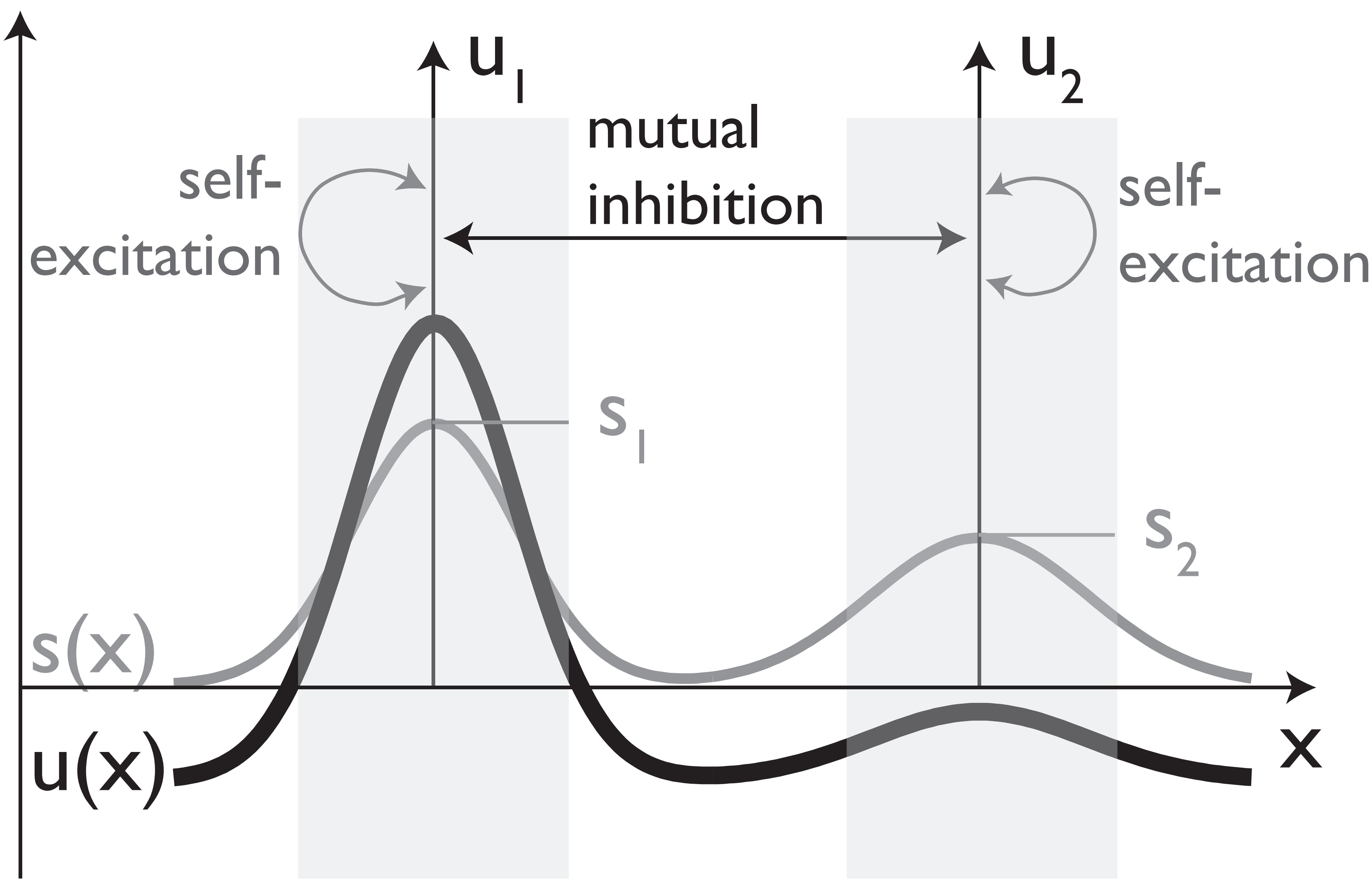
- sigmoidal nonlinearity is

$$\sigma(u) = \frac{1}{1+\exp[-\beta(u-u_0)]}$$

Interaction: convolution



Relationship to the dynamics of discrete activation variables



=> simulations

solutions and instabilities

- input driven solution (sub-threshold) vs. self-stabilized solution (peak, supra-threshold)
- detection instability
- reverse detection instability
- selection
- selection instability
- memory instability
- detection instability from boost