Complex networks

Weakly connected oscillators

$$\ddot{x}_i + \omega_i^2 x_i = \sum_{j \neq i} \mu_j x_j$$

$$\begin{cases} \dot{x}_i = y_i \\ \dot{y}_i = -\omega_i^2 x_i + \sum_{j \neq i} \mu_j x_j \end{cases}$$

$$\begin{cases} x_i^{k+1} = x_i^k + h y_i^k \\ y_i^{k+1} = y_i^k + h(-\omega_i^2 x_i^k + \sum_{j \neq i} \mu_j x_j^k) \end{cases}$$

Izhikevich model for neurons

$$\begin{cases} \dot{v}_i = v_i^2 - u_i + I_i \\ \dot{u}_i = a(bv_i - u_i) \\ I_i = \sum_j A_{ji}\,(v_j - v_i) \\ if\, v_i \geq 1, then\, v_i = c, u_i = u_i + d \end{cases} \qquad \begin{cases} v_i^{k+1} = v_i^k + h({v_i^k}^2 - u_i^k + I_i^k) \\ u_i^{k+1} = u_i^k + ha(bv_i^k - u_i^k) \\ I_i^k = \sum_j A_{ji}\,(v_j^k - v_i^k) \\ if\, v_i^k \geq 1, then v_i^k = c, u_i^k = u_i^k + d \end{cases}$$