Reaction-Diffusion-Process

The Fitz-Hugh-Nagumo model is a reaction-diffusion system for excitable media. Each cell has two real variables, electric potential (f_1) and ion concentration (f_2). The potential can change quickly and has therefore a large diffusion coefficient D_1, the ion concentration has a smaller diffusion coefficient D_2. With constants a and b, the RDS is characterized by the following differential equations:

$$\frac{\partial f_1}{\partial t} = (a - f_1)(f_1 - 1) f_1 - f_2 + D_1 \nabla^2 f_1 \qquad \frac{\partial f_2}{\partial t} = e(b f_1 - f_2) + D_2 \nabla^2 f_2$$

The system has a stationary state. When the system is excited enough, it will return to the stable state taking a „detour“ through the two-dimensional state space. When using a finite universe, this can lead to inifinite repetition, i. e. periodic behavior. Although the state is defined by real numbers and all computation is done with full precision, the state is quantized to 2^8 levels before storing the result using probabilistic rounding.