Dynamical behaviour of BAM ... network is described by the following set of differential equations:

$$\dot{u}_i(t) = -a_i u_i(t) + \sum_{j=1}^{m} w_{ji} f_j(z_j(t)) + I_i$$

$$\dot{z}_j(t) = -b_j z_j(t) + \sum_{i=1}^{n} v_{ij} f_i(u_i(t)) + J_j$$

Vector-Matrix form

$$\dot{u}(t) = -Au(t) + W f(z(t)) + I$$

$$\dot{z}(t) = -Bz(t) + V f(u(t)) + J$$

n: number of the neurons in the first layer

m: " " " in the second "

$u_i(t)$: state of the ith neuron in the first layer

$z_j(t)$: state of the jth neuron in the second layer

w_{ji}, v_{ij}: synaptic connection strengths

$f_{i,j}(\cdot)$: activation functions

I_i, J_j: inputs

Pure-Delayed BAM:

$$\dot{u}(t) = -Au(t) + Wf(z(t-\tau)) + I$$

$$\dot{z}(t) = -Bz(t) + Vf(u(t-\sigma)) + J$$

Hybrid BAM:

$$\dot{u}(t) = -Au(t) + Wf(z(t)) + W^{\tau} f(z(t-\tau)) + I$$

$$\dot{z}(t) = -Bz(t) + Vf(u(t)) + V^{\tau} f(u(t-\sigma)) + J$$

a^1 : key vector $\quad b^0 = [-1 \quad -1 \quad \dots]^T$

$$b^2 = \Gamma\left[W^T \cdot a^1\right]$$

$$b^2 = (7\times 16)(16\times 1) = (7\times 1)$$

$$\Gamma\left[\quad\right]\begin{bmatrix}-1\\-1\\-1\\ \vdots\\ \vdots\end{bmatrix} = \Gamma\begin{bmatrix}-16\\16\\0\\0\\32\\-16\\0\end{bmatrix} = \begin{bmatrix}-1\\1\\-1\\-1\\1\\-1\\-1\end{bmatrix}$$

$$a^3 = \Gamma\left[W \cdot b^2\right]$$

$$(16\times 7)(7\times 1) = (16\times 1)$$

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