Erratum

Learning and Pattern Recognition in Spin Glass Models

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Due to a programming error the numerical results were obtained from an algorithm which is slightly different from the one described in Sect. 1. Consider a network with spins $\mathbf{S}=(S_1, S_2, \dots, S_N)$, $S_i = \pm 1$, and bonds J_{ij} . Its dynamics is defined by sequentially flipping the spins into their internal fields if necessary, i.e.,

$$S'_i = \text{sgn } h_i; \quad h_i = \sum_j J_{ij} S_j \quad (1)$$

and updating the fields h_j by

$$h'_j = h_j - \lambda J_{ij} (S_i - S'_i) / 2 \quad (2)$$

where λ is a parameter. With a given initial state $\mathbf{S}(0)$ and its internal fields

$$h_i(0) = \sum_j J_{ij} S_j(0) \quad (3)$$

this algorithm defines a deterministic time evolution $\mathbf{S}(t)$ in discrete times steps $t=0, 1, 2, \dots$, where one time step is one sweep through the system. After time t the internal fields are given by

$$h_i(t) = (1 - \lambda/2) \sum_j J_{ij} S_j(0) + \lambda/2 \sum_j J_{ij} S_j(t) \quad (4)$$

For $\lambda=2$ one obtains the usual energy relaxation at zero temperature as discussed in Sect. II. For $\lambda=0$ the algorithm leads to a *simultaneous* spin flip which becomes stable after the first flip. In the article $\lambda=1$ was used. With Eq. (4) this leads to an algorithm which has some memory to the initial state.

Surprisingly, with $\lambda=1$ the retrieval error is less than the one of the energy relaxation $\lambda=2$. This is shown in Fig. 1, where the retrieval overlap is shown as a function of λ for different noise levels p_n of the initial patterns. The maximum is close to $\lambda=1$ for the case $N=400$.

Hence the numerical results for the retrieval overlap q are somewhat smaller for the energy relaxation λ

Fig. 1. Average retrieval overlap $\langle q \rangle$ and its standard deviation $\Delta q = \langle (q - \langle q \rangle)^2 \rangle^{1/2}$ vs the parameter λ of Eq. (2). The system size is $N=400$, and $M=30$ random patterns are stored with the Cooper relation, Eq. (7) of the article. The data are shown for different initial noise levels; dots: $p_n=0.3$, squares: $p_n=0.4$ and triangles: $p_n=0.35$.

$=2$ than the q values of the article which used $\lambda=1$. In addition for $p_n=0$ and $p_s \geq 0.15$ there is a strong size dependence of $\langle q \rangle$, and $P(q)$ is double-peaked in agreement with a discontinuous transition at $p_s \approx 0.138$ which recently has been obtained analytically [1].

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References

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