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A KIND OF LORENZ ATTRACTOR BEHAVIOR AND ITS APPLICATION IN ASSOCIATION MEMORY

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Abstract. *Lorenz system has been attracting dramatic attention for its strange attractor behavior. Its attractors are researched widely for interesting dynamic behavior and applied to enormous fields, such as optimization. In this paper, a constant control term is introduced to Lorenz system, whose attractors evolve with the control volume varying and their attracting basins are determined by the control volume. Dynamical behaviors of this controlled system are analyzed in detail, and some useful characteristics are discovered. With small control, Lorenz system still wanders chaotically around its attractors, but while the control becomes large enough it trends to a stable equilibrium rapidly. This characteristic is used to bidirectional association memory (BAM), by replacing each neuron with a controlled Lorenz system, in which control amplitude increases when the association tends to synchronization with a stored pattern (the target pattern is recalled perfectly). When this synchronization occurs, all neurons having 'correct' status, the control term of each neuron become large enough to stable each subsystem to its fixed point, which means the target pattern reappears stably. This novel chaos BAM is superior to conventional ones in convergence style. It does not converge in the means of Lyapunov stability. When a pattern is presented, neurons in this novel BAM evolve not only determined by local attracting basin but also depending on their chaotic dynamics. This chaos wandering behavior helps BAM to get over local attractors and improve anti-noise ability. If the input pattern is embedded in the network, it will trend to its attracting basin crossing other local ones. If it is a new pattern, network status constantly travel chaotically, which means 'I don't know'. Simulation researches depict that this novel BAM is more robust to noise than conventional ones.*
Keywords: Chaos attractor, Associative memory, Lorenz system, Pattern recognition, BAM.

1. **Introduction.** In 1963, Lorenz found the first chaotic attractor in a three-dimensional (3D) autonomous system when he studied atmospheric convection. As the first chaotic model, Lorenz system has become a paradigm of chaos research. Based on Lorenz system, the other two important chaos system are proposed–Chen system [1-2] and Lü system [3] ,