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An improved extremum seeking algorithm based on the chaotic annealing recurrent neural network and its application.

Liu, Derong (ed.) et al., Advances in neural networks – ISNN 2007. 4th international symposium on neural networks, ISNN 2007, Nanjing, China, June 3–7, 2007. Proceedings, Part II. Berlin: Springer (ISBN 978-3-540-72392-9/pbk). Lecture Notes in Computer Science 4492, 47-56 (2007).

Summary: The application of sinusoidal periodic search signals into the general extremum seeking algorithm (ESA) results in the “chatter” problem of the output and the switching of the control law and incapability of escaping from the local minima. An improved chaotic annealing recurrent neural network (CARNN) is proposed for ESA to solve those problems in the general ESA and improve the global searching capability. The paper converts ESA into seeking the global extreme point where the slope of Cost Function is zero, and applies a CARNN to finding the global point and stabilizing the plant at that point. ESA combined with CARNN doesn’t make use of search signals such as sinusoidal periodic signals, which solves those problems in previous ESA and improves the dynamic performance of the controlled system greatly. During the process of optimization, chaotic annealing is realized by decaying the amplitude of the chaos noise and the probability of accepting continuously. The process of optimization was divided into two phases: the coarse search based on chaos and the elaborate search based on ARNN. At last, CARNN will stabilize the system to the global extreme point. At the same time, it can be simplified by the proposed method to analyze the stability of ESA. The simulation results of a simplified UAV tight formation flight model and a typical Schaffer function validate the advantages mentioned above.

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