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| P.O.Box 8718, Beijing 100080, China | Journal of Software, June 2004,15(6):881-890 |
| E-mail: jos@iscas.ac.cn | ISSN 1000-9825, CODEN RUXUEW, CN 11-2560/TP |
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# 连续时间Hopfield网络模型数值实现分析

叶世伟, 郑宏伟, 王文杰, 马 琳, 史忠植



叶世伟1,2, 郑宏伟3, 王文杰1, 马 琳1, 史忠植2, 1(中国科学院 研究生院 信息科学与工程学院,北京 100039) 2(中国科学院 计算技术研究所 智能信息处理重点实验室,北京 100080)
作者简介: 叶世伟(1968－),男,四川仁寿人,博士,副教授,主要研究领域为神经网络理论,机器学习;郑宏伟(1966－),男,讲师,主要研究领域为泛函分析,人工智能;王文杰(1964－),男,博士,副教授,主要研究领域为人工智能,多Agent系统;马琳(1978－),男,硕士生,主要研究领域为神经网络理论,机器学习;史忠植(1941－),研究员,博士生导师,主要研究领域为人工智能,多Agent系统,神经计算,机器学习.
联系人: 叶世伟 Phn: +86-10-88256016, Fax: +86-10-88256056, E-mail: shwye@gscas.ac.cn, http://www.gscas.ac.cn
Received 2003-09-02; Accepted 2003-10-15

Abstract
The choices of discrete time step for Euler method and trapezoidal method and terminating condition of iteration in trapezoidal method are discussed in this paper for numerical implementation of continuous time Hopfield network. The decreasing conditions of an energy function are investigated by the use of convex function. By utilization of the primal convex function, the conditions are analyzed under which its conjugate function minus a quadratic function is also convex. Based on the analysis of the proof for convergence of the continuous time Hopfield network model, a generalized model is proposed. For the common Euler and trapezoidal methods, the choice of their discrete time step is discussed for numerical implementation of the continuous time Hopfield network. As the trapezoidal method is an implicit scheme, its realization needs an iterated procedure. The conditions to terminate the iterated procedure are analyzed. According to the special forms of the continuous time Hopfield network model, an improved iterated algorithm for trapezoidal method is proposed and analyzed. The numerical results show that choosing a suitably large discrete time step will be helpful not only to accelerate the numerical implementation but also to improve the optimization performance.

Ye SW, Zheng HW, Wang WJ, Ma L, Shi ZZ. Analysis for numerical implementation of continuous time Hopfield network model. *Journal of Software*, 2004,15(6):881~890.
http://www.jos.org.cn/1000-9825/15/881.htm

摘要
讨论使用Euler方法和梯形方法在数值求解连续时间的Hopfield网络模型时,离散时间步长的选择和迭代停止条件问题.利用凸函数的定义研究了能量函数下降的条件,根据凸函数的性质分析它的共轭函数减去二次函数之差仍为凸函数的条件.分析连续时间Hopfield网络模型的收敛性证明,提出了一个广义的连续时间Hopfield网络模型.对于常用的Euler方法和梯形方法数值求数值实现连续时间Hopfield网络,讨论了离散时间步长的选择.由于梯形方法为隐式方法,分析了它的迭代求算法的停止条件.根据连续时间Hopfield网络的特点,提出改进的迭代算法,并对其进行了分析.

数值实验的结果表明,较大的离散时间步长不仅加速了数值实现,而且有利于提高优化性能.

基金项目: Supported by the Presidential Foundation of Graduate School of the Chinese Academy of Sciences under Grant No.YZJJ200206 (中国科学院研究生院院长基金); the Opening Foundation of Key Laboratory of Intelligent Information Processing, Institute of Computing Technology, the Chinese Academy of Sciences under Grant No.IIP 2003-4(中国科学院计算技术研究所智能信息处理重点实验室开放基金)

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