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An outlook about evolution modeling of small world brain functional network simulating memory connection mechanism

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ABSTRACT

In order to understand the character of the brain functional network, we propose a new evolution model to simulate the mechanism of the brain network. With the reference of the memory mechanism, the network was set up by the compression path algorithm and displayed good effect of its characteristic on degree distribution**,** average path length and clustering coefficient, especially on community.

Introduction

The brain's structural and functional systems have features of complex networks, especially many important network properties.

Recent developments in the quantitative analysis of brain functional networks in according with small-world topology that had the characters of small-world, based largely on graph theory, have been rapidly translated to studies of the brain functional network simulation.

The evolution mechanisms of small-world, regarded as typical feature of the complex network, account significantly to establish the simulation of the anatomical and functional brain networks and to discover the characteristic research profoundly. Community, the prominence character of small-world model and the complex network, provides the branches and channels to the brain functional network explorations.

Computational modeling serves well for the comprehensive understanding of the simulation and the system internal relation among the architecture, the feature and the dynamics if it's more correspondence with the realistic system.

On the basis of above conclusion, it is a vigorous and effective step towards the investigation of brain functional network by the evolution mechanism of small world simulation.

Results

In this article, we devote to explore an evolution mechanism model to simulate the brain functional network conforming to small world characters and community based on memory factor and path compression, with describing the modeling and processing, discussing the computing and simulating to the model such as degree distribution, clustering coefficient and mean path length, finally detect this evolution mechanisms with the same structure as small-world, especially the distinct community properties.

The highlights in the connections during the evolution involve the reflection of the brain memory to functional network, not exactly the same as the preferential attachment mechanisms used in regular ring lattice and random network, holding the memory factors that induced the path compression to the functional connection in establishing the algorithms for the increasing model, resulting in the convergence rapidly to the small-world network and the representation intimately of the realistic complex networks.

The results of the simulation of the brain functional network by that way represent the properties of small-world, high clustering coefficient and modularity, especially the mean path length that indicates exclusively shorter close to a constant independent on the node scale.

The work of the article is expected to play an increasingly important part in our efforts to comprehend the physics of the brain's connectome.

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