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Graph Structural Complexity

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Introduced the quantitative measure of the structural complexity of the graph (complex network, etc.) based on a procedure similar to the renormalization process, considering the difference between actual and averaged graph structures on different scales. The proposed concept of the graph structural complexity corresponds to qualitative comprehension of the complexity. The proposed measure can be obtained for the weighted graphs also.

The structural complexities for various graph types were found – the deterministic infinite and finite size graphs, artificial graphs of different natures including percolation structures, and the time series of cardiac rhythms mapped to complex networks using the parametric visibility graph algorithm. The latter reaches a maximum near the formation of a giant component in the graph or at the percolation threshold for 2D and 3D square lattices when a giant cluster having a fractal structure has emerged. Therefore, the graph structural complexity allows us to detect and study the processes similar to a second-order phase transition in complex networks.

A new node centrality index, characterizing the structural complexity of a certain node within the graph structure is introduced also, it can serve as a good auxiliary or generalization to the local clustering coefficient. Such an index provides another new ranking manner for the graph nodes.

Being an easily computable measure, the graph structural complexity might help to reveal different features of complex systems and processes of the real world.

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