Limits of modularity maximization in community detection

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Modularity maximization is the most popular technique for the detection of community structure in graphs. The resolution limit of the method is supposedly solvable with the introduction of modified versions of the measure, with tunable resolution parameters. We show that multiresolution modularity suffers from two opposite coexisting problems: the tendency to merge small subgraphs, which dominates when the resolution is low; the tendency to split large subgraphs, which dominates when the resolution is high. In benchmark networks with heterogeneous distributions of cluster sizes, the simultaneous elimination of both biases is not possible and multiresolution modularity is not capable to recover the planted community structure, not even when it is pronounced and easily detectable by other methods, for any value of the resolution parameter. This holds for other multiresolution techniques and it is likely to be a general problem of methods based on global optimization.

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