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The tree decomposition number

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ABSTRACT

A decomposition of a graph $G = (V, E)$ is a partition of its set E of edges . The minimum number of parts in decompositions of G into acyclic parts is the *arboricity* $a(G)$ of the graph, which is known to be a good measure of its maximum local edge density. If we ask for connected acyclic parts we obtain a closely related invariant. The *tree decomposition number* $\tau(G)$, is defined as the minimum number of parts in a decomposition of G into trees. Clearly $\tau(G) \geq a(G)$.

There is a well known formula for the arboricity of a graph obtained independently by Nash-Williams and Tutte in the early 70's. However the values of $\tau(G)$ are only known for some particular families of graphs.

We present some recent results on the determination of the tree decomposition number.

We show that $\tau(G) = a(G)$ for graphs with minimum degree $\delta(G) \geq |V|/2$ and both parameters attain their minimum possible values.

The bound on $\delta(G)$ is best possible.

The same result holds for regular graphs provided that some measures of isoperimetric connectivity are large enough. In particular we prove that $\tau(G) = a(G)$ for Hamiltonian regular random graphs of degree $d \geq 13$ and also for vertex transitive graphs of degree $d \geq 2\sqrt{|V|}$.

On the other hand, we exhibit families of regular graphs whose isoperimetric connectivities are not large enough and have tree decomposition numbers arbitrarily close to its absolute upper bound, $|V|/2$.

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