

Graphs, groups and semigroups

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In the 1960s, group theorists began using graphs to study permutation groups; these methods led to simpler proofs of old results and to new stronger results (for example, the construction of several sporadic finite simple groups). Graphs are now a standard part of the group theorist's toolkit. For example, a permutation group G is primitive if and only if all non-null G -invariant graphs are connected.

In the last decade, in collaboration with João Araújo and Wolfram Bentz, I have been applying the methods of permutation groups and graph theory to some old problems in transformation semigroups, including synchronization, regularity, and idempotent generation. These have led to some deep problems expressed in terms of graphs, one of which asks for an extension of Keevash's theorem on the asymptotic existence of t -designs.

I will explain these problems and some of the techniques used.