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Indiscernibles and Wideness in Monadically Stable and Monadically NIP Classes

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Abstract: Monadically stable and monadically NIP classes of structures were initially studied in the context of model theory and defined in logical terms. They have recently attracted attention in the area of structural graph theory, as they generalize notions such as nowhere denseness, bounded cliquewidth, and bounded twinwidth.

Our main result is the - to the best of our knowledge first - purely combinatorial characterization of monadically stable classes of graphs, in terms of a property dubbed flip-widness. A class C of graphs is flip-wide if for every fixed radius r, every sufficiently large set of vertices of a graph $G \in C$ contains a large subset of vertices with mutual distance larger than r, where the distance is measured
in some graph G' that can be obtained from G by performing a bounded number of flips that swap edges and non-edges within a subset of vertices. Flip-wideness generalizes the notion of uniform quasi-wideness, which characterizes nowhere dense classes and had a key impact on the combinatorial and algorithmic treatment of nowhere dense classes. To obtain this result, we develop tools that also apply to the more general monadically NIP classes, based on the notion of indiscernible sequences from model theory. We show that in monadically stable and monadically NIP classes indiscernible sequences impose a strong combinatorial structure on their definable neighborhoods. All our proofs are constructive and yield efficient algorithms.

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