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Uniform mixing in distance-regular graphs

In 2001, Moore and Russell showed that the hypercube demonstrates exact uniform mixing: it has a continuous-time quantum walk that not only mixes faster than a classical random walk but also has a distribution which is perfectly uniform across all vertices. While quantum walks have proven to be applicable to a variety of other graphs, the problem of determining which graphs exhibit exact uniform mixing has not been resolved and appears to be of independent combinatorial interest.

In this talk, we show that two of the more obvious candidate classes of highly structured graphs do not exhibit exact uniform mixing. In particular, there is no uniform mixing in strongly-regular graphs with more than 4 vertices, and the only antipodal distance-regular graph of diameter 3 that exhibits uniform mixing is the 3-cube. These observations follow from some new combinatorial results about type-II matrices in association schemes.

This is joint work with Ada Chan.