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Quantum walks in association schemes

The continuous-time quantum walk on a graph X is given by the unitary operator e^{-itA}, where A is the adjacency matrix of X. The graph X admits fractional revival from u to v at time τ if

$$e^{-i\tau A} = \alpha e_u + \beta e_v,$$

for some $\alpha, \beta \in \mathbb{C}$. Here e_u and e_v denote the characteristic vectors of vertices u and v, respectively.

Perfect state transfer from u to v and periodicity at u are two special cases of fractional revival with $\alpha = 0$ and $\beta = 0$, respectively. These two properties have been extensively studied but not so much for fractional revival when both α and β are nonzero.

Instantaneous uniform mixing is another interesting phenomenon of the continuous-time quantum walk on a graph. This happens when $\sqrt{n}e^{-i\tau A}$ is a complex Hadamard matrix.

In this talk, we look for graphs in association schemes that satisfy one or more of these phenomena.