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Hadamard diagonalizable PST graphs

Our work focuses on Hadamard diagonalizable graphs. For integer-weighted Hadamard diagonalizable graphs, we give an eigenvalue characterization of when such a graph exhibits perfect state transfer (PST) at time $\pi/2$, and then generalize the result to rational-weighted Hadamard diagonalizable graphs. We also define a new binary graph operation, the merge, which keeps the property of being Hadamard diagonalizable, and can be used to produce a lot of PST graphs. We give conditions on two integer-weighted Hadamard diagonalizable graphs for their merge to have PST. Finally we show an intriguing result about the merge operation: if exactly one of the two weights on this operation is an integer, and the other one is an irrational number, then the merge exhibits pretty good state transfer (PGST) from one vertex to several other vertices under certain circumstances.