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Factorizable Quantum Channels and Linear Matrix Inequalities

We find a connection between the existence of a factorization of a quantum channel through the algebra $M_N(\mathbb{C})$ and the existence of low-rank solutions to certain linear matrix inequalities. Using this, we show that if a quantum channel is factorized by a direct integral of factors, it must lie in the convex hull of quantum channels which are factorized respectively by the factors in the direct integral. We use this to characterize some non-trivial extreme points in the set of factorizable quantum channels and give a class of examples.