
Noncommutative Approximation: Smoothness, Off-Diagonal Decay and Spectral Invariance in Banach Algebras of Infinite Matrices

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We investigate two systematic constructions of inverse-closed subalgebras of a given Banach algebra or operator algebra \mathcal{A} , both of which are inspired by classical principles of approximation theory. The first construction requires a closed derivation or a commutative automorphism group acting on \mathcal{A} and yields a family of smooth inverse-closed subalgebras of \mathcal{A} that resemble the usual Hölder-Zygmund spaces of functions. The second construction starts with a graded sequence of subspaces and yields a class of inverse-closed subalgebras that resemble the classical approximation spaces. We prove a theorem of Jackson-Bernstein type to show that in certain cases both constructions are equivalent.

These results about abstract Banach algebras are applied to algebras of infinite matrices with off-diagonal decay. In particular, we obtain new and unexpected forms of off-diagonal decay that is preserved under matrix inversion.