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On Cyclicity of Linear Relations

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Abstract

In this paper, we introduce the notions of cyclicity and cyclic transitivity for linear relations (multivalued linear operators) on an infinite-dimensional separable Banach space. The study of cyclicity for linear operators has been extensively developed in recent years [1,3]. In the context of linear relations, recent contributions have extended classical results to the multivalued setting [2,4].

We provide several examples and establish various properties of cyclic multivalued linear operators. We also determine conditions under which TS is a cyclic multivalued linear operator if and only if ST is cyclic. Furthermore, we show that if a linear relation T is cyclic, then $T - aI$ is also cyclic for every $a \in \mathbb{C}$.

Moreover, we present several characterizations of cyclic transitive linear relations and give the connection between cyclic multivalued linear operators and cyclic transitive multivalued linear operators. Finally, we provide criteria for determining the cyclicity of multivalued linear operators and establish the relationship between weakly invariant subspaces and cyclic vectors for linear relations.

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