Normal and Hyponormal Matrices in Inner Product Spaces

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Complex matrices that are structured with respect to a possibly degenerate indefinite inner product are studied. Based on the theory of linear relations, the notion of an adjoint is introduced: the adjoint of a matrix is defined as a linear relation which is a matrix if and only if the inner product is nondegenerate.

This notion is then used to give a new definition for normal matrices which allows the generalization of an extension result for positive invariant subspaces from the case of nondegenerate inner products to the case of degenerate inner products.

Moreover, we will introduce the notion of hyponormal matrices in inner product spaces and discuss some of their properties.