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The Perron-Frobenius theory for matrix semigroups: a geometrical approach

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The Perron-Frobenius theory was extended to multiplicative matrix semigroups relatively recently and has found many applications to synchronizing automata, nonhomogeneous Markov chains, linear dynamical systems, graphs, etc. This theory connects the spectral and combinatiorial properties of semigroups of nonnegative matrices. In particular, the concept of primitivity is especially important. A set of nonnegative matrices is called primitive if it possesses at least one strictly positive product. There are rather surprising links between primitive semigroups and the geometrical problem of self-similar partitions of a convex body. They can produce short and clear proofs of some known results on primitivity, for example, the characterization of primitive families, the existence of a common invariant affine subspace for matrices of non-synchronizing automata, etc. A new approach is also useful to study Hurwitz primitive (or k-primitive) semigroups. We derive possible generalizations of those results to sets of matrices with a common invariant cone.

Primary author: PROTASOV, Vladimir (University of L'Aquila)

Presenter: PROTASOV, Vladimir (University of L'Aquila)

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