

# Minkowski Sums and Optimization Based Techniques in Set Invariance

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## **Abstract:**

The talk is concerned with the theory of minimal invariant sets for discrete time dynamical systems. The first part of the talk discusses characterization of the minimal invariant set for a particular case of discrete time dynamical systems. We also characterize a family of finite-time parameterized sets that approximate arbitrarily close (in the sense of the Hausdorff metric) the minimal invariant set for the particular case.

The second and main part of the talk discusses in more detail linear/affine case and it demonstrates that the corresponding minimal invariant set and its arbitrarily close approximations can be obtained by appropriately defined Minkowski sums. We further discuss an optimization based method for improving roughly speaking geometry, i.e. shape/orientation/complexity, of the sets parameterized as a Minkowski sum of a finite number of summands. The family of parameterized invariant sets is novel. A relevant feature is that a selection of an invariant set (member of the described family) can be obtained from a solution of a single linear program in the linear-polytopic case that is frequently encountered in control theory.

A brief discussion on the use of results for robust control of constrained discrete time linear time invariant systems as well as indication of a set of plausible, potentially interesting, future research lines conclude the talk.

**Keywords:** Set Invariance, Minimal Invariant Sets, Optimized Invariant Sets, Minkowski Sums, Banach Contraction Principle.

## **Biographical Information:**

Saša V. Raković received the B.Sc. degree in Electrical Engineering from the Technical Faculty Čačak, University of Kragujevac (Serbia), the M.Sc degree in Control Engineering and PhD degree in Control Theory from Imperial College London. From 2004 to November 2006, he held the post of a research associate in the Control and Power Research Group at Imperial College London. He will join the Automatic Control Laboratory, IFA, ETHZ from November 2006. His main research interests are set invariance and robust control of constrained uncertain dynamical systems.