

# Homogeneity in Quadrotor Control

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## Abstract

Homogeneity is an invariance of a mathematical object (e.g., a function or a set) with respect to a class of transformations called dilations. All linear and a lot of essentially nonlinear models of physics are homogeneous (symmetric) in some sense. The dilation symmetry simplifies stability and robustness analysis, controllers and observers design, discretization and digital implementation of nonlinear systems. Homogeneous control systems appear as solutions of various nonlinear problems such as finite/fixed-time stabilization. Despite of an essential non-linearity, homogeneous controllers admit simple tuning rules similar to linear algorithms. Homogeneous control systems are robust with respect to various of uncertainties and disturbances. In this talk, an introduction to homogeneity-based design is going to be presented. We will study a class of homogeneous control systems, which admit a very simple tuning rules based on an upgrade of the already existing/operating linear feedback. This method of the control upgrade is universal and applicable for any control systems governed by linear feedback law. It is theoretically proven and experimentally validated that the homogeneous control may guarantee faster response, smaller overshoot and better robustness than the linear control. In this talk, the method is going to be illustrated on quadrotor control and supported with real experiments.



**Andrey Polyakov** received his PhD Degree in System Analysis, Control and Information Processing from the Voronezh State University, Russia in 2005. Till 2010 he was an Associate Professor in the same university. From 2007 to 2008 he was a postdoc in CINVESTAV, Mexico. Form 2010 to 2014, Andrey Polyakov was a Leading Researcher of the Institute of Control Sciences of Russian Academy of Sciences. In 2013, he joined the Inria centre of the University

of Lille in France as a researcher. His main research interests include various aspects nonlinear control and estimation. In 2012, he proposed the concept of fixed-time stabilization being rather popular today. Andrey Polyakov is an author of more than 100 journal papers and three books: “Generalized Homogeneity in Systems and Control”, “Roadmap for Sliding Mode Control Design”, “Attractive Ellipsoids in Robust Control”.