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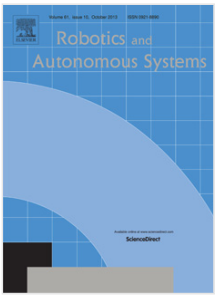

A leader-following trajectory generator with application to quadrotor formation flight

V. Roldão, R. Cunha, D. Cabecinhas, C. Silvestre, P. Oliveira

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ACCEPTED MANUSCRIPT

A leader-following trajectory generator with application to quadrotor formation flight

V. Roldão[a,1], R. Cunha[a,1,*], D. Cabecinhas[a,b,1], C. Silvestre[a,b,1], P. Oliveira[a,1]

[a] *Department of Electrical Engineering and Computer Science, and Institute for Systems and Robotics, Instituto Superior Técnico, Universidade de Lisboa, 1046-001 Lisbon, Portugal*
[b] *Department of Electrical and Computer Engineering, Faculty of Science and Technology, University of Macau, Av. Padre Tomás Pereira, Taipa, Macau, China*

Abstract

This paper presents a strategy for real-time generation of formation trajectories using a leader-follower approach. A trajectory generator prescribes the motion of a group of virtual vehicles, using a Lyapunov-based nonlinear controller that stabilizes the position of the leader in the reference frame of the virtual vehicles at a predefined distance vector. This strategy differs from the standard approach of defining the desired distance vector in an inertial frame and can be used to obtain rich formation trajectories with varying curvatures between vehicles. By imposing adequate constraints on the motion of the virtual vehicles, the generation of valid formation trajectories is naturally guaranteed, bypassing the demanding task of obtaining complete path descriptions. The trajectories are generated online and provided to a trajectory tracking controller specifically designed for quadrotor vehicles. Simulation and experimental flight tests are presented to evaluate the performance of the solution proposed, applied to formation control of quadrotors.

Keywords: trajectory generation, leader-follower, formation flight, nonlinear control, Lyapunov methods, autonomous vehicles, quadrotors

1. Introduction

The problem of controlling multiple vehicles to perform cooperative tasks poses important challenges to automatic control. It has been the scope of a number of publications and experimental results are beginning to appear (see [1] for a survey on the topic and [2, 3, 4, 5, 6, 7] for more specific examples). Cooperative control of multi-vehicle systems has proven to be advantageous in carrying out a variety of tasks such as surveillance and area exploration [3], where it results in a faster and more efficient process, or load transportations

*Corresponding author. Fax: +351 218418291
Email address: rita@isr.ist.utl.pt (R. Cunha)

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