On a Linear Group Pursuit Problem with Fractional Derivatives

A. I. Machtakova[1,2,*] and N. N. Petrov[1,2,**]

Abstract—A problem of pursuit of one evader by a group of pursuers is considered in a finite-dimensional Euclidean space. The dynamics is described by the system

$$D^{(\alpha_i)} z_i = A_i z_i + B_i u_i - C_i v, \quad u_i \in U_i, \quad v \in V,$$

where $D^{(\alpha)} f$ is the Caputo derivative of order α of a function f. The sets of admissible controls of the players are convex and compact. The terminal set consists of cylindrical sets M_i of the form $M_i = M_i^1 + M_i^2$, where M_i^1 is a linear subspace of the phase space and M_i^2 is a convex compact set from the orthogonal complement of M_i^1. We propose two approaches to solving the problem, which ensure the termination of the game in a certain guaranteed time in the class of quasi-strategies. In the first approach, the pursuers construct their controls so that the terminal sets "cover" the evader's uncertainty region. In the second approach, the pursuers construct their controls using resolving functions. The theoretical results are illustrated by model examples.

Keywords: differential game, group pursuit, pursuer, evader, fractional derivative.

[1]Udmurt State University, Izhevsk, 426034 Russia

[2]Krasovskii Institute of Mathematics and Mechanics, Ural Branch of the Russian Academy of Sciences, Yekaterinburg, 620108 Russia

e-mail: *bichurina.alyona@yandex.ru, **kma3@list.ru