Nonlinear Dynamics and Systems Theory, **25** (4) (2025) 410–423

Transformation and Generalised H_∞ Optimization of Descriptor Systems

A. G. Mazko *

Institute of Mathematics, National Academy of Sciences of Ukraine,
3 Tereshchenkivska St., Kyiv, 01024, Ukraine

Received: December 22, 2024; Revised: July 7, 2025

Abstract: The generalized type H_∞ control problem is investigated for a class of linear descriptor systems with nonzero initial state. A generalized performance measure is used, which characterizes the weighted damping level of external and initial disturbances. A non-degenerate transformation of the system is proposed, which allows to apply known evaluation methods and achieve desired performance measures for ordinary lower-order systems. A numerical example of the descriptor control system is given to show the effectiveness of the obtained results.

Keywords: *descriptor system; exogenous disturbances; weighted performance measure; H_∞ control; LMI.*

Mathematics Subject Classification (2020): 34A09, 34D10, 93B17, 93B36, 93C05, 93D09, 93D15.

1 Introduction

In modern control theory, great attention is paid to descriptor (differential-algebraic) systems, which are used in modeling the motion of objects in mechanics, robotics, energy, electrical engineering, economics, etc. (see, e.g., [1–5]). Equations of motion, inputs and outputs of controlled objects may contain uncertain elements (parameters, external disturbances, measurement inaccuracies, etc.) that necessitate solving the problems of robust stabilization and minimize the impact of bounded disturbances on the quality of transient processes (H_∞ *optimization*).

A typical performance measure in the H_∞ optimization problem for systems with zero initial state is a damping level of external (exogenous) disturbances, which corresponds

* Corresponding author: mailto:mazkoag@gmail.com