

# Summary of the thesis

## **Application of feedback control in linear descriptor dynamical systems**

Many of the dynamical systems require mathematical model represented by a combined set of differential (or difference) and algebraic equations. The latter usually refer to constraints imposed on the system in a natural way, resulting from physical laws (e.g. the law of conservation of energy) or defined by the designer (e.g. constrained motion of the object related to his area of work). There are many applications of the descriptor systems theory such as analysis of electrical, mechanical and multibody systems as well as modelling of problems in robotics, fluid mechanics, chemical engineering, economy and demography.

The main purpose of the dissertation was to develop a coherent theory of the continuous-time and discrete-time linear descriptor systems models considering Laurent series expansion method, Drazin inverse matrix method and Weierstrass-Kronecker decomposition method, and consisting of:

- establishment of the analytical conditions of the positivity, stability and superstability,
- solution of the feedback control problem aimed at obtaining the positivity, stability and superstability of the system.

The work consists of the introduction, 4 chapters and conclusions.

In the introduction the literature review is carried out as well as the main purpose and characteristics of the dissertation are introduced.

In the first chapter state equations of the linear descriptor continuous-time systems are presented and their solution is given. The analytical conditions of the positivity, stability and superstability of such systems are established. The Laurent series expansion method, Drazin inverse matrix method and Weierstrass-Kronecker decomposition method are considered.

In the second chapter state equations of the linear descriptor discrete-time systems are presented and their solution is given. The analytical conditions of the positivity, stability and superstability of such systems are established. The Laurent series expansion method, Drazin inverse matrix method and Weierstrass-Kronecker decomposition method are considered. Moreover, for each method and for the assumed approximation of the derivative (Euler method) formulas associating the matrices of continuous-time and discrete-time models are given.

In the third chapter considerations concerning the problem of the static and dynamic state-feedback and output-feedback synthesis aimed at obtaining the positivity, stability and superstability of the linear descriptor system are presented.

In the fourth chapter some applications of the developed theory are discussed. A three-link planar manipulator, which is a simplified model of a cleaning robot and an RLC three-phase star connection circuit, which can be a simplified model of a power line with a capacitive load are considered.

In the conclusions author's original results are shown and potential directions for further research are given.

The presented approach demonstrate that the main purpose of the dissertation has been achieved.