

Review from the supervisor

for the master's thesis **Valentin Sergeevich Zhigalov** "Controllability and observability of linear systems with unbounded delay"

The paper considers the problems of constructing program control and observation of a linear stationary system of differential-difference equations with a linearly increasing delay. The solution of the problems of transferring a system from point to point and determining the initial conditions for systems without delay has been early known. However, for systems with delay, the problems of control and observation become much more complicated. The direct step-by-step construction of a solution over a given time interval leads to the solution of a system of integral non-stationary equations. The reverse course of the sequential construction of the solution from the end of the observation interval to the initial condition leads to the problem of differentiating functions with an error.

Master's thesis by V.S. Zhigalov consists of an introduction, three chapters, a conclusion and a list of sources used. In the introduction and in the first chapter, the author introduces the necessary concepts and definitions for systems with a linearly increasing delay, and also describes possible applications of the considered class of equations. In the second chapter, the control problem is considered, sufficient conditions for complete controllability on a given time interval are proved, and an algorithm for constructing a program control is formulated. Further in the third chapter, V.S. Zhigalov formulates the necessary conditions for complete observability. Sections 3.3, 3.4 consider the case of a nonsingular matrix with a term with a linearly increasing delay, provide an algorithm for restoring the initial function, and give an example of an admissible algorithm for filtering the observed signal in order to smooth out differentiation errors. In paragraph 3.5 of this chapter, V.S. Zhigalov studies the case of incomplete observation, namely, the observation is a linear combination of the components of the state vector. In Theorem 5, conditions for complete observability are formulated and the construction of an asymptotic observer is given.

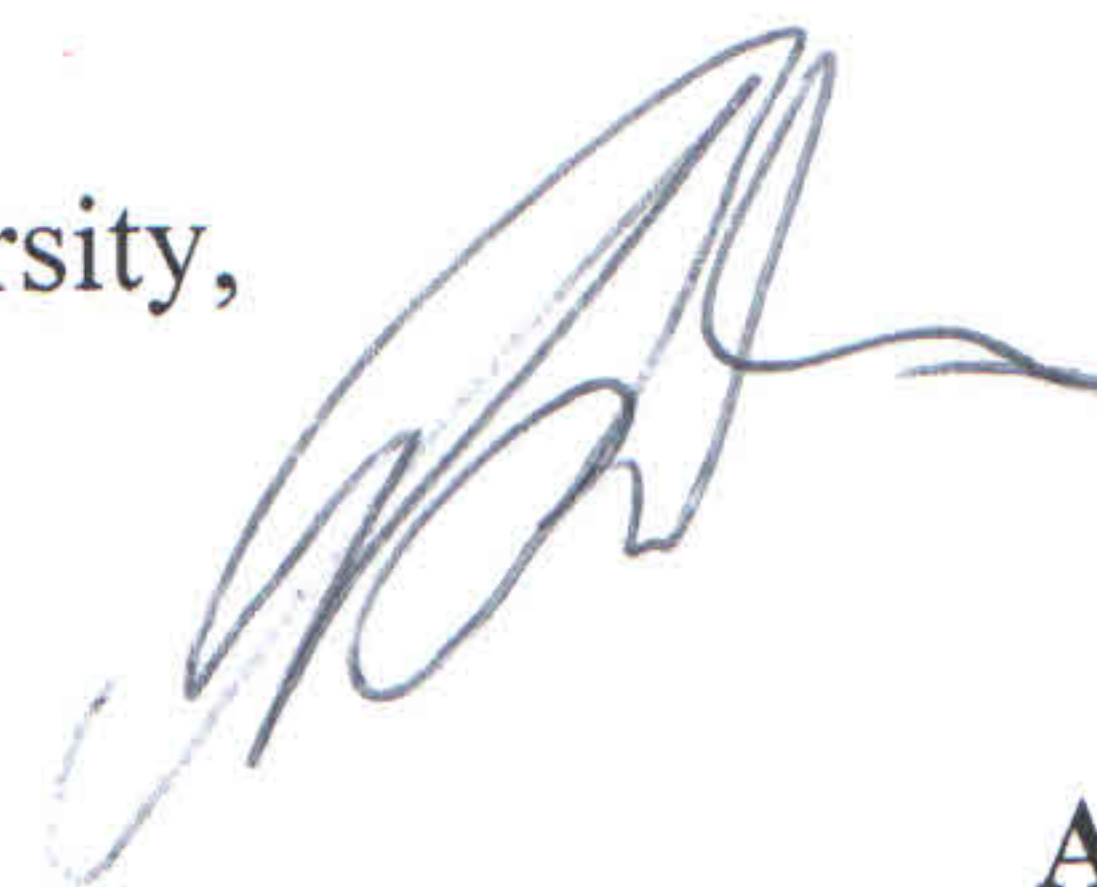
The problems under consideration are of great practical importance. Systems with linearly increasing delay are used to describe processes such as the operation of an information server, the movement of cars on a circular highway, or the operation of a mixing tank. Therefore, the results obtained can be applied in practical applications.

Presentation of the material in the VRC V.S. Zhigalov is clearly formulated, easy to read, logically consistent. The short comments include the brevity of the presentation of the material. However, based on the foregoing, I believe that the final qualifying work of **Zhigalov Valentin Sergeevich** deserves an "Excellent" rating, and can be recommended as an essay entering graduate school.

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