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Stability of Dynamic Graph on Time Scales

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Abstract: This paper is aimed at establishing stability conditions for a dynamic graph on a time scale in terms of the matrix Lyapunov function and the principle of comparison. Dynamic graphs on time scales are defined in a linear spaces as a one-parameter mapping of the space of graphs with N nodes into itself. In the analysis of the dynamic graph this mapping is referred to as a motion of the corresponding dynamic graph. A notion of motion stability of a dynamic graph is introduced together with a notion of stability of an equilibrium adjacent matrix of dynamic graph. The dynamic graph on a time scale is considered for the first time and the necessity of introducing these objects is caused by the presence of a series of unsolved problems on stability of complex systems, whose subsystem interconnections are changing in time continuous-discrete mode. A method of matrix-valued function is proposed to solve the motion stability problem for the dynamic graph on a time scale. The essence of this method is that the problem on stability of an equilibrium graph of the given dynamic graph is replaced by a simpler problem on stability of the equilibrium state of a matrix equation. The application of the theory of dynamic graphs to the modeling of time-varying interconnections between subsystems of complex system of Lotka-Volterra type is proposed for the first time. A mathematical model is constructed in the form of a dynamic graph for the equilibrium adjacency matrix of which the existence conditions are established as well as the sufficient stability conditions.

Keywords: *dynamic graphs on time scales; matrix Lyapunov functions; comparison principle; Lotka-Volterra systems; stability.*

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