FLOQUET THEORY BASED ON NEW PERIODICITY CONCEPT FOR DISCRETE, CONTINUOUS, AND HYBRID PERIODIC LINEAR SYSTEMS

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Abstract. In this study, we construct a unified Floquet theory for homogeneous and nonhomogeneous periodic linear systems defined on arbitrary closed subsets of reals that are periodic with respect to shift operators $\delta_{\pm}$. New periodicity concept based on shift operators $\delta_{\pm}$ ([1]) enables the use of Floquet theory for the investigation of periodicity and stability of the solutions of linear dynamic systems on closed subsets of reals which are not necessarily additive periodic but periodic in shifts. The dynamic systems considered in this study are generated by Hilger derivative ([2]) and include not only the discrete and continuous systems but also hybrid systems with discrete and continuous parts. This general approach can particularly be useful to know more about Floquet theory for linear q-difference systems

$$D_q x(t) = A(t)\, x(t) + F(t)\,,\ x(t_0) = x_0$$

generated by the q-derivative

$$D_q f(t) = \frac{f(qt) - f(t)}{(q-1)\,t}, q > 1$$

on the set $\overline{q^{\mathbb{Z}}} := \{q^n : n \in \mathbb{Z}\} \cup \{0\}$. By constructing the solution of matrix exponential equation we establish a canonical Floquet decomposition theorem. Determining the relation between Floquet multipliers and Floquet exponents, we give a spectral mapping theorem on closed subsets of reals that are periodic in shifts. Finally, we utilize the constructed theory to discuss stability properties of the system.

The analytical approach adopted in this study can be extended to autonomous systems.

References

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