

On topological properties connected with some nonlinear operators in spaces of almost periodic functions

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The theory of almost periodic functions has been widely developed which is connected, in particular with the fact that such functions have applications in many areas. Let us indicate that almost periodic patterns, which correspond to almost periodic measures, describe the structure of quasicrystals. There are many various classes of almost periodic functions among which the class of almost periodic functions in view of the Lebesgue measure (briefly μ -a.p. functions) seems to be important and interesting. In this talk we are going to discuss autonomous superposition operators acting in the space of μ -a.p. functions. We will indicate necessary and sufficient conditions under which the autonomous superposition operator maps the space under consideration into itself as well as conditions under which it is continuous. As a corollary from these results we indicate when the autonomous superposition operator defined on that space is a bijection. Next, we will analyze in detail the situation when the composition of μ -a.p. function with a continuous function or with a homeomorphism gives a Stepanov almost periodic function. Further, we are going to discuss the behavior of μ -a.p. functions under convolution. We will focus on convolutions of some particular μ -a.p. functions with some restrictions of exponential functions. We will discuss some topological as well as set-theoretical properties connected with those convolutions. As applications of our results we will present a theorem concerning μ -a.p. solutions to linear differential equations of the first order. The results presented in this talk come mainly from the papers [2] and [3]. Moreover, we refer the reader interested in basic properties of almost periodic functions and some of their perturbation (in particular, in those connected with the convolution) to the recently published monograph [1].

References

- [1] M. Borkowski, D. Bugajewska, P. Kasprzak, *Selected topics in nonlinear analysis*, Juliusz Schauder Center for Nonlinear Studies, Toruń, Lecture Notes in Nonlinear Analysis, 19, 2021.
- [2] D. Bugajewski, A. Nawrocki, *On autonomous superposition operators in spaces of μ -almost periodic functions and applications to linear differential equations*, submitted.
- [3] D. Bugajewski, K. Kasprzak, A. Nawrocki, *Asymptotic properties and convolutions of some almost periodic functions with applications*, Annali di Matematica Pura ed Applicata vol. 202 (2023) pp. 1033–1050.