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Invariant sets of certain non-linear extensions of dynamic systems on manifolds

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Many investigations have been dedicated to the study of invariant toroidal manifolds of dynamic systems. The concept of [1] Green-Samoilenko function on invariant tori has made it possible to explain the theory of perturbation of both differential and continuous invariant manifolds from a single perspective. This report has been dedicated to the investigation of the mentioned above issues. Consider the following non-linear system of differential equations

$$\frac{d\varphi}{dt} = \omega(\varphi, X),$$

$$\frac{dX}{dt} = \lambda(XA_1(\varphi)X + A_2(\varphi)X + XA_3(\varphi) + A_4(\varphi) + F(\varphi, X, \lambda)), \quad (1)$$

де $\varphi = (\varphi_1, \dots, \varphi_m) \in \mathcal{T}_m$, X – the matrix of dimension $r_1 \times r_2$, $A_i(\varphi)$ ($i = \overline{1, 4}$) matrix functions from space $C^0(\mathcal{T}_m)$ – the dimensions respectively $r_2 \times r_1$, $r_2 \times r_2$, $r_1 \times r_1$, $r_1 \times r_2$, $\omega(\varphi, X)$ – m – dimension vector function from space $C^0(\mathcal{T}_m)$, $C^0(\mathcal{T}_m)$ – the space of functions jointly continuous by the totality of variables φ i 2π – periodic in each variable $j = \overline{1, m}$. $F(\varphi, X, \lambda)$ – matrix function defined and continuous on $\mathcal{T}_m \times R^{r_1+r_2} \times [\lambda_0, \infty)$.

Using the generalized extended Lyapunov function that is considered in quadratic forms, for such systems the issue of existence of invariant toroidal manifold has been studied. Namely, there have been obtained sufficient conditions enabling the existence of such a manifold for the systems of type (1) when the parameter λ is of quite a big value.

- [1] Yu. A. Mitropolsky, A.M. Samoilenko, V.L. Kulik, *Dichotomies and Stability in Nonautonomous Linear Systems*. Taylor & Francis, London – New York, 2003.
- [2] Smoothness of invariant manifolds of non-linear Rikkati-type systems [in Ukrainian], Bukovyna Mathematical Journal, Vol. (2), 2015, 25 – 37.