Periodicity and stabilization control of the delayed Filippov system with perturbation.  
(English) Zbl 1436.34066  
Discrete Contin. Dyn. Syst., Ser. B 25, No. 4, 1439-1467 (2020).

In this paper, the problems of periodicity and stabilization for a general class of delayed Filippov system with perturbation are investigated. The Leray-Schauder nonlinear alternative of set-valued maps is used to achieve the periodicity analysis, while the asymptotic stabilization and exponential stabilization control of delayed Filippov system with perturbation are realized via non-Lyapunov method, by introducing appropriate switching state-feedback controller. The obtained results are applied to time-delayed neural networks with perturbation and discontinuous activation functions under a periodic environment.

Reviewer: Sotiris K. Ntouyas (Ioannina)

MSC:

34K09 Functional-differential inclusions  
34K13 Periodic solutions to functional-differential equations  
34K20 Stability theory of functional-differential equations  
47N20 Applications of operator theory to differential and integral equations  
34K35 Control problems for functional-differential equations

Keywords:  
time-delay; Filippov system; differential inclusion; periodic solution; stabilization

Full Text: DOI

References:

[1] J.-P. Aubin and A. Cellina, Differential Inclusions, Set-Valued Functions and Viability Theory, Grundlehren der Mathema-
tischen Wissenschaften, 264. Springer-Verlag, Berlin, 1984.
[2] J.-P. Aubin and H. Frankowska, Set-Valued Analysis, Systems & Control: Foundations & Applications, 2. Birkhäuser Boston, Inc., Boston, MA, 1990.
[3] M. Benchohra; S. K. Ntouyas, Existence results for functional differential inclusions, E. J. Diff. Equ., 8 pp (2001) · Zbl 0980.34062
[4] A. Boucherif; C. C. Tisdell, Existence of periodic and non-periodic solutions to systems of boundary value problems for first-order differential inclusions with super-linear growth, Appl. Math. Comput., 204, 441-449 (2008) · Zbl 1165.34004 · doi:10.1016/j.amc.2008.07.001
[5] Z. W. Cai; J. H. Huang; L. H. Huang, Generalized Lyapunov-Razumikhin method for retarded differential inclusions: Applications to discontinuous neural networks, Discrete & Continuous Dynamical Systems-Series B, 22, 3591-3614 (2017) · Zbl 1371.34107 · doi:10.3934/dcdsb.2017181
[6] F. H. Clarke, Optimization and Nonsmooth Analysis, Canadian Mathematical Society Series of Monographs and Advanced Texts, A Wiley-Interscience Publication, John Wiley & Sons, Inc., New York, 1983. · Zbl 0582.49001
[7] J. Cortés, Discontinuous dynamical systems: A tutorial on solutions, nonsmooth analysis, and stability, IEEE Control Syst. Mag., 28, 36-73 (2008) · Zbl 1395.34023 · doi:10.1109/MCS.2008.919306
[8] F. S. De Blasi; L. Górniewicz; G. Pianigiani, Topological degree and periodic solutions of differential inclusions, Nonlinear Anal., 37, 217-245 (1999) · Zbl 0936.34009 · doi:10.1016/S0362-546X(98)00044-3
[9] B. C. Dhage, Fixed-point theorems for discontinuous multivalued operators on ordered spaces with applications, Comput. Math. Appl., 51, 589-604 (2006) · Zbl 1110.47043 · doi:10.1016/j.camwa.2005.07.017
[10] J. Dugundji and A. Granas, Fixed Point Theory, Springer Monographs in Mathematics, Springer-Verlag, New York, 2003. · Zbl 1025.47002
[11] A. F. Filippov, Differential Equations with Discontinuous Right-hand Side, Mathematics and Its Applications (Soviet Series), 18. Kluwer Academic, Boston, 1988.
[12] M. Forti; M. Grazzini; P. Nistri; L. Pancioni, Generalized Lyapunov approach for convergence of neural networks with discontinuous or non-Lipschitz activations, Phys. D, 214, 88-99 (2006) · Zbl 1103.34044 · doi:10.1016/j.physd.2005.12.006
[13] G. Haddad, Monotone viable trajectories for functional differential inclusions, J. Differential Equations, 42, 1-24 (1981) · Zbl
[31] S. C. Hu; N. S. Papageorgiou, Periodic solutions of nonconvex valued differential inclusions in \((\begin{document}R^N \end{document}, \begin{document}R^N \end{document})\), Proc. Amer. Math. Soc., 123, 3043-3050 (1995) - Zbl 0851.34014 - doi:10.2307/2160658

[32] S. C. Hu; D. A. Kandilakis; N. S. Papageorgiou, Periodic solutions for nonconvex functional differential inclusions, Proc. Amer. Math. Soc., 127, 89-94 (1999) - Zbl 0905.34036 - doi:10.1090/S0002-9939-99-04338-5

[33] J. P. Lasalle, The Stability of Dynamical Systems, SIAM, Philadelphia, 1976. - Zbl 0364.93002

[34] A. Lasota; Z. Opial, An application of the Kukutani-Ky Fan theorem in the theory of ordinary differential equations, Bull. Acad. Pol. Ser. Sci. Math. Astron. Phys., 13, 781-786 (1965) - Zbl 0151.10703

[35] Y. Li; Z. Lin, Periodic solutions of differential inclusions, Nonlinear Anal., 24, 631-641 (1995) - Zbl 0828.34012 - doi:10.1016/0362-546X(94)00111-T

[36] G. C. Li; X. P. Xue, On the existence of periodic solutions for differential inclusions, J. Math. Anal. Appl., 276, 168-183 (2002) - Zbl 1020.34015 - doi:10.1016/S0022-247X(02)00397-9

[37] K.-Z. Liu; X.-M. Sun; J. Liu; A. R. Teel, Stability theorems for delay differential inclusions, IEEE Trans. Autom. Control, 61, 3215-3220 (2016) - Zbl 1359.34062 - doi:10.1109/TAC.2015.2507782

[38] V. Lupulescu, Existence of solutions for nonconvex functional differential inclusions, E. J. Diff. Equ., 6 pp (2004) - Zbl 1075.34055

[39] D. O'Regan, Integral inclusions of upper semi-continuous or lower semi-continuous type, Proc. Am. Math. Soc., 124, 2391-2399 (1996) - Zbl 0860.45007 - doi:10.1090/S0002-9939-96-03456-9

[40] B. E. Paden; S. S. Sastry, A calculus for computing Filippov's differential inclusion with application to the variable structure control of robot manipulator, IEEE Trans. Circuits Syst., 34, 73-82 (1987) - Zbl 0632.34005 - doi:10.1109/TCS.1987.1086038

[41] N. S. Papageorgiou, Periodic solutions of nonconvex differential inclusions, Appl. Math. Lett., 6, 99-101 (1993) - Zbl 0784.34012 - doi:10.1016/0893-9659(93)90110-9

[42] S. T. Qin; X. P. Xue, Periodic solutions for nonlinear differential inclusions with multivalued perturbations, J. Math. Anal. Appl., 424, 988-1005 (2015) - Zbl 1318.34031 - doi:10.1016/j.jmaa.2014.11.057

[43] A. V. Surkov, On the stability of functional-differential inclusions with the use of invariantly differentiable Lyapunov functionals, Differential Equations, 43, 1079-1087 (2007) - Zbl 1187.34084 - doi:10.1134/S001226610708006X

[44] D. Turkoglu; I. Altun, A fixed point theorem for multi-valued mappings and its applications to integral inclusions, Appl. Math. Lett., 20, 563-570 (2007) - Zbl 1130.47057 - doi:10.1016/j.aml.2006.07.002

[45] K. N. Wang; A. N. Michel, Stability analysis of differential inclusions in Banach space with application to nonlinear systems with time delays, IEEE Trans. Circuits Syst. I, 43, 417-426 (1996) - doi:10.1109/81.526677

[46] X. P. Xue; J. F. Yu, Periodic solutions for semi-linear evolution inclusions, J. Math. Anal. Appl., 331, 1246-1262 (2007) - Zbl 1125.47057 - doi:10.1016/j.jmaa.2006.09.056

[47] P. Zecca; P. L. Zezza, Nonlinear boundary value problems in Banach spaces for multivalued differential equations in noncompact intervals, Nonlinear Anal., 3, 347-352 (1979) - Zbl 0443.34060 - doi:10.1016/0362-546X(79)90024-5

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.