

Maqbul, Md.; Raheem, A.

Application of Rothe's method to some functional differential equations with Dirichlet boundary conditions. (English) [Zbl 1476.35291](#)

Differ. Equ. Dyn. Syst. 29, No. 3, 633-643 (2021).

Summary: The existence and uniqueness of a strong solution for a class of partial functional differential equations with Dirichlet boundary conditions is established by applying Rothe's method. As an application, we included an example to illustrate the main result.

MSC:

[35R10](#) Partial functional-differential equations

[35K20](#) Initial-boundary value problems for second-order parabolic equations

[35D35](#) Strong solutions to PDEs

[47D06](#) One-parameter semigroups and linear evolution equations

Keywords:

Rothe's method; functional differential equation; strong solution; semigroup of bounded linear operators

Full Text: [DOI](#)

References:

- [1] Rubanik, VP, Oscillations of Quasilinear Systems with Retardation (1969), Moscow: Nauka, Moscow · [Zbl 0188.40501](#)
- [2] Cook, K.; Krumme, D., Differential difference equations and nonlinear initial-boundary-value problems for linear hyperbolic partial differential equations, *J. Math. Anal. Appl.*, 24, 372-387 (1968) · [Zbl 0186.16902](#) · [doi:10.1016/0022-247X\(68\)90038-3](#)
- [3] Islam, MN; Raffoul, YN, Periodic solutions of neutral nonlinear system of differential equations with functional delay, *J. Math. Anal. Appl.*, 331, 1175-1186 (2007) · [Zbl 1118.34057](#) · [doi:10.1016/j.jmaa.2006.09.030](#)
- [4] Damak, M.; Ezzinbi, K.; Souden, L., Weighted pseudo-almost periodic solutions for some neutral partial functional differential equations, *Electron. J. Differ. Equ.*, 2012, 47, 1-13 (2012) · [Zbl 1244.34092](#)
- [5] Rothe, E., Two-dimensional parabolic boundary value problems as a limiting case of one-dimensional boundary value problems, *Math. Ann.*, 102, 650-670 (1930) · [Zbl 56.1076.02](#) · [doi:10.1007/BF01782368](#)
- [6] Agarwal, S.; Bahuguna, D., Method of semidiscretization in time to nonlinear retarded differential equation with nonlocal history conditions, *IJMMS*, 37, 1943-1956 (2004) · [Zbl 1122.34344](#)
- [7] Raheem, A.; Bahuguna, D., A study of delayed cooperation diffusion system with Dirichlet boundary conditions, *Appl. Math. Comput.*, 218, 8, 4169-4176 (2011) · [Zbl 1247.65125](#)
- [8] Raheem, A.; Bahuguna, D., Delay differential equations with homogeneous integral conditions, *Electron. J. Differ. Equ.*, 2013, 78, 1-11 (2013) · [Zbl 1295.35183](#)
- [9] Raheem, A.; Bahuguna, D., Rothe's method for solving some fractional integral diffusion equation, *Appl. Math. Comput.*, 236, 161-168 (2014) · [Zbl 1334.39048](#)
- [10] Dubey, S.A.: The method of lines applied to nonlinear nonlocal functional differential equations. *J. Math. Anal. Appl.* 376, 275-281 (2011) · [Zbl 1216.34076](#)
- [11] Kartsatos, AG; Zigler, WR, Rothe's method to abstract parabolic equation, *Czech. Math. J.*, 24, 496-500 (1974) · [doi:10.21136/CMJ.1974.101263](#)
- [12] Kato, T., Nonlinear semigroup and evolution equations, *Math. Soc. Japan*, 19, 508-520 (1967) · [Zbl 0163.38303](#) · [doi:10.2969/jmsj/01940508](#)
- [13] Rektorys, K., *The Method of Discretization in Time and Partial Differential Equations* (1982), Dordrecht: D. Reidel Publishing Company, Dordrecht · [Zbl 0522.65059](#)
- [14] Rektorys, K., On application of direct variational methods to the solution of parabolic boundary value problems of arbitrary order in the space variables, *Czech. Math. J.*, 21, 96, 318-339 (1971) · [Zbl 0217.41601](#) · [doi:10.21136/CMJ.1971.101024](#)
- [15] Rektorys, K.: Numerical and theoretical treating of evolution problems by the method of discretization in time. In: *Proceeding of the International Conference on Differential Equations and Their Applications*, pp. 71-84 (1985)
- [16] Kacur, J., Method of Rothe in evolution equations, *Lect. Notes Math.*, 1192, 23-34 (1985) · [doi:10.1007/BFb0076049](#)
- [17] Kacur, J., Application of Rothe's method to perturbed linear hyperbolic equations and variational inequalities, *Czech. Math. J.*, 34, 1, 92-106 (1984) · [Zbl 0554.35086](#) · [doi:10.21136/CMJ.1984.101928](#)
- [18] Kikuchi, N.; Kacur, J., Convergence of Rothe's method in Hölder spaces, *Appl. Math.*, 48, 5, 353-365 (2003) · [Zbl 1099.65079](#) · [doi:10.1023/B:APOM.0000024481.01947.da](#)

- [19] Bouziani, A., Mechri, R.: The Rothe's method to a parabolic integrodifferential equation with a nonclassical boundary conditions. *Int. J. Stoch. Anal.*, Art. ID 519684 (2010) · [Zbl 1194.35201](#)
- [20] Merazga, N.; Bouziani, A., On a time-discretization method for a semilinear heat equation with purely integral conditions in a nonclassical function space, *Nonlinear Anal. TMA*, 66, 604-623 (2007) · [Zbl 1105.35044](#) · [doi:10.1016/j.na.2005.12.005](#)
- [21] Merazga, N.; Bouziani, A., Rothe time-discretization method for a nonlocal problem arising in thermoelasticity, *J. Appl. Math. Stoch. Anal.*, 1, 13-28 (2005) · [Zbl 1077.74019](#) · [doi:10.1155/JAMSA.2005.13](#)
- [22] Merazga, N.; Bouziani, A., Rothe method for a mixed problem with an integral condition for the two dimensional diffusion equation, *Abstract Appl. Anal.*, 16, 899-922 (2003) · [Zbl 1065.35026](#) · [doi:10.1155/S1085337503305019](#)
- [23] Slodika, M., Semigroup formulation of Rothe's method: application to parabolic problems, *Comment. Math. Univ. Carol.*, 33, 2, 245-260 (1992)
- [24] Necas, J., Application of Rothe's method to abstract parabolic equations, *Czech. Math. J.*, 24, 3, 496-500 (1974) · [Zbl 0311.35059](#) · [doi:10.21136/CMJ.1974.101263](#)
- [25] Nagase, H., On an application of Rothe's method to nonlinear parabolic variational inequalities, *Funkcialaj Ekvacioj*, 32, 273-299 (1989) · [Zbl 0693.35100](#)
- [26] Pultar, M., Solutions of abstract hyperbolic equations by Rothe method, *Appl. Math.*, 29, 1, 23-39 (1984) · [Zbl 0575.65089](#) · [doi:10.21136/AM.1984.104065](#)
- [27] Chaoui, A.; Guezane-Lakoud, A., Solution to an integrodifferential equation with integral condition, *Appl. Math. Comput.*, 266, 903-908 (2015) · [Zbl 1410.65354](#)
- [28] Chaoui, A.; Ellagoune, F.; Guezane-Lakoud, A., Full discretization of wave equation, *Bound. Value Probl.*, 2015, 133, 1-11 (2015) · [Zbl 1338.35225](#)
- [29] Pazy, A., *Semigroup of Linear Operators and Application to Partial Differential Equations* (1983), New York: Springer, New York · [Zbl 0516.47023](#) · [doi:10.1007/978-1-4612-5561-1](#)

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.