ISSN 1978-3787 (Cetak)
ISSN 2615-3505 (Online)

ESTIMASI PARAMETER PADA PERSAMAAN OSILATOR HARMONIK *FUZZY*: PERBANDINGAN SOLUSI HUKUHARA DIFERENSIAL DAN INKLUSI DIFERENSIAL *FUZZY* DENGAN MENGGUNAKAN METODE RUNGE-KUTTA DIPERLUAS

Muhammad Ahsar Karim
Program Studi Matematika FMIPA Universitas Lambung Mangkurat; Banjarbaru, Indonesia
email: m_ahsar@ulm.ac.id

Abstract

Most of the real systems in the world may contain uncertainties, which are possibly due to the limitations of available data, complexity of the network of systems, and environmental or demographic changes at the time of observation. One of the system behaviors that often appears in mathematical modeling is periodic behavior, which often shows complex dynamic behavior, depending on initial values and parameters. By accommodating the uncertainties in the model, in-depth studies are needed to describe mathematical structure, methodology for determining solution, and procedure for estimating parameters. Among the mathematical models that describe periodic behavior is harmonic oscillator equation. In this paper, the model is assumed to have uncertainty in the initial values in the form of fuzzy numbers, which is then called by fuzzy harmonic oscillator equation. The model is examined by comparing three fuzzy differential approaches, namely Hukuhara differential, generalized Hukuhara differential and fuzzy differential inclusions. Applications of fuzzy arithmetic concepts to the models lead to a deterministic alpha-cut systems, which are solved using extended Runge-Kutta method. In contrast to the standard Runge-Kutta method, the extended Runge-Kutta method using the first derivative approximation of the evaluation function to increase the accuracy of the solution. Among the three fuzzy approaches, the fuzzy differential inclusion type is the most appropriate approach to capture the periodic behavior of the equation. Next, it is shown how to estimate the parameters of solution of the fuzzy differential inclusion type and simulation of fuzzy data using lsqnonlin method.

Keywords: *Parameter estimation; Hukuhara differential; Fuzzy differential inclusion; Extended Runge-Kutta method; Fuzzy harmonic oscillator equation*