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Simulating the damped vibrations of a fractional oscillator with fuzzy initial conditions

Stefania Tomasiello, Jan Awrejcewicz

Abstract: A Picard-like scheme using quadrature and differential quadrature rules, formerly introduced to solve integro-differential equations, is herein adapted to solve the problem of an oscillator with damping defined by the Riemann- Liouville fractional derivative and with fuzzy initial conditions. Considering fuzzy initial conditions has the meaning of a fuzzification of the problem via the Zadeh's extension principle. Following Zadeh, fuzziness is a way to take into account an uncertainty which cannot be identified as randomness. In the crisp domain, the proposed approach is able to approximate the reference analytical solutions with high accuracy and a relatively low computational cost. In the linear regime, the technique proposed becomes a non-recursive scheme, providing semi-analytical solutions by means of operational matrices and vectors of known quantities. In this sense, an example of application is given by the free damped vibrations of a linear oscillator in a medium with small viscosity, usually solved by using the method of multiple scales (in the crisp domain).

[1)] Stefania Tomasiello, Ph.D.: Corisa, University of Salerno, via Giovanni Paolo II, 132 - Fisciano (SA), ITALY (stomasiello@unisa.it), the author presented this work at the conference.

[2)] Jan Awrejcewicz, Professor: Lodz University of Technology, 1/15 Stefanowskiego Street, 90-924 Lodz, POLAND (jan.awrejcewicz@p.lodz.pl).