A Novel Numerical Optimization technique to Control the Accuracy of Semi-Analytical Methods for Solving Volterra Integral Equations with Discontinuous Kernel

Noeiaghdam S.[1,2] and Sidorov D.N.[1,3]

[1] *Industrial Mathematics Laboratory, Baikal School of BRICS, Irkutsk National Research Technical University, Irkutsk, 664074, Russia.*

[2] *Department of Applied Mathematics and Programming, South Ural State University, Lenin prospect 76, Chelyabinsk, 454080, Russia.*

[3] *Energy Systems Institute of Russian Academy of Science, 130 Lermontov Street, 664033 Irkutsk, Russia;*

snoei@istu.edu; noiagdams@susu.ru; dsidorov@isem.irk.ru

The aim of this study is to discuss application of the CESTAC method and the CADNA library to control the accuracy of the Adomian decomposition method and the homotopy perturbation method to solve the linear and nonlinear Volterra integral equations with discontinuous kernel. The importance of solving this problem is because of its applications in the load leveling problems, energy storage with renewable and diesel generation, charge/discharge storages control and others [1].

In general, the mathematical methods for solving the mentioned problem are based on floating point arithmetic and the accuracy of the method has been discussed using the traditional absolute error which depends on the exact solution and also a positive small value ε. But in real life problems we do not have the exact solution. Also, based on this condition we will not be able to find more accurate approximations because we do not have information about optimal ε. For small values of ε, the numerical algorithm can not be stopped and extra iterations will be produced without improving the accuracy. For large values of ε, the numerical algorithm will be stopped in initial steps without producing enough iterations.

Because of the mentioned problems we apply a new termination criterion which depends on two successive approximations. For this aim we apply the CESTAC method and the CADNA library which are based on stochastic arithmetic. In this condition, not only we do not need to have the exact solution but also we would be able to identify the optimal approximation, optimal iteration and optimal error of numerical procedure. Also, the CADNA library is applied as an important software for this validation. The CADNA library should be done on the LINUX operating system and its codes should be written using C, C++ or ADA codes [2].

REFERENCES

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