

$$\begin{cases} i_{1,m}(t) = \sum_{k=0}^n I_{1,m}(k)(t - t_{m-1})^k \\ i_{2,m}(t) = \sum_{k=0}^n I_{2,m}(k)(t - t_{m-1})^k \end{cases} \text{ for } t \in [t_{m-1}, t_m] \quad (13)$$

And

$\forall j \in \{0, \dots, M-1\}$ and $[0, T] = \cup_{j=0}^{M-1} [t_j, t_{j+1}]$ and for all $t \in [0, T]$, we have

$$\begin{cases} i_1(t) = \sum_{j=0}^{M-1} i_{1,j}(t) \chi_{[t_j, t_{j+1}]}(t) \\ i_2(t) = \sum_{j=0}^{M-1} i_{2,j}(t) \chi_{[t_j, t_{j+1}]}(t) \end{cases} \quad (14)$$

For the numerical results, we compare the proposed method to the analytical approximation given in [4] by:

$$i_2(t) = -0.100858e^{-0.1t} + 11.1952161e^{-10t} - 11.094358e^{-100t}A$$

And for comparison purposes, the numerical method mentioned above are tested with different time steps 0.001s, 0.01s, 0.02s and 0.03s in computation and with order 5.

Table 6. Comparison of the numerical results with reference solution [4] with different time steps T

T	Reference value	PDTM	Absolute error
0.001	0.9533093	0.9035725	0.0497
0.005	3.8475817	3.796201	0.0514
0.01	5.9781937	5.9386937	0.0395
0.02	7.5751726	7.5345726	0.0406
0.03	7.6321926	7.5820926	0.0501

5. CONCLUSION

In this work, we presented a new approach for applying the partitioning differential transform method for solving nonlinear integro-differential equations for large time interval. In Example 1, we show the effectiveness of this method when the classical differential transform method fail or give the bad results. The analytical approximations to the solutions are reliable, and confirm the power and ability of the partitioning DTM methods as an easy device for computing the solution of a non-linear system of differential or intergo-differential equations. For the considered test, the presented technique generated numerical results and is effective in solving nonlinear integro-differential equations.

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REFERENCES

- [1] Abdel-Halim Hassan IH. (2004). Differential transformation technique for solving higher-order initial value problems. Appl. Math. Comput. 154: 299-311. [https://doi.org/10.1016/S0096-3003\(03\)00708-2](https://doi.org/10.1016/S0096-3003(03)00708-2)
- [2] Abdel-Halim Hassan IH. (2008). Application to differential transformation method for solving systems of differential equations. Applied Mathematical Modelling 32(12): 2552-2559. <https://doi.org/10.1016/j.apm.2007.09.025>
- [3] Arikoglu A, Ozkol I. (2008). Solution of integral and integro-differential equation systems by using differential transform method. Comput. Math. Appl. 65: 2411-2417. <https://doi.org/10.1016/j.camwa.2008.05.017>
- [4] Hui SYR, Christopoulos C. (1991). Discrete transform technique for solving coupled integro-differential equations in digital computers. In IEE Proceedings A - Science, Measurement and Technology 138(5): 273-280. <https://doi.org/10.1049/ip-a-3.1991.0039>
- [5] Mohanty M, Jena SR. (2018). Differential transformation method (DTM) for approximate solution of ordinary differential equation (ODE). Advances in Modelling and Analysis B 61(3): 135-138 https://doi.org/10.18280/ama_b.610305
- [6] Odibat ZM. (2008). Differential transform method for solving volterra integral equation with separable kernels. Math. and Comput. Model. 48: 1144-1149. <https://doi.org/10.1016/j.mcm.2007.12.022>
- [7] Odibat ZM, Bertelle C, Aziz-Alaoui MA, Duchamp GHE. (2010). A multi-step differential transform method and application to non-chaotic or chaotic systems. Computers and Mathematics with Applications 59(4): 1462-1472. <https://doi.org/10.1016/j.camwa.2009.11.005>
- [8] Evg. Pukhov G. (1982). Differential transforms and circuit theory. Circuit Theory and Applications 10: 265-276. <https://doi.org/10.1002/cta.4490100307>
- [9] Zhou JK. (1986). Differential transformation and its application for electrical circuits. Huarjung University Press, Wu-uhahn, China.