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## OPERATIONAL MATRIX METHOD FOR SOLVING TWO POINT BOUNDARY VALUE PROBLEMS

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### **ABSTRACT**

The main purpose of this study is to give numerical solution of differential equations based on operational matrix method. Converting differential equations into algebraic expressions is the basic idea of this method. Since the simplicity of the computations, Haar wavelet is preferred. The properties of haar operational matrix method is presented. At the end, illustrative examples are included to show the efficiency and the applicability of this technique.

### REFERENCES

- [1] S. Arora, "Haar Wavelet Matrices for the Numerical Solutions of Differential Equations," vol. 97, no. 18, pp. 33-36, 2014.
- [2] N. Berwal, D. Panchal, and C. L. Parihar, "Solution of differential equations based on haar operational matrix," vol. 3, no. 2, pp. 281-288, 2014.
- [3] A. H. Bhrawy, T. M. Taha, and J. A. T. Machado, "A review of operational matrices and spectral techniques for fractional calculus," Nonlinear Dyn., 2015.
- [4] M. Cui and F. Geng, "Solving singular two-point boundary value problem in reproducing kernel space," vol. 205, pp. 6-15, 2007.
- [5] E. H. Doha, A. H. Bhrawy, and S. S. Ezz-Eldien, "A new Jacobi operational matrix: An application for solving fractional differential equations," Appl. Math. Model., vol. 36, no. 10, pp. 4931-4943, Oct. 2012.
- [6] J.-S. GUF and W.-S. JIANG, "The Haar wavelets operational matrix of integration," Int. J. Syst. Sci., vol. 27, no. 7, pp. 623-628, Jul. 1996.
- [7] A. S. V. R. Kanth and K. Aruna, "Solution of singular two-point boundary value problems using differential transformation method," vol. 372, pp. 4671-4673, 2008.
- [8] Y. Keskin and G. Oturanç, "Reduced Differential Transform Method for Partial Differential Equations," Int. J. Nonlinear Sci. Numer. Simul., vol. 10, no. 6, Jan. 2009.
- [9] J. Lu, "Variational iteration method for solving two-point boundary value problems," vol. 207, pp. 92-95, 2007.

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- [10] A. Mathematics, "Numerical solution of differential equations using Haar wavelets," vol. 68, pp. 127-143, 2005.
- [11] S. Momani, "Variational iteration method for solving nonlinear boundary value problems," vol. 183, pp. 1351-1358, 2006.
- [12] A. Sunmonu, "Implementation of Wavelet Solutions to Second Order Differential Equations with Maple Haar Wavelets Method," vol. 6, no. 127, pp. 6311-6326, 2012.
- [13] O. Acan, Y. Keskin, "Approximate solution of Kuramoto-Sivashinsky equation using reduced differential transform method," en: 12 Th Int. Conf. Numer. Anal. Appl. Math., AIP Publishing, 2015: p. 470003. doi:10.1063/1.4912680.

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