

**PROCEEDINGS**

## **Solving the Time-Dependent Diffusion Problems by the Method of Fundamental Solutions and the Particle Swarm Optimization**

**Tan Phat Lam<sup>1,2</sup>, Chia-Ming Fan<sup>1,\*</sup>, Chiung-Lin Chu<sup>1</sup> and Fu-Li Chang<sup>1</sup>**

<sup>1</sup>Department of Harbor and River Engineering, National Taiwan Ocean University, Keelung, 20224, Taiwan

<sup>2</sup>Faculty of Water Resource Engineering, College of Engineering, Can Tho University, Can Tho 94000, Vietnam

\*Corresponding Author: Chia-Ming Fan. Email: fanchiaming@gmail.com

### **ABSTRACT**

In this study, the combination of the Method of Fundamental Solutions (MFS) and the Particle Swarm Optimization (PSO) is proposed to accurately and stably analyze the multi-dimensional diffusion equations. The MFS, truly free from mesh generation and numerical quadrature, is one of the most promising meshless methods. In the implementation of the MFS, only field points and sources, which are located out of the computational domain, are required. The numerical solutions of the MFS is expressed as a linear combination of diffusion fundamental solutions with different strengths. The unknown coefficients in the solution expressions can be acquired by solving the resultant system of linear algebraic equations, which is yielded by enforcing the satisfactions of interior condition and boundary conditions. The numerical solutions of the MFS are extremely accurate once the optimal locations of sources are discovered. Hence, in this study, the PSO is adopted to determine the optimal location of sources in the space-time domain. The PSO is one of the newly-proposed metaheuristic optimization algorithms, so it can be used to efficiently choose the optimal location of sources without the extra information and conditions. Several numerical examples in one-dimensional, two-dimensional and three-dimensional computational domains are provided to verify the merits of the proposed combination of the MFS and the PSO. In addition, the stability, the accuracy and the efficiency of the proposed meshless numerical scheme will be examined by adopting various parameters in the MFS and the PSO.

### **KEYWORDS**

Diffusion equation; meshless method; method of fundamental solutions; particle swarm optimization

**Funding Statement:** The authors received no specific funding for this study.

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.