
Adviser: Jui-Sheng Chen

Presenter: Nung-Pin Chen

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Outline

- Introduction
- Objectives
- Methodology
- Discussion
- Future work
Introduction
Introduction

• Advection-Dispersion Equation (ADE)

2-D Advection-Dispersion Equation

\[ D_x \frac{\partial^2 C}{\partial x^2} + D_y \frac{\partial^2 C}{\partial y^2} - V_x \frac{\partial C}{\partial x} - V_y \frac{\partial C}{\partial y} = R \frac{\partial C}{\partial t} \]

coefficient of hydrodynamic dispersion
Introduction

• Tracer test
Introduction

• Type Curve fitting method
Introduction

- The traditional curve-fitting method for the estimation of dispersivity from a convergent flow tracer test is quite time-consuming and the error caused by artificial curve fitting.
Objectives

- To present a back-propagation neural network (BPN) model to improve the feasibility of the two-dimensional convergent flow tracer transport model. (Chen et al., 2003)
Methodology

(Mathematical model)

• For determining transport parameters herein, the mathematical model presented by Chen et al. (2003) is chosen.

Homogeneous and isotropic aquifer
Methodology
(Mathematical model)

\[
\frac{a_L A}{r} \frac{\partial^2 C}{\partial r^2} + \frac{A}{r} \frac{\partial C}{\partial r} + \frac{a_T A}{r^3} \frac{\partial^2 C}{\partial \theta^2} = R \frac{\partial C}{\partial t}
\]

Dimensionless

\[
\frac{1}{Pe} \frac{1}{r_D} \frac{\partial^2 C}{\partial r_D^2} + \frac{1}{r_D} \frac{\partial C}{\partial r_D} + \frac{1}{Pe} \frac{a_D}{r_D^3} \frac{\partial^2 C}{\partial \theta^2} = \frac{2R}{1 - r^2_{WD}} \frac{\partial C}{\partial t_D}
\]

Laplace transform finite difference (LTFD)
Methodology
(Artificial neural network)

- Artificial Neural Network, ANN is a universal approximator, proven to be highly effective for modeling non-linear problems, with application to a diversity of large-scale problems, including pattern recognition, classification, and control.
Methodology
(Artificial neural network)

• Back-propagation neural network, BPN
Methodology

Mathematical model

Curve characteristics

ANN

Transport parameters

Training
Methodology

(BPNFM BPN-φ)
Methodology

(BPNFM BPN-$a_L$)

\[ Pe = \frac{R_L}{Pe} \]

\( a_L = \frac{R_L}{Pe} \)

Dimensionless concentration

Dimensionless time

\( C_{ex} \)

\( t_{ex} \)

Pe=1

Pe=10

Pe=100
Methodology
(BPNFM BPN-\(a_T\))

Type curve fitting

\[ a_T = a_L X \]
Discussion

(BPN-ϕ)

- Training data: 50 sets
Discussion

(BPN-\(a_L\))

[Graph showing a scatter plot with RE\% on the y-axis and longitudinal dispersivity on the x-axis. The graph has a grid with red data points scattered across it.]

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Discussion

(BPN-\(a_T\))

\[ a_T = a_L X \]

\[ X = 0.2 \]
Future work

• To increase the range of transverse/longitudinal dispersivity ratio and the total amount of training data points.

• For the hypothetical case, comparing the difference of the analysis data between the employment of BPNFM and type curve fitting method.
Thanks for your attention.