INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	**Mamata Das**
Roll Number	:	**166104035**
Programme of Study	:	**Ph.D.**

Thesis Title: **Development of inverse optimization model for identification of virus sources in the saturated-unsaturated zone.**

Name of Thesis Supervisor(s)	:	**Prof. Rajib Kumar Bhattacharjya & Prof. Suresh A Kartha**
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SHORT ABSTRACT

Groundwater aquifers, essential drinking water sources, are vulnerable to virus contamination. Identifying the source of viruses in groundwater can help determine the appropriate measures needed to prevent or mitigate contamination, protect public health, and maintain the quality of groundwater resources. This study focuses on developing an effective source identification model in an unconfined groundwater aquifer considering both the unsaturated and saturated zones. This model is developed using a linked simulation optimization model, where the objective function minimizes the error between the observed and simulated virus concentration. Current computational models like HYDRUS-3D and MT3DMS have shortcomings in addressing variable degrees of saturation and activation rates of viruses. To overcome these limitations, a three-dimensional virus transport model is developed, encompassing the unsaturated and saturated zones and accommodating variations in transport parameters due to saturation degree. The model is developed in the MATLAB environment. However, some of these parameters are not available on field and laboratory scale and thus need a parameter estimation model. As such a parameter estimation model is developed for coupled unsaturated and saturated zone to estimate the flow and transport parameters using Metaheuristic optimization algorithm. Once the computational virus transport model is developed, it is linked with an optimization model to identify the virus sources in the aquifer. The Shuffled Frog Leaping Algorithm (SFLA) is used as an optimization algorithm to identify the virus source location and source strength. The SFLA source identification model accurately determined the virus source locations and the source fluxes. However, the computational time required for the process was quite high. Thus, to overcome this limitation, an improved source identification model algorithm is developed by using Recurrent Neural Network (RNN) in conjunction with the computational simulation model and shuffled Frog Leaping Algorithm. This model is efficient both in computation time and predicting performance.