Application of Neural Networks Coupled with Genetic Algorithms to Optimize Soil Cleanup Operations in Cold Climates

Cleanup
CU-1049

RESEARCH CATEGORY: 6.2 Applied Research

LEAD AGENCY: U.S. Army

LAB: Cold Regions Research and Engineering Laboratory - Hanover, VT

PRINCIPAL INVESTIGATOR: Dr. John M. Sullivan, (603) 646-4328

FY 1998 COMPLETED PROJECT

OBJECTIVE: This project has two objectives for site characterization and contaminant fate, transport, and remediation analysis for site cleanup alternatives. The first objective is automated decomposition of Ground Penetrating Radar (GPR) signals into stratigraphic layers using Neural Networks (NNs). GPR can probe the subsurface non-invasively at high resolution but methods to quantitatively interpret these data are sparse. We propose to train NNs, which are ideally suited for pattern recognition, to recognize various stratigraphic layer configurations. This tool will allow enhanced quantitative site conceptualization. The second objective is to develop and implement a rapid solution strategy to analyze selected remediation/monitoring alternatives using NNs coupled to Genetic Optimization (GO) routines. The NNs will be trained to recognize contaminant distributions as a function of boundary conditions. The GO routines will be developed for decision analysis of remediation alternatives and monitoring strategies based on the simulated behavior predicted by the NN. The coupling of these applied research areas can potentially yield an analysis technique for characterizing subsurface stratigraphy and the selection of an optimum remediation strategy.

BENEFIT: The expected benefits of this project are an accurate, non-invasive tool for site conceptualization and an optimized remediation and monitoring deployment plan for sites requiring cleanup and monitoring of groundwater. The ability to characterize a site will increase by two orders of magnitude from current practices and gains realized in predicting subsurface contaminant flow would be an order of magnitude. Optimized deployment routines could reduce remediation and monitoring cost of a contaminated site by one third.

ACCOMPLISHMENTS: In FY98, this project successfully developed a preliminary framework for and demonstrated PC based Windows application of NN and CLI programs. Established Phase-2 objectives and directions for merging CLI and NN programs into one orchestrated system and the Windows based NN and CLI program demonstrated for multiple GPR input situations. Completed interim report delineating the advances of CLI and NN.

TRANSITION: The project intends to transition the optimized deployment routines to be developed and tested under this project beyond the cold regions applications to many contaminated sites.