GEOTECHNICAL IN-SITU MONITORING WITH INTELLIGENT GIS

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Monitoring of geotechnically complex sites via *in situ* sensor networks is increasingly common, but little work has been done to date on using spatial analysis and visualization tools such as Geographic Information Systems as a platform for sensor data fusion and intelligent analysis. The Geotechnical In-Situ Sensor Network (GIST) project combines sensor network monitoring tools with intelligent systems technology to embody geotechnical, physical, and geospatial rules, and to feed results to a GIS-based Decision Support System interface (Figure 1). The Decision Support System interface provides spatial analytical tools for operator-driven use as well as an interface for rule-based programming, built on commercial off-the-shelf GIS technology. A supporting data library and archive interface provides access to historical data archives, supporting documentation and operator training materials.

Rules expressed in GIST combine multiple sensors into abstract clusters, perform automated spatial analysis for pattern detection, and monitor overall system performance to guarantee near-real-time response. Second order rules provide the ability for the system to postulate new rules, to perform exploratory spatial analysis to judge rule relevance, and to link to numerical modeling codes. Reliance on extensive case-study libraries and data archives provides opportunities for machine-learning techniques to be applied towards the generation of potentially novel rules.

GIST thus provides a framework for testing sensor array configurations, new sensor analysis paradigms, automated rule generation, and linkages between numerical modeling and GIS approaches to geotechnical monitoring. The intelligent systems engine in GIST is based on a grammar for monitoring and modeling that includes spatial, temporal, and fuzzy logics to capture the rich semantics of complex natural phenomena. Research to support and extend GIST includes investigations of intelligent systems with an emphasis on reasoning under uncertainty and spatial modeling grammars, supported by the generation of geotechnical rule bases and targeted case studies.

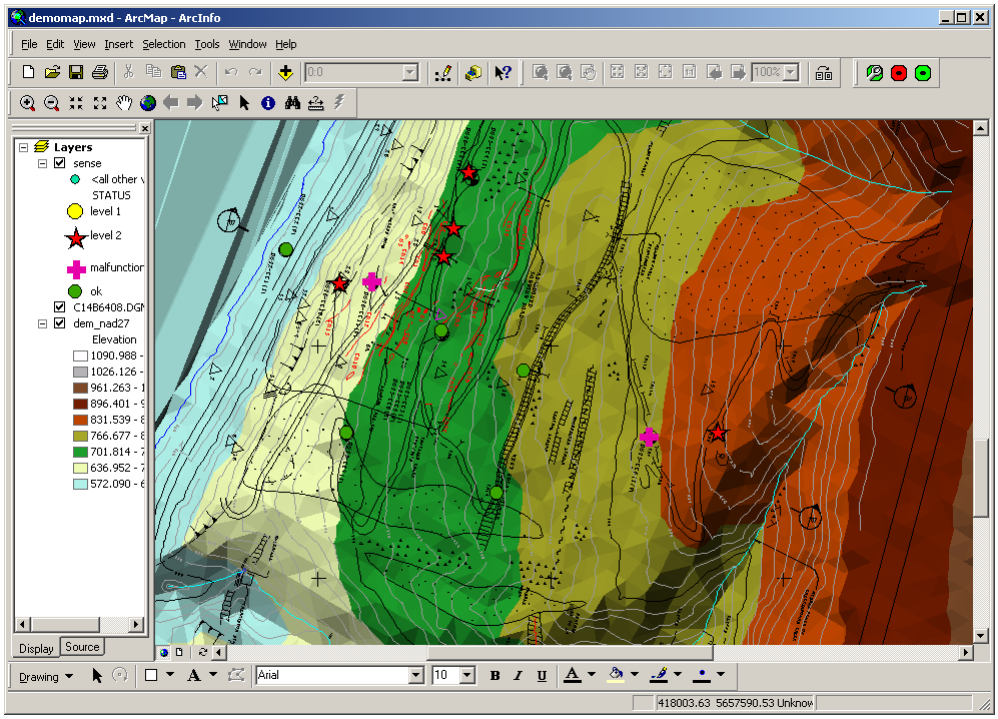

Figure 1: ArcGIS display of CLIPS results for GIST software (under development). Alert levels for different geotechnical instruments, based on time series analysis of the network of geotechnical data, are shown.

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