

## Displacement back analysis based on support vector machine and simulated annealing

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Correcting the mechanical parameters of rock mass in the calculation model by using the measured displacement data through the back analysis, has become a kind of effective geotechnical engineering research method. In order to overcome the weakness about big calculate workload, poor stability solution and easily trapping in local minima shortcomings of general inverse analysis methods, a method based on support vector machine (SVM) and simulated annealing algorithm for the displacement back analysis is proposed (S-S Back Analysis Method).

The displacement back analysis is the process of adopting the optimization method to search for a group of rock mechanics parameters inversion, to make corresponding displacement calculation value to the measured displacement value approach. For complex rock mass engineering, the measure point displacement of the finite element method is used for different rock mass mechanics parameters in the process of optimization, and calculation workload is very huge. Therefore, support vector machine is used to establish rock mechanics parameters and rock mass displacement of complicated nonlinear mapping relationship. This method need not know the relationship between independent variables and dependent variables in advance, the dependent variable and the mapping relationship between independent variables can be obtained through the finite sample training, which has good generalization ability. For the linear support vector machine regression algorithm, the regression function can be determined by adopting linear function and fitting training samples. For nonlinear support vector regression, it can be solved as a linear problem by mapping the original problem into the high dimensional feature space through nonlinear mapping.

The proposed back analysis method is applied to a large underground cavern group inversion analysis of excavation process, 68 displacement measuring points are fixed in all, and 8 mechanic parameters of rock mass are determined by back analysis, including deformation modulus and shear strength of each layer of rock mass and disturbed belt  $f$ ,  $c$ . Inversion results are used to finite element forward analysis, the average error between each displacement calculated value and measured value of points is about 0.63 mm, for the large underground cavern, the result is quite good.

**Keywords:** Displacement back analysis, support vector machine, simulated annealing, underground cavern group