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APPLYING OF REGULARIZATION IN MODEL TRAINING ON A FINITE DATA SET

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The effectiveness of a model is determined by its ability to adequately solve a particular problem. To minimize the loss function for a finite data set, it is effective to use a regularization algorithm when training the model. The training algorithm solves the problem of parameter optimization. The objective function is to minimize the discrepancy between the original predicted $\hat{z}_j$ and the given reference value z_j . Error function for the LSE method is:

$$E = \frac{1}{2} \sum_{j=1}^N (z_j - \hat{z}_j)^2 \rightarrow \min.$$

The general expression for Lp norms is: $\|x\|_p = \left(\sum_{i=1}^N |x|^p \right)^{\frac{1}{p}}$.

The most common method is L2 regularization, particularly for ANFIS-like models, which leads to more stable, less sparse models. By applying the Euclidean L2 norm in the optimization algorithm, the loss function is given by

$$L(q) = \frac{1}{n} \sum_{j=1}^n E(z_j, \hat{z}_j) + \frac{\lambda}{2n} \|q\|_2^2, \text{ where } \|q\|_2^2 = \sum_{j=1}^m q_j^2 \text{ is the square Euclidean}$$

norm with the vector q , λ is the regularization coefficient.

According to the simulation results, the use of L2 regularization when training the model led to improved convergence of the optimization algorithm and reduced error (Fig. 1).

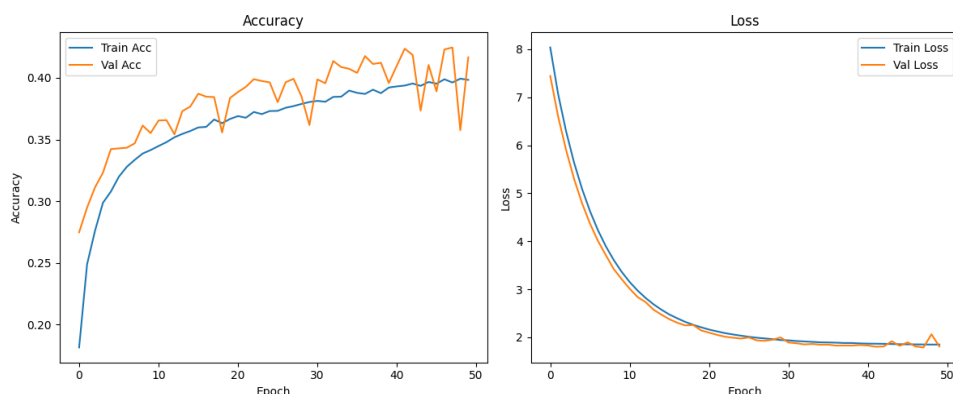


Fig. 1. Model training results when applying L2 regularization

The results obtained show that the model implemented by a neural network with training and regularization ensures error minimization.