Inversion of One Dimensional Electrical Resistivity Data in Anisotropic Media via Artificial Neural Networks

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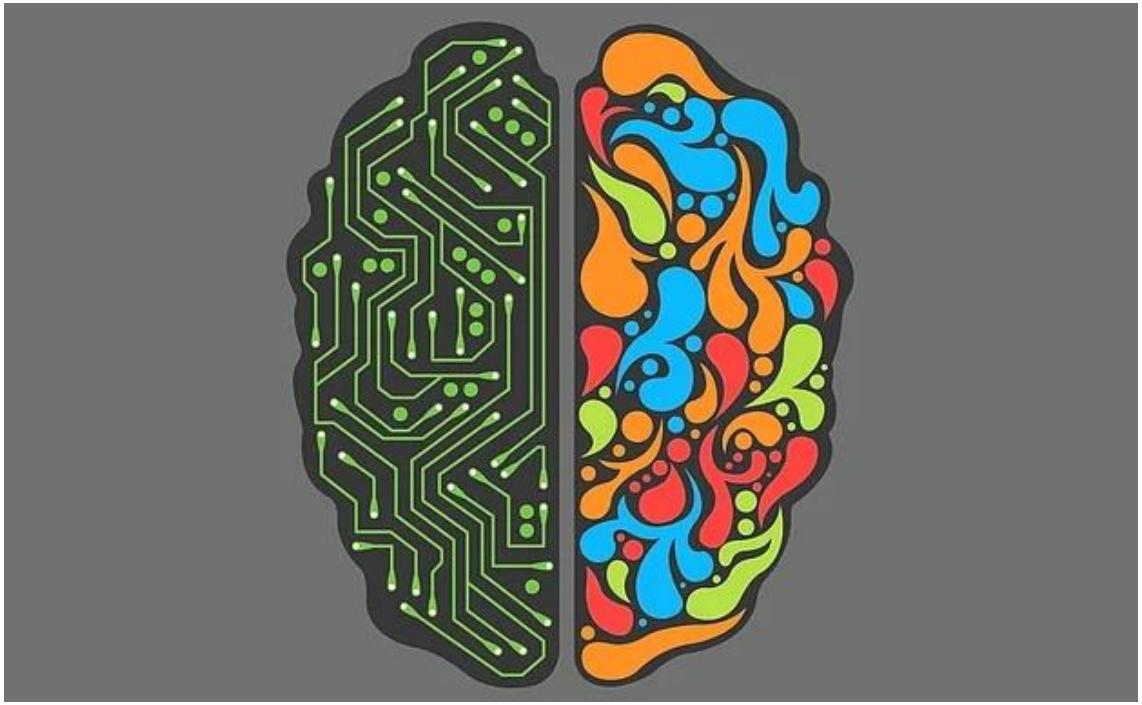
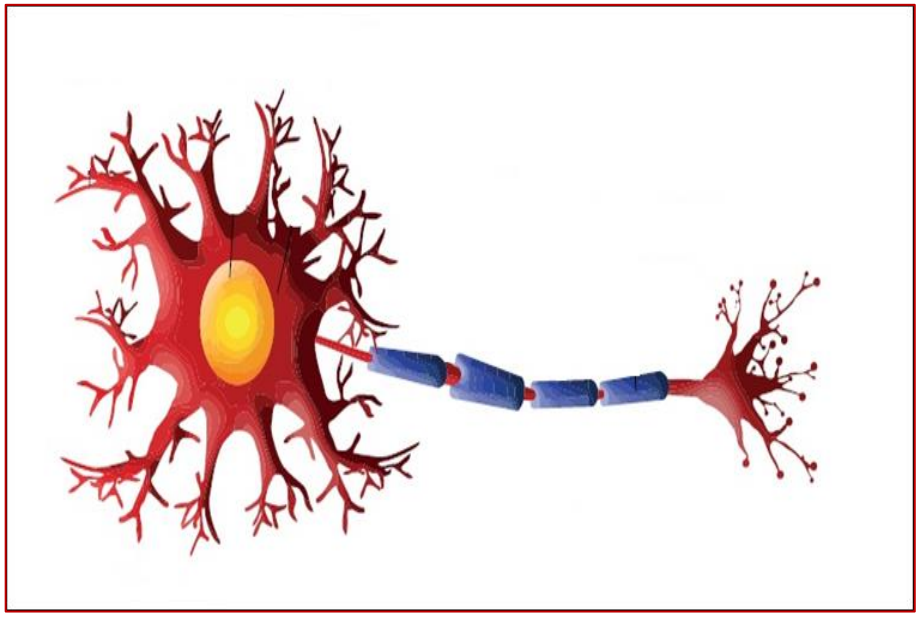
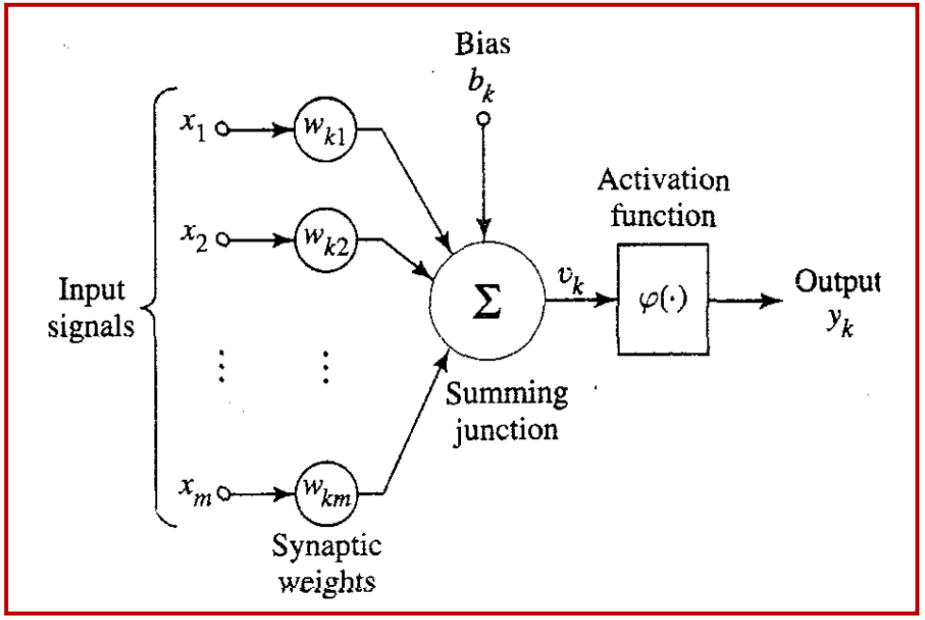
Artificial Neural Networks

Artificial Neural Networks (ANNs) are approaches that try to create a new system by imitating the function of the human brain (Sağıroğlu et al. 2003).



Artificial Neural Networks





(Haykin, 1994)

Biological Nervous System	ANN
Dendrite	Summing Junction
Cell Body	Transfer Function
Axone	Output
Synapse	Bias

Algorithm

Input (1st Step)

Create a training set by using forward model (2nd Step)

Create a neural network (3rd Step)

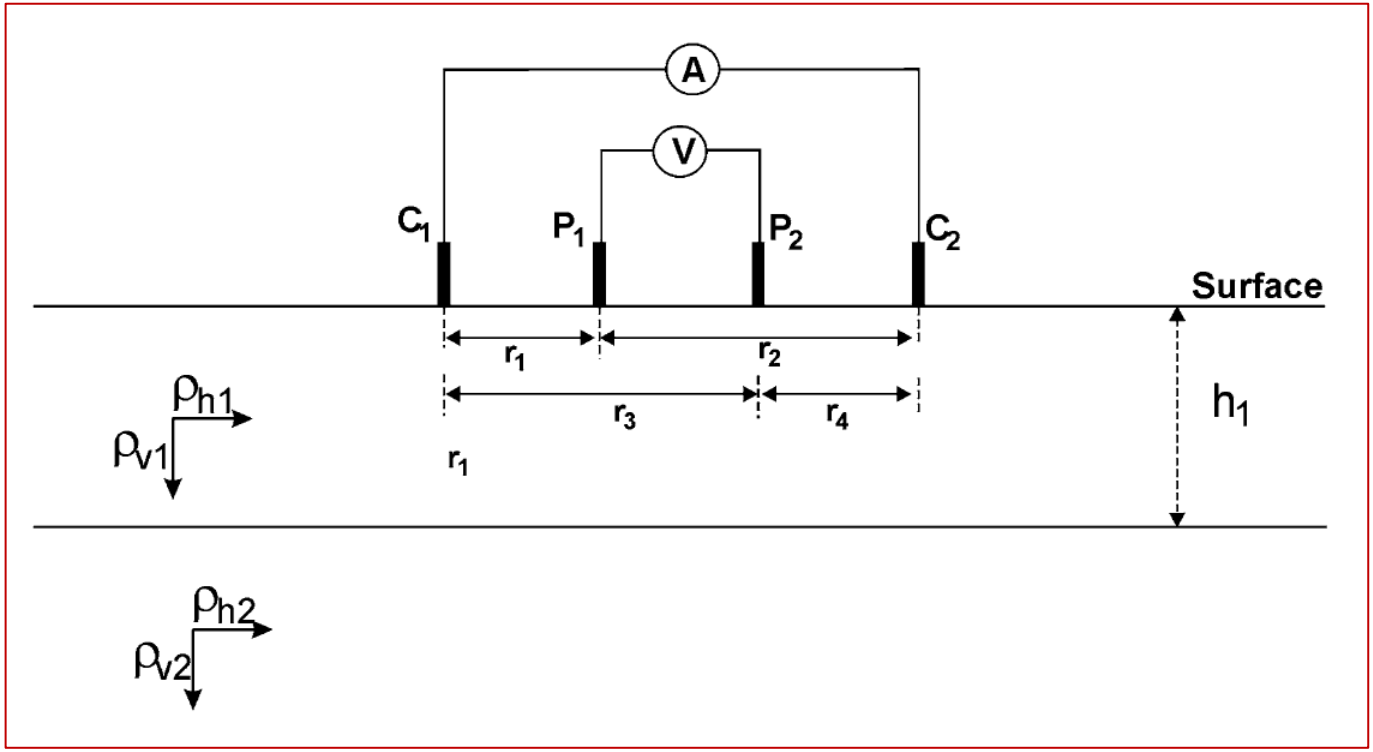
Train the network (4th Step)

Simulate observed data in the trained network (5th Step)

Compare simulation result with observed data (6th Step)
Is the error (difference) less than the threshold value?
If not, go back to 3th step

Print the best parameter values as a result (7th Step)

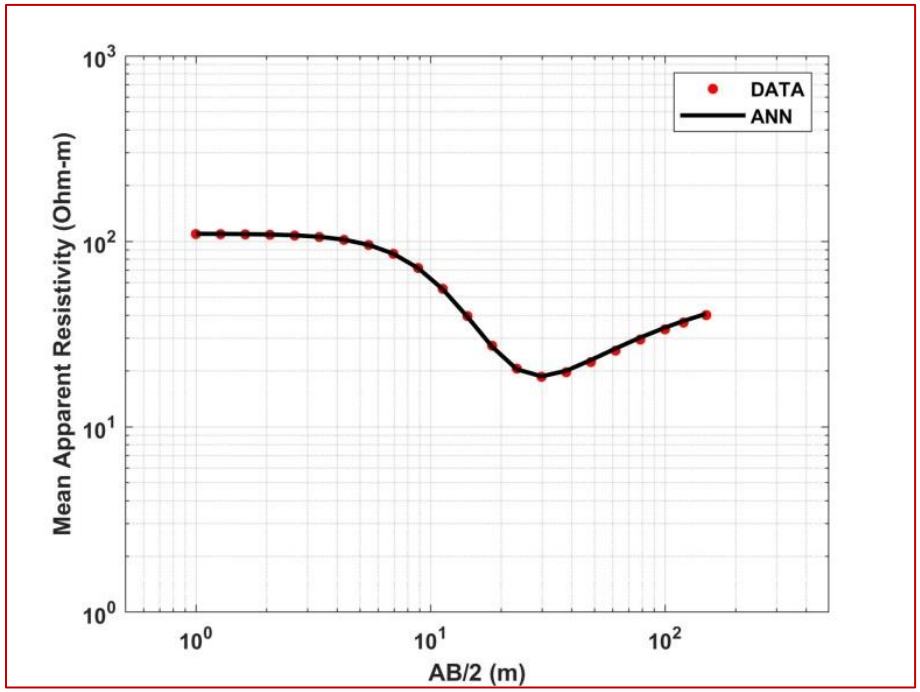
Electrical Resistivity in Anisotropic Media



$$f_n = \sqrt{\frac{\rho_{v_n}}{\rho_{h_n}}}$$

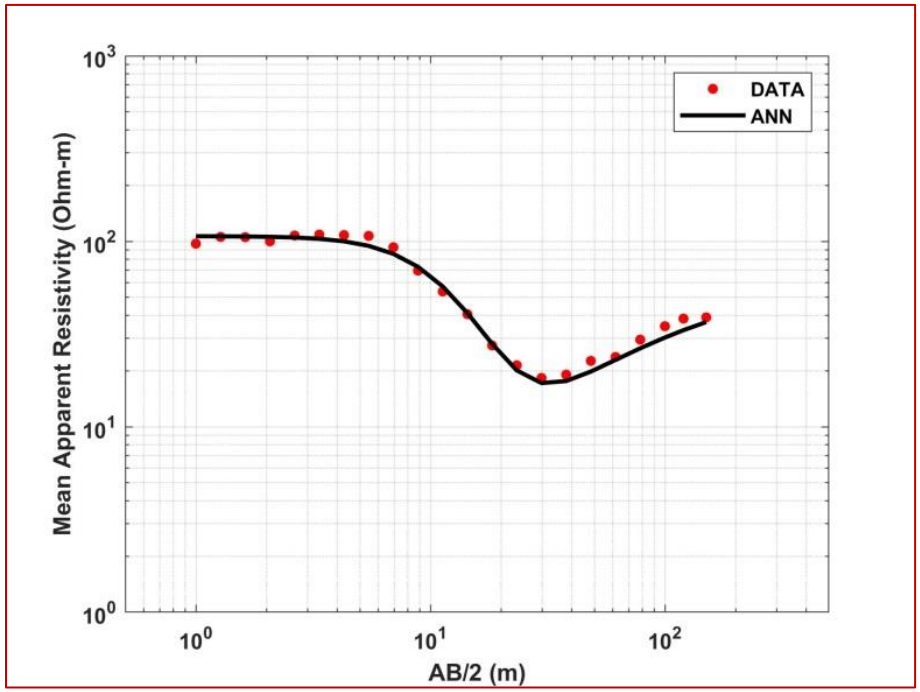
$$\rho_n = \sqrt{\rho_{v_n}\,\rho_{h_n}}$$

Numerical Tests



Parameter	Model Parameter	ANN Result	Mean Resistivity of Model	Mean Resistivity of ANN Result	Anisotropy Coefficient of Model	Anisotropy Coefficient of ANN Result
Noisy Free Synthetic Data						
ρ_{v1}	120	122.94	109.54	109.89	1.09	1.12
ρ_{h1}	100	98.22				
h_1	5	4.90				
ρ_{v2}	14	14.90	11.83	11.20	1.18	1.33
ρ_{h2}	10	8.41				
h_2	15	11.96				
ρ_{v3}	65	71.09	57.00	56.83	1.14	1.25
ρ_{h3}	50	45.43				
Relative Error (%)		0.99				

Numerical Tests



Parameter	Model Parameter	ANN Result	Mean Resistivity of Model	Mean Resistivity of ANN Result	Anisotropy Coefficient of Model	Anisotropy Coefficient of ANN Result
%5 Noisy-Added Synthetic Data						
ρ_{v1}	120	113.50	109.54	106.62	1.09	1.06
ρ_{h1}	100	100.16				
h_1	5	5.43				
ρ_{v2}	14	14.84	11.83	10.87	1.18	1.36
ρ_{h2}	10	7.97				
h_2	15	14.08				
ρ_{v3}	65	69.56	57.00	55.14	1.14	1.26
ρ_{h3}	50	43.71				
Relative Error (%)		6.56				

Results

- The results are preliminary in this study.
- The algorithm was tested on both noisy-free and five percent noisy synthetic data.
- Thickness, vertical and horizontal resistivity of the layers are estimated by using the code.
- The estimated parameters and the parameters of the subsurface model were similar with acceptable error rates.
- The application of ANN can be successful for inversion in anisotropic media.
- The method is suitable to avoid from local minimum.
- The method will be tested with field data as soon as possible.

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